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### Message from Associate Editor In Chief



Let me first of all take this opportunity to wish all our readers a very happy, peaceful and prosperous year ahead.

This is the Third Issue of the Fifth Volume of International Journal of Engineering Research and General Science. A total of 40 research articles are published and I sincerely hope that each one of these provides some significant stimulation to a reasonable segment of our community of readers.

In this issue, we have focused mainly on the Global challenges and its innovative solutions. We also welcome more research oriented ideas in our upcoming Issues.

Author's response for this issue was really inspiring for us. We received many papers from many countries in this issue but our technical team and editor members accepted very less number of research papers for the publication. We have provided editors feedback for every rejected as well as accepted paper so that authors can work out in the weakness more and we shall accept the paper in near future. We apologize for the inconvenient caused for rejected Authors but I hope our editor's feedback helps you discover more horizons for your research work.

I would like to take this opportunity to thank each and every writer for their contribution and would like to thank entire International Journal of Engineering Research and General Science (IJERGS) technical team and editor member for their hard work for the development of research in the world through IJERGS.

Last, but not the least my special thanks and gratitude needs to go to all our fellow friends and supporters. Your help is greatly appreciated. I hope our reader will find our papers educational and entertaining as well. Our team have done good job however, this issue may possibly have some drawbacks, and therefore, constructive suggestions for further improvement shall be warmly welcomed.

Er. Pragyan Bhattarai,

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# Analysis of Industrial process Implementing VSM with software simulation based approach

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**Abstract-** This study is conducted at industry manufacture earth moving bucket. Earth moving Bucket is used as reference part for this study. This study starts from visiting the company and then the study of the plant and data collect for the bucket manufacturing process. Then on basis of collected data, process analysis is done and current state value stream map is draw. Value stream mapping used for identified value added and non-value added activity. The information's at individual station is collected for cycle time, utilization, setup time, work in process, and raw to finish work flow using VSM. Types of wastes are also identified at individual stations and remedies are suggested for each waste and at each station. After process study and analysis, results data of process study put on the arena software. Model creation, simulation, visualization of process and software analysis is performed using Arena software simulation. In the third step we used lean manufacturing tools for processes improvement and after process improvement again process analysis done and results of process are analyzed. We simulated the model of bucket manufacturing process on arena software and in last finally draw future state value stream map. In results comparison between present state of process and future value stream mapping is presented in terms of cycle time comparison for individual and overall cycle times, lead time comparison, work in process comparison, simulation result comparison and TAKT time comparison is presented in the form of histogram and line diagrams or graphs.

**Keywords:** Value Stream Mapping, Arena Simulation, Process Study and Analysis, Lead Time, WIP, productivity Value-added and Non-value-added activities.

## Introduction

Although Lean was initially introduced by the automobile industry, its principles have more recently spread into other industries. There are a variety of companies that have experienced the advantages of applying Lean in their manufacturing area [1]. Value stream mapping (VSM) is a lean manufacturing technique and it has emerged as the preferred way to support and implement the lean approach. Value stream mapping (VSM) focuses on the identification of waste across an entire process [12]. A VSM chart identifies all of the actions required to complete a process while also identifying key information about each action item. Key information will vary by the process under review but can include total hours worked, overtime hours, cycle time to complete transaction, error rates, and absenteeism [2]. VSM can serve as a good starting point for any enterprise that wants to be lean and describe value stream as a collection of all value added and non-value added activities which are required to bring a product or a group of products using the same resources through the main flows, from raw material to the hands of customers.

Every important part of value stream mapping process is documenting the relationships between the manufacturing processes and the controls used to manage these processes, such as production scheduling and production information, unlike most process mapping techniques that often, only document the basic product flow, value stream mapping also documents the flow of information within the system, where the materials are stored (raw materials and work in process, WIP) and what triggers the movement of material from one process to the next are key pieces of information. Value-added activities are considered the actions and the process elements that accomplish those transformations and add value to the product from the perspective of the customer (e.g., tubing, stamping, welding, painting, etc.). Non-value-added activities are the process elements that do not add value to the product from the perspective of the customer such as setting up. An alternative branch of artificial intelligence, neural networks, has appeared as a viable alternative for estimating manufacturing cost. Which too suggest the use of lean manufacturing tool to improve productivity [9-11].

## Objectives

For accomplishment of goal following objectives are identified:

- Implement lean manufacturing philosophy.
- Study of present process and analysis of process.
- Draw the present VSM map for identify the value added and non-value added activity.
- Identify waste and implement all suggesting for eliminate waste involve in manufacturing of bucket.
- Compute Plant lay out simulation using Arena for process improvement.
- Reduce time for production for increasing productivity.

## Methodology

Then a well reputed manufacturing organization was selected based on judgmental sampling techniques to carry out the implementation study. As the first step site tour was conducted in order to get a clear idea about the existing products and the overall

process of the company. A style was then selected to draw the current state VSM by collecting the relevant data. In order to carry out this tasks groups were formed which were responsible for analyzing the current process. Then the current state VSM has been analyzed and various improvement proposals were identified to reduce the non-value adding waste in the process. After that future state value stream map was drawn. After the development of future state VSM, the conclusion was made [3-4]. The first input the surface model of the contour generated in the CAD based application of calculation tool VFC and second input data is the milling head. Based on the input data system executes two steps. At first step each surface part is examined locally order to verify which of the available head and second the compound of all surfaces is analyzed to detect potentially collisions between the head and a surface part while another part is machined [8].

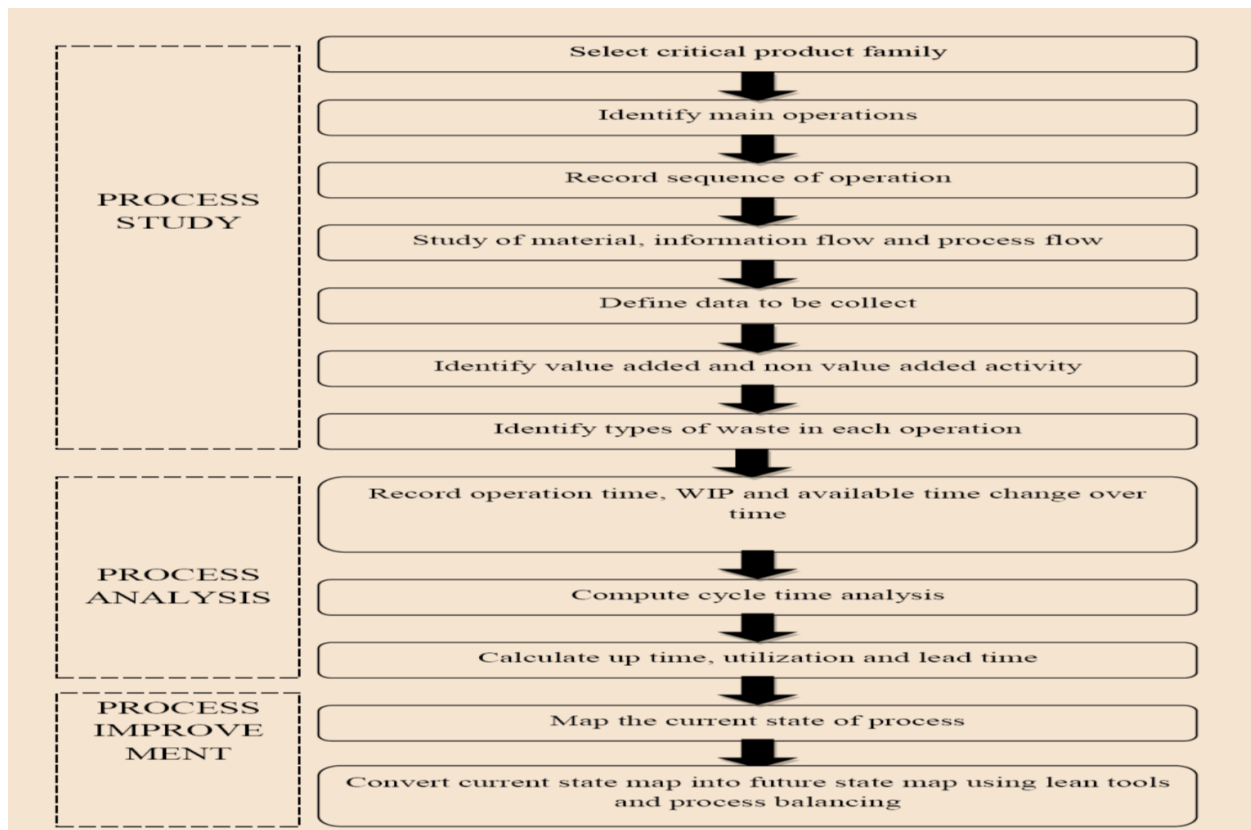


Figure 1.1: Flow chart Implementation of VSM

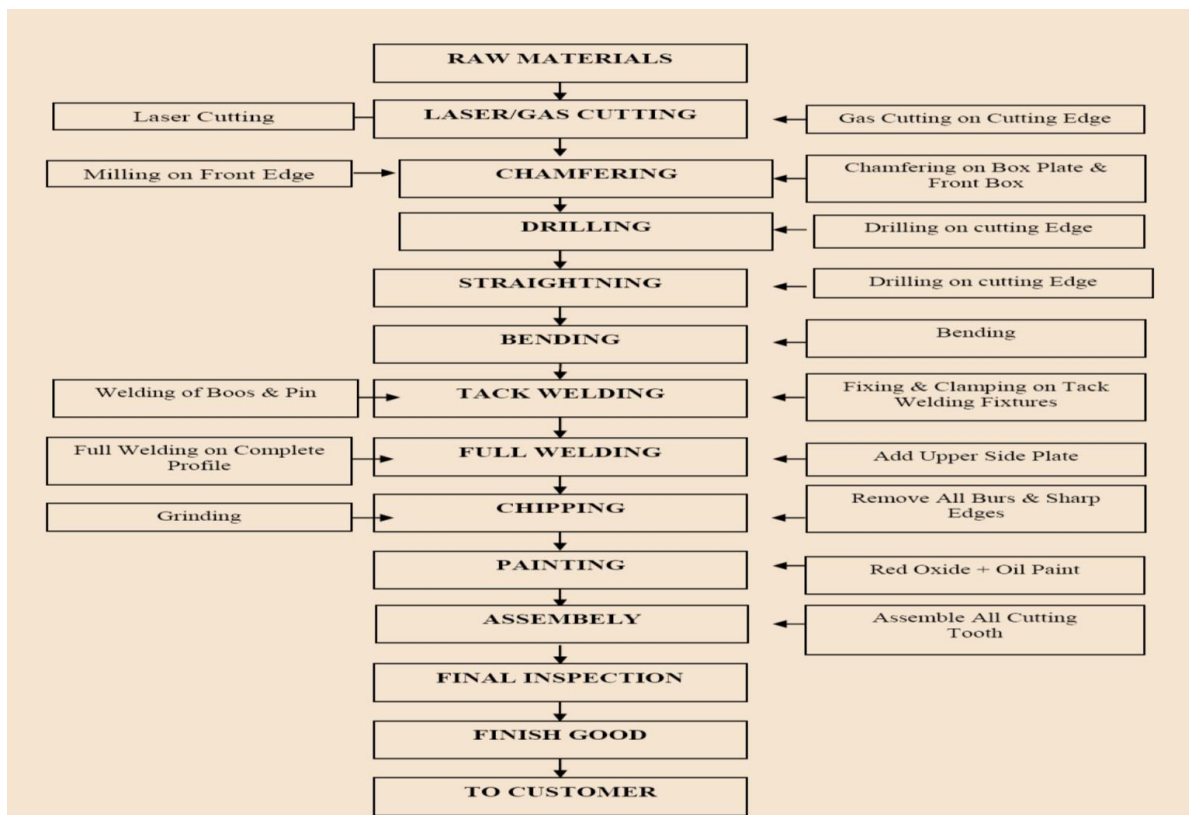


Figure 1.2: Sequence of operations

#### Calculations:-

Product life cycles today are typically less than half of those in the 1980s, owing to the frequent entry of new products with more features into the market. Manufacturing competitiveness is measured in terms of shorter lead-time to market, without sacrificing quality and cost. One way to reduce the lead-time is by employing near net shape (NNS) manufacturing processes. In the analytical cost and time estimation, the entire manufacturing activity is decomposed into elementary tasks, and each task is associated with an empirical equation to calculate the manufacturing cost and time [5-7].

Table 1.1: WIP between processes in terms of bucket

Process	Day1	Day2	Day3	Day 4	Average
Cutting and Straightening	20	0	16	22	19
Cutting and Bending	25	27	21	24	24
Straightening and Bending	21	5	26	19	19
Milling and Drilling	36	9	0	30	25
Milling and Bending	36	9	0	30	25
Bending and Tack Welding	25	29	28	22	26
Tack Welding and Full Welding	25	29	28	22	26
Full Welding and Chipping	20	21	19	20	20
Chipping and Painting	20	21	19	20	20
Painting and Assembly	20	21	19	20	20
Assembly and Finish good	20	25	22	23	22

Table 1.2: Number of operators, operation time and change over and handling time

Processes	No. of operators	Operation time in min	Changeover time in min	Handling time in min
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<b>Laser Cutting</b>	3	9	2	6
<b>Milling/Chamfering</b>	-	-	-	-
<b>Drilling</b>	-	-	-	-
<b>Straightening</b>	2	4	-	-
<b>Bending</b>	3	25	30	6
<b>Welding</b>	4	150	25	10
<b>Chipping</b>	1	30	-	-
<b>Painting</b>	1	30	-	-
<b>Assembly</b>	1	30	-	-

Table 1.3: Result of process analysis of all operations

Process	operation time in min	Batch time in min
Cutting	15	90
Bending	32	197
Tack welding	55	330
Full welding	115	690

Table 1.4: Cycle time, WIP, Lead Time and over all cycle time of all Processes

Sr. No	PROCESS	Cycle Time In min	WIP In Piece	Lead Time In Days	Over all cycle time In min
1	Laser Cutting	15	12	2	975
2	Bending	32	24	4	1952
3	Straightening	4	19	3.17	1512
4	Milling/Drilling	-	13	4.34	2084
5	Tack welding	55	26	4.34	2183
6	Full welding	115	26	4.34	2190
7	Chipping	30	20	3.34	1635
8	Painting	30	20	3.34	1635
9	Assembly	30	20	3.34	1635
10	Finish Good	-	22	3.67	1760
11	total	311		36	17561

Total non-value added time is 36days.

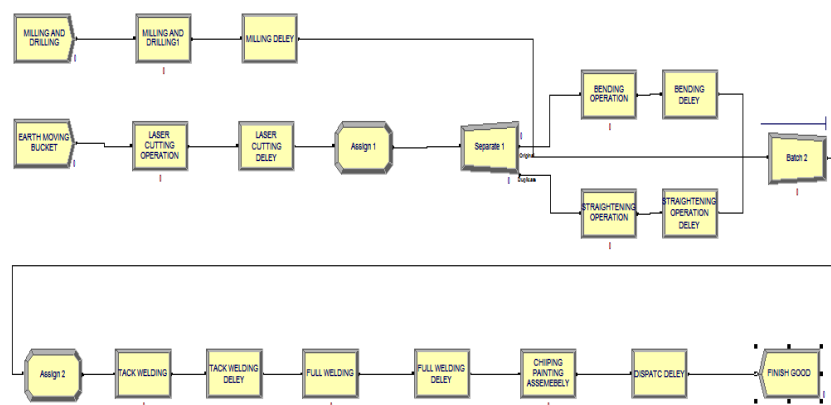


Figure 1.3: Arena simulation based on current state map

Table 1.5: Operation time, WIP, Lead time and Overall cycle time for FVSM

Sr.No	Process	Operation Time in min	WIP In Piece	Lead time in days	Overall cycle time In min
1	Laser cutting	9	7	1.16	780
2	Bending	24	18	3	1464
3	Straightening	4	10	1.67	805

4	Milling/Drilling	-	13	2.17	1040
5	Tack welding	45	15	2.5	1248
6	Full welding	90	15	2.5	1290
7	Chipping	30	12	2	990
8	Painting	30	12	2	990
9	Assembly	30	12	2	990
10	Finish Good	-	10	1.67	800
11	Total			21	10397

Table 1.6: Result of process analysis of all operations

Process	Cycle time in min	Batch time in min
Cutting	12	72
Bending	24	144
Tack welding	45	288
Full welding	90	564

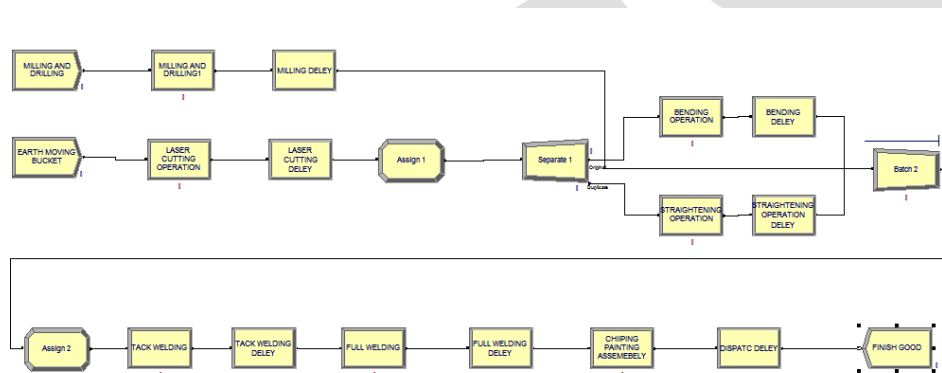


Figure 1.4: Modal of manufacturing process of bucket in arena software for FVSM

### Comparison between CVSM and FVSM for Cycle Time in min

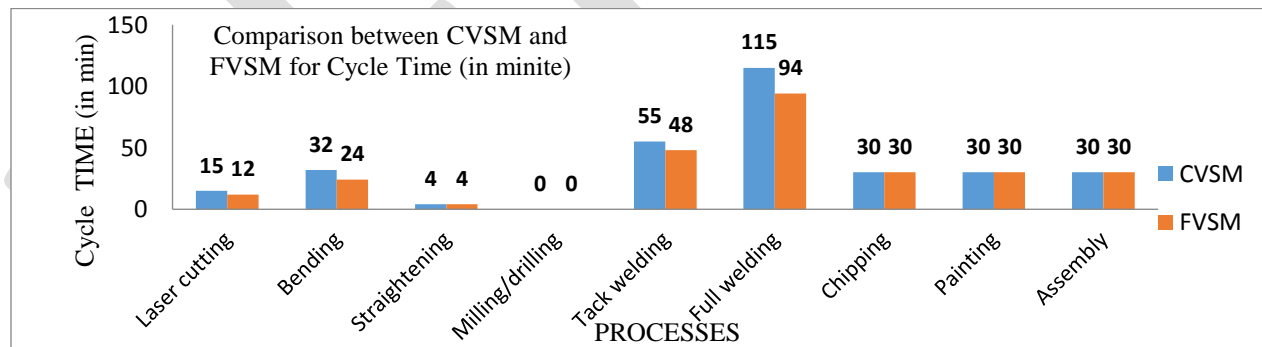


Figure 1.5: Comparison of result between CVSM and FVSM for Cycle Time in minute (bar chart)

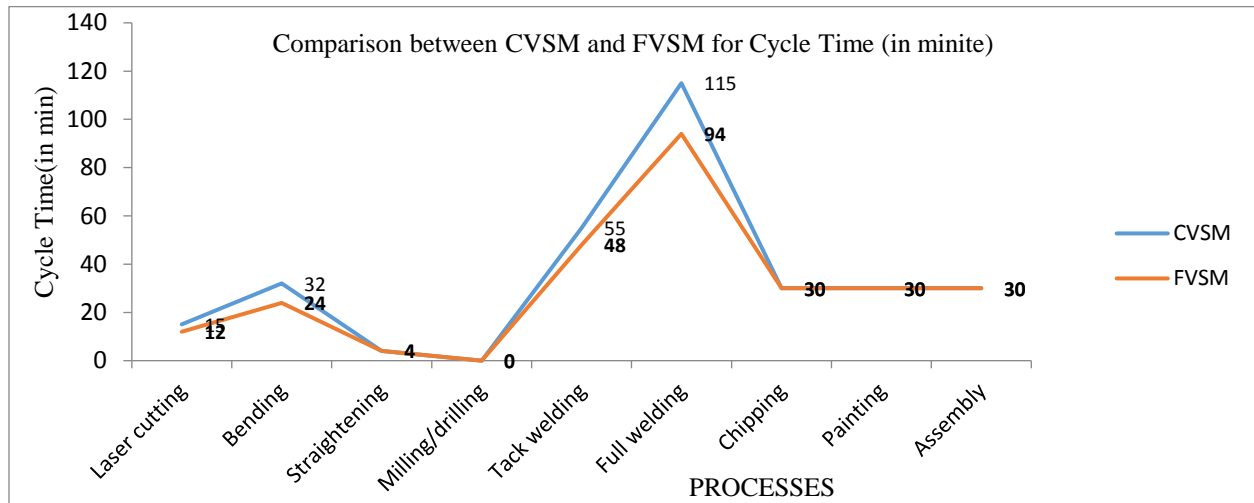


Figure 1.6: Comparison of result between CVSM and FVSM for Cycle Time in minute (Line chart)

#### Comparison between CVSM and FVSM for Overall Cycle Time

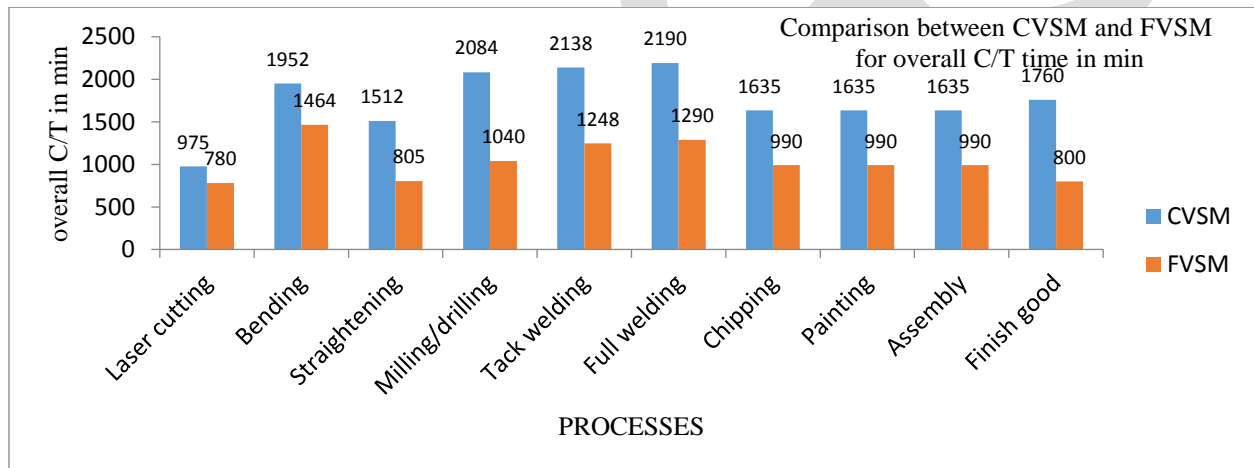


Figure 1.7: Comparison of result between CVSM and FVSM for Overall Cycle Time in minute (bar chart)

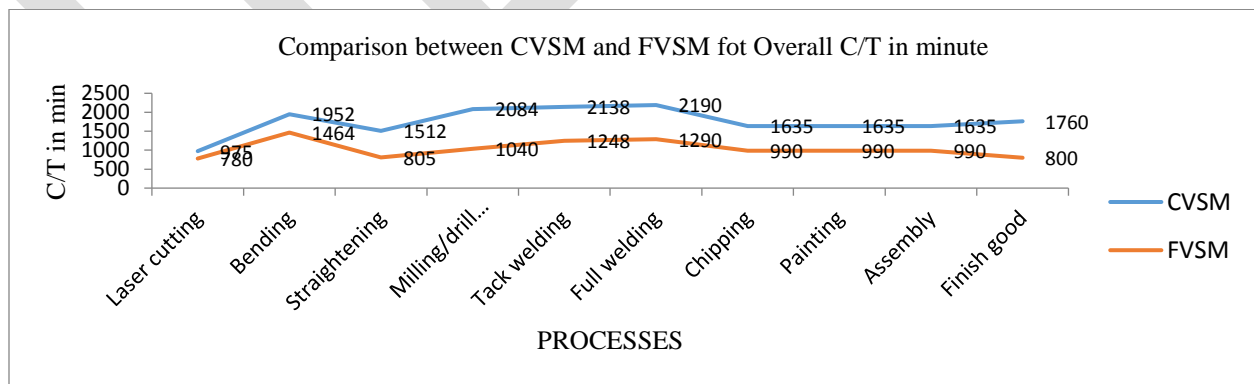


Figure 1.8: Comparison of result between CVSM and FVSM for Overall Cycle Time in minute (Line chart)

#### Comparison between CVSM and FVSM for Lead Time

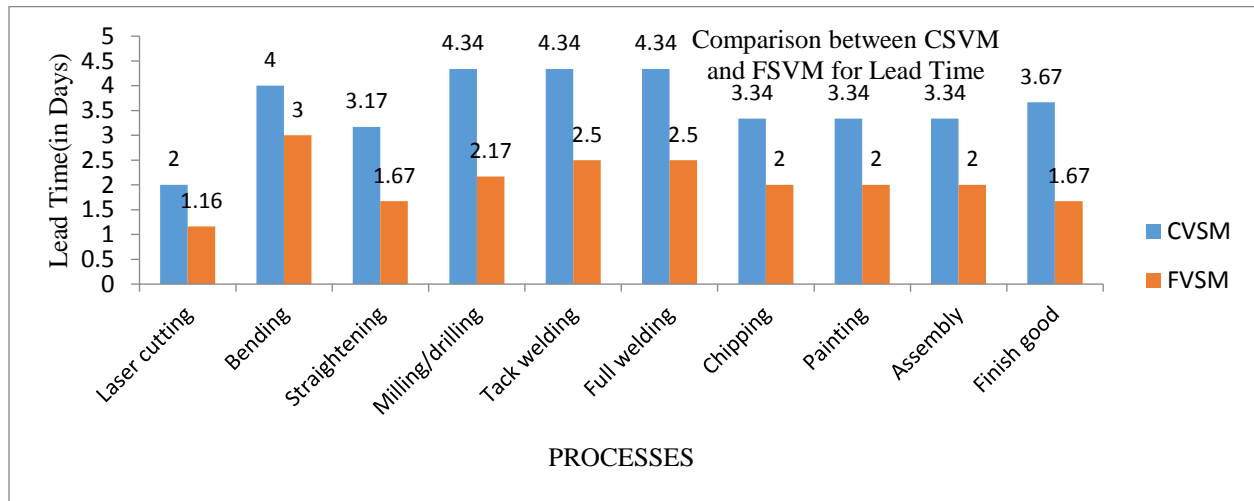


Figure 1.9: Comparison of result between CVSM and FVSM for Lead time in Days

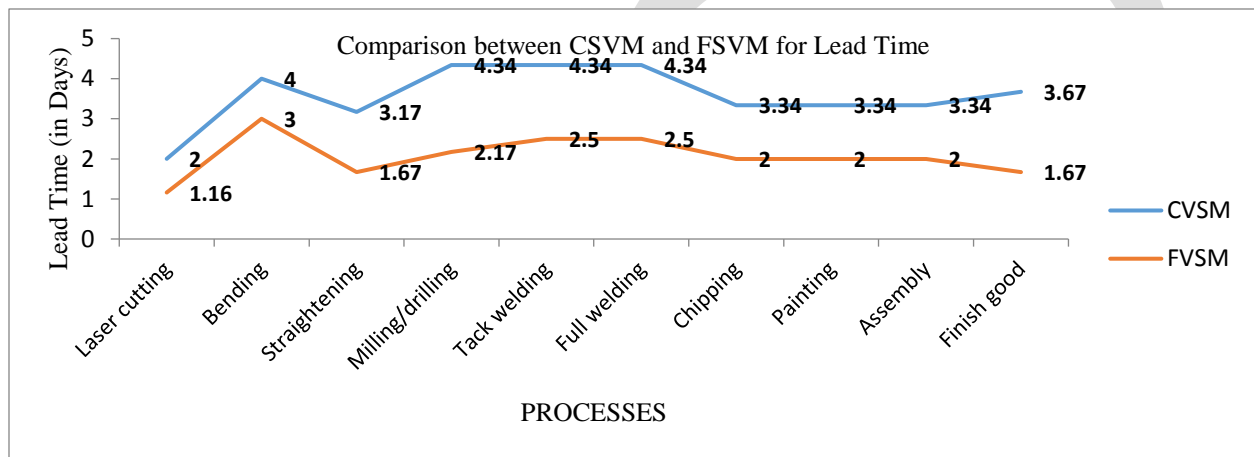


Figure 1.10: Comparison of result between CVSM and FVSM for Lead Time

Comparison between CSVM and FSVM for WIP

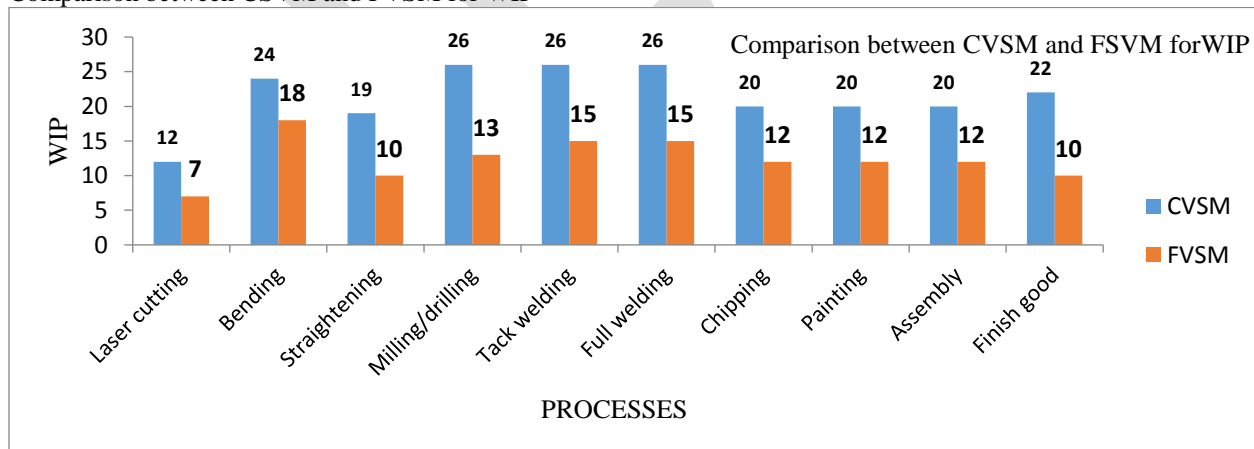


Figure 1.11: Comparison of result between CVSM and FVSM for WIP

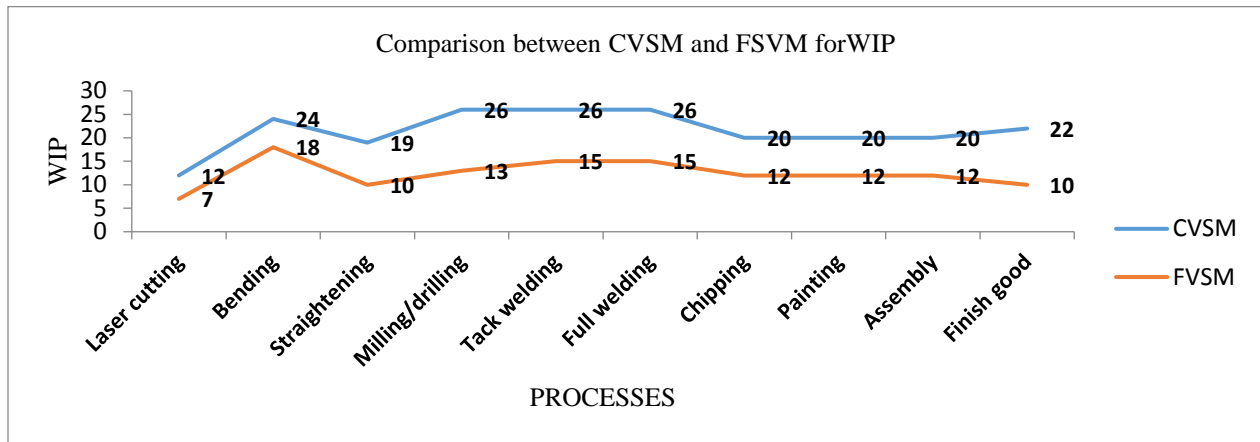


Figure 1.12: Comparison of result between CVSM and FVSM for WIP

#### Comparison of Output in CVSM and FVSM

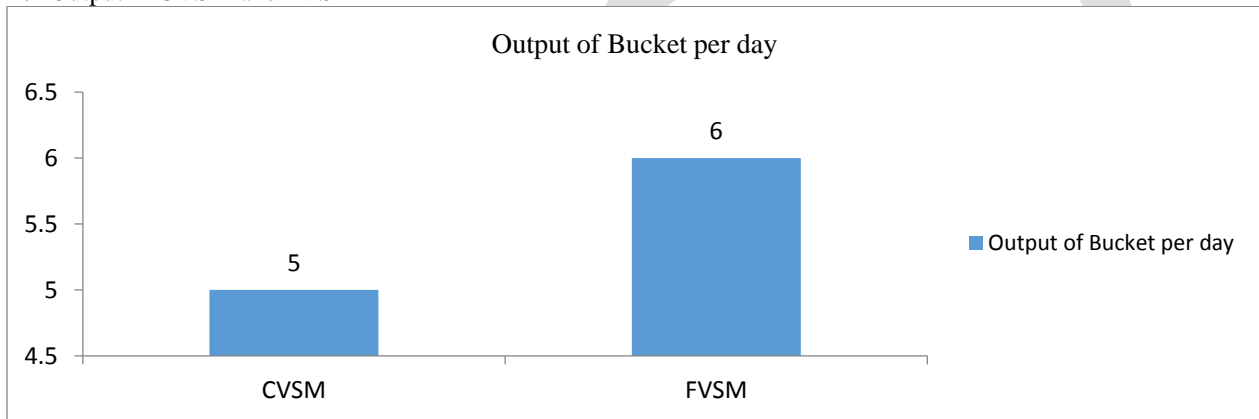


Figure 1.13: Comparison of result between CVSM and FVSM for Output per Day

#### Comparison of result between CVSM and FVSM for TAKT time

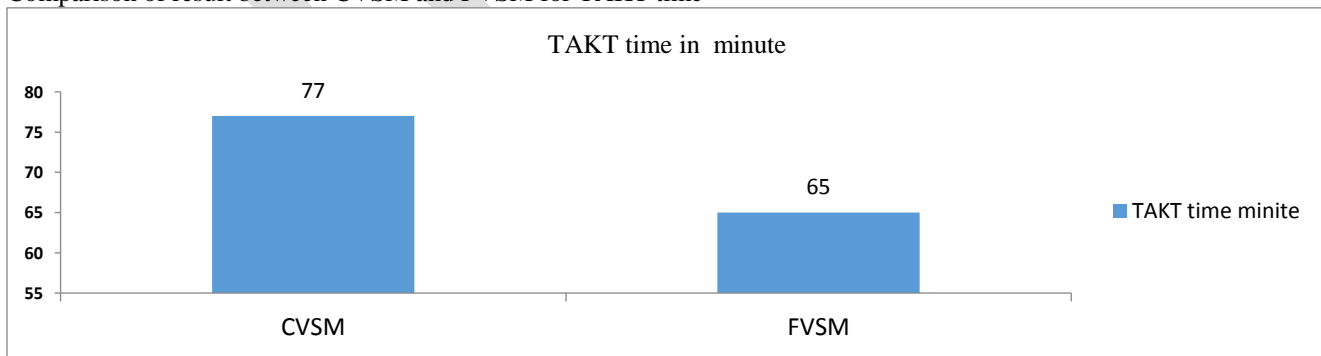


Figure 1.14: Comparison of result between CVSM and FVSM for TAKT time

#### Conclusion:-

On the Shop floor, time is money. On the shop floor the need to eliminated of wastages and delays. It helps in mapping the process it manifests itself as the objective of designing a process for which manufacturing is a low cost process. To start improving productivity by identifying waste and then removing it by implementing lean principle in the industry there is no better tool than Value Stream Mapping. Value stream mapping used for identifying value added and non-value added activity. The non-value added actions are identified in each step and between steps.

The integration of VSM with simulation software will help to analyze the system properly. Simulation using arena helps in finding value added and non-value added time of complete process and also for finding output per day. By applying VSM in bucket manufacturing process, a current state map is devolved.

A future state value stream map is created by eliminating waste non value added activities and future state map is showing the improvements in process. Final results show that after improving process using lean manufacturing and value stream mapping, WIP in manufacturing of bucket is reduce by 36 %, lead time reduced from 36 days to 21 days resulting improving of 41% total cycle time reduced from 17516 minute to 10397 minute resulting improving of 42%, output increased from 5 bucket per day to 6 bucket per day resulting improving of 20%, cycle time reduced from 311 minute to 272 minute resulting improving of 12.5%, TAKT reduce from 77 minute to 65 minute per bucket resulting improving of 15 %.

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# STUDY OF MATHEMATICS INVOLVED IN GAS ATOMISATION PLANTS AND SPRAY FORMINGS

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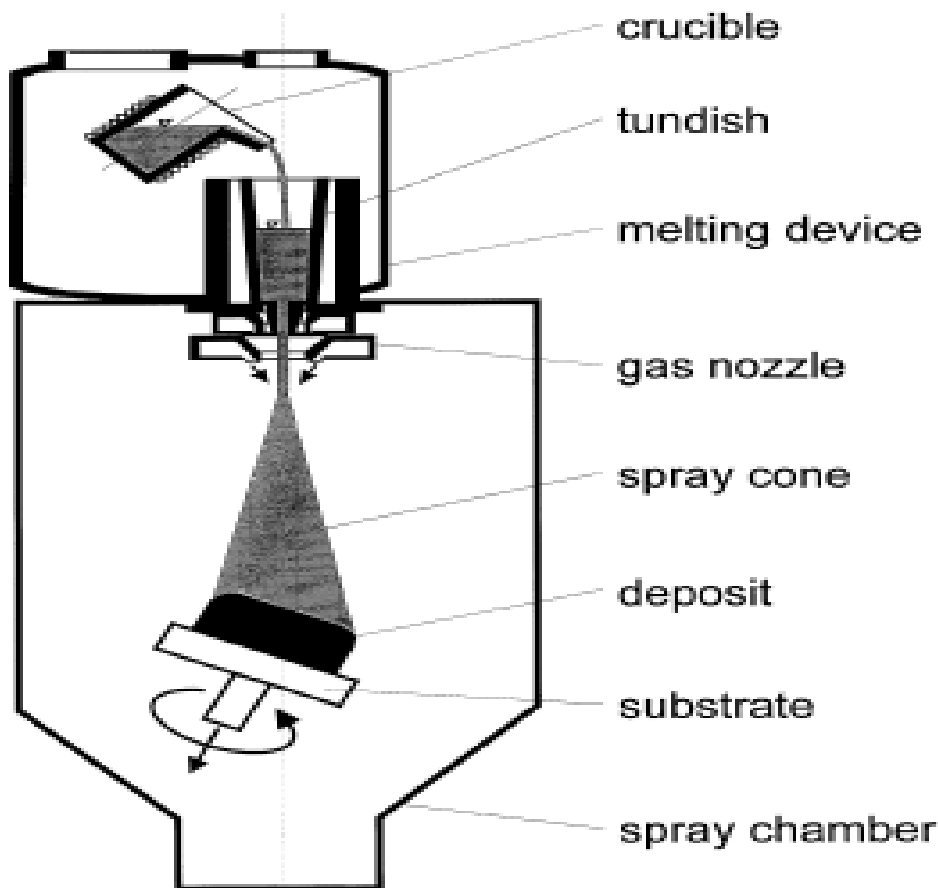
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**ABSTRACT-** In Spray forming processes, a continuous molten metal stream is atomized by impinging a very high speed inert gas jets. The velocity of jet is very high to atomised the molten liquids. In the generated spray cone, the resulting metal droplets are rapidly cooled by the huge temperature difference to the surrounding gas phase and thereby partly solidify. After a certain flight and residence time inside the spray cone, the droplets impinge on the substrate and form the product sometimes called deposit. The material properties of this product depend on several process parameters and especially on the thermal state of the deposited droplets at impingement. Smaller droplets cool very fast and may impinge onto the product in a completely solidified state as solid metal powder particles. Larger droplets contain a higher amount of thermal energy and impact during the state of phase change or even still completely liquid. In this contribution, a mathematical model is introduced to describe the cooling and solidification of individual metal droplets in the spray cone during the droplet–gas interaction in flight. By introducing this model into a standard two phase flow simulation model for the spray cone description, it is possible to calculate the transient droplet temperature and solid fraction contents of individual particles depending on overall process parameters and flight path. It is very important to study mathematics involved in the metal forming processes only because of it we enable to predict the thermal behaviour of the spray formed products.

## 1. INTRODUCTION

In recent years spray formings have been an emerging forming process for the production of near net shape products with the benefits that of rapid solidification, semi solid processing etc. This spray forming processes combine the advantage of metal casting and powder metallurgy. Spray forming has minimized the multiple steps of powder metallurgy which includes processes like powder production, sieving, de-gasing and consolidation into a single processing step and still micro-structural characteristics remains the same. Figure 1, illustrates the schematic view of spray forming.

Professor Singer at the Swansea University first developed the idea of gas atomized spray forming in 1970s in which a high pressure gas jet impinges on a stable melt stream to cause atomization. The resulting droplets are then collected on a target, which can be manipulated within the sprays and used to form a near-dense billet of near-net shape. Spray forming, also known as spray casting, spray deposition is a method of casting near net shape metal components with homogeneous microstructures via the deposition of semi-solid sprayed droplets onto a shaped substrate. In spray forming an alloy is melted, normally in an induction furnace, then the molten metal is slowly poured into a conical tundish into a small-bore ceramic nozzle. The molten metal exits the furnace as a thin free-falling stream and is broken up into droplets by an annular array of gas jets, and these droplets then proceed downwards, accelerated by the gas jets to impact onto a substrate. The process is arranged such that the droplets strike the substrate whilst in the semi-solid condition, this provides sufficient liquid fraction to 'stick' the solid fraction together. Deposition continues, gradually building up a spray formed billets of metal on the substrates.



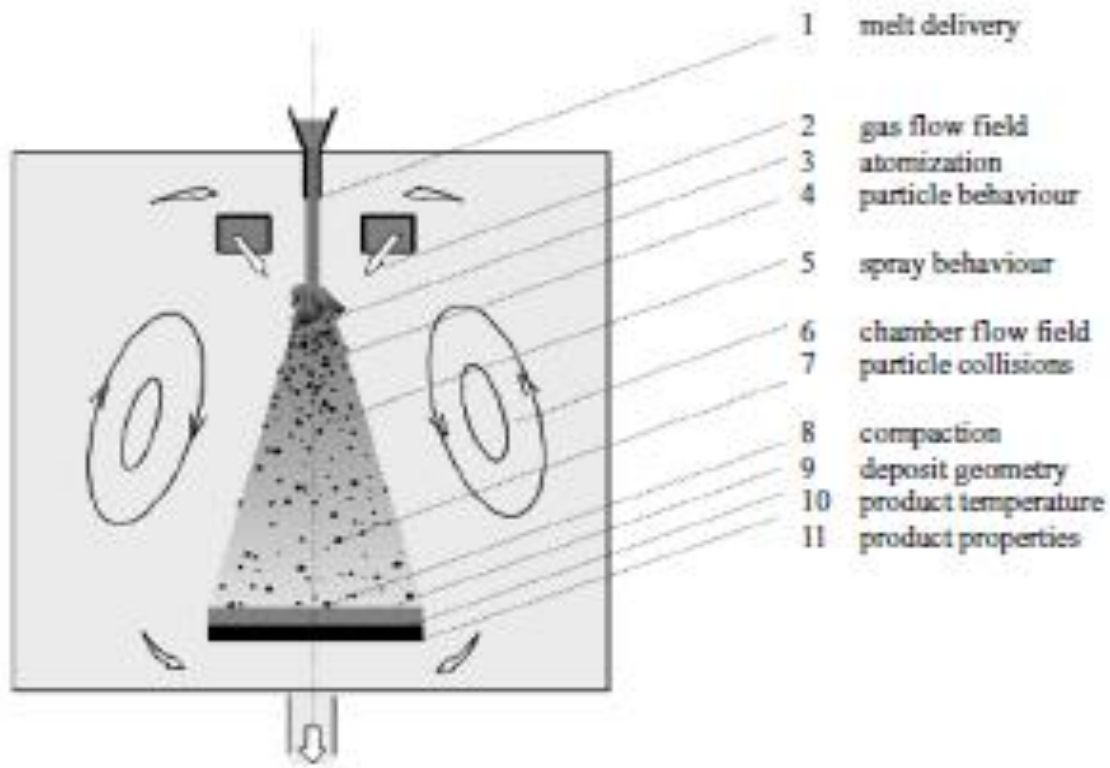
**FIGURE 1.1 Schematic view of spray forming processes**

In the spray forming processes the metal is heated in the crucible until the superheat temperature is reached and the molten metal is poured in the tundish. The molten metal stream is poured into the atomization chamber using the gravity, where the molten metal stream gets disintegrated into spherical droplets due to jets of inert gases with very high kinetic energy. The spray thus formed gets accelerated towards the preformed substrate, cools down and solidifies partly as a result of high rate of heat transfer from the spray to the cold inert gas. The diameters of gas atomized droplets varies from  $5\mu\text{m}$  to  $500\mu\text{m}$ . Later on the droplets impacts on to the substrate, merges and forms the deposit.

It was in 1960 in Swansea, Wales, by Singer and his colleagues when the first use of metal spray forming was used. In 1970s, spray forming was used as a substitute for conventional forming as production of preform was done directly from the melt. The spray forming process for money-making was first used by a number of singer's young researchers and as a result of which they founded the company Osprey Metals in Neath, Wales. Hence sometimes spray forming process is also called as the Osprey process. Since then, application potentials of the spray forming process has ignited several research and development works at universities and at various industries. In the late '80s Lavernia and Grant developed the liquid dynamic compaction (LDC) process which was similar to spray forming. LDC, Osprey process and spray formings are the generic names of similar or related processes.

## 2. SUBDIVISION OF SPRAY FORMING PROCESSES

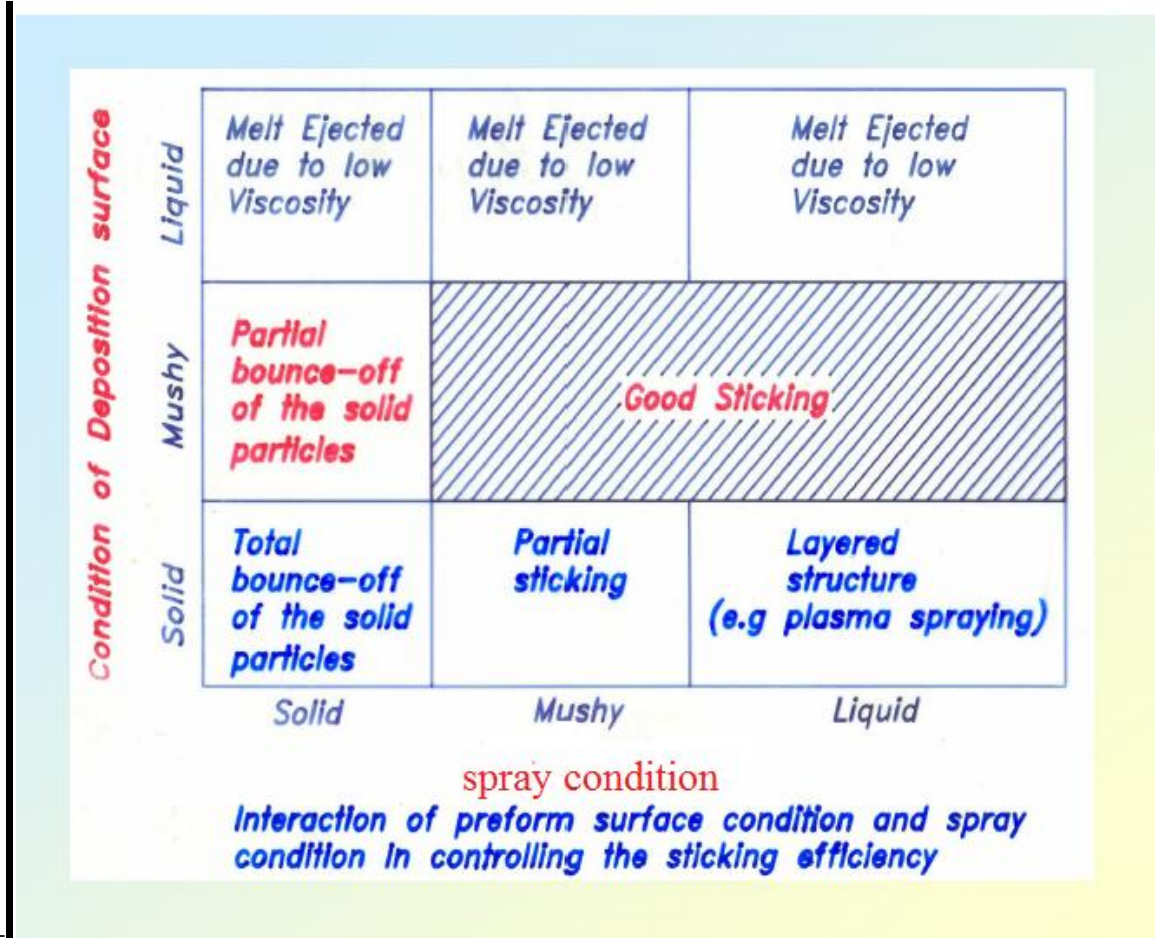
From the process technology view point spray forming is divided into many sub processes. The subdivision of the complete spray forming is shown in fig 2.1.



**FIGURE 2.1 Sub process view of spray forming.**

The spray structure consists of in-flight accelerated, thus cooled and partially solidified, melt droplets as well as rapidly heated and decelerated gas flow. Analysis of individual droplet is done to know the behavior regarding movement and cooling of the droplet.

Ojha *et al* described the reason of why analysis of droplet is done before they impinge onto the substrate and is shown as



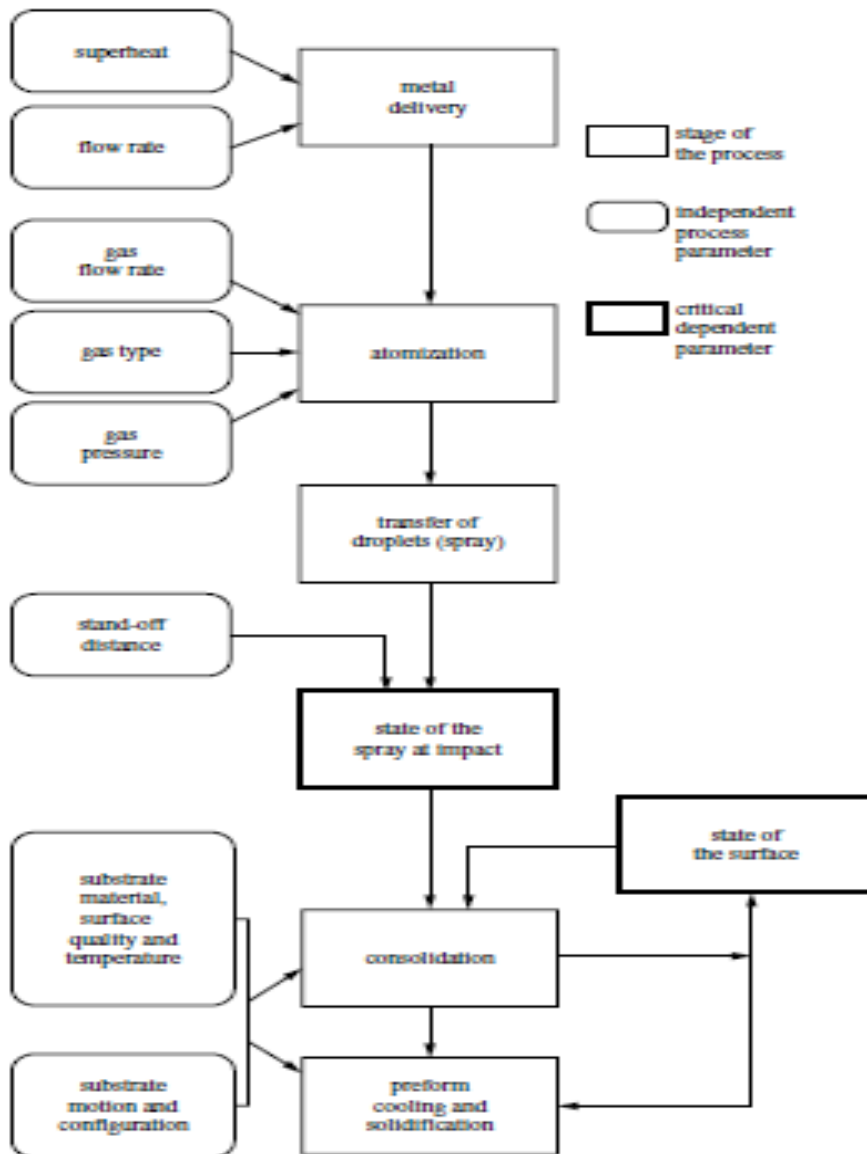
under:-

**TABLE 2.1: Interaction of preform surface condition and spray condition in controlling the sticking efficiency**

Lawley *et al* (1990) and Mathur *et al.* (1991) have inspected the spray forming process, and have discovered how fundamental knowledge of atomization and the compaction processes affect the system construction. In this way it was found that the appropriate control of processes parameters, such as substrate movements, sprays oscillation, deposit temperature and so on is must, as shown in figure 2.2. This diagram consists of process that can be controlled by operator on the left side and processes that cannot be controlled by operator directly and the bottom consist of the spray conditions at impact and the surface conditions of the substrate/deposit.

The main purpose of Lawley *et al.*'s and Mathur *et al.*'s was to know parameter that can be controlled and they found that the significant parameters are

- Geometry and dimension of deposits
- The microstructures of the final product (porosity and grain size).



**FIGURE 2.2 Modelling of independent & dependent process parameters**

In his work, **Ottosen (1993)** identified the main function in analysis of an integral spray forming model was the modelling and simulation of complex heat transfer and momentum exchange processes.

**Bauckhage and Uhlenwinkel (1996)** laid emphasis on automated and optimized spray forming process, by dividing the spray formings in 3 parts which are melting and atomization, particles transport in spray and compaction.

The process parameters and product quality was linked by **Payne et al (1993)** by the empirical spray forming process model. For suitable process control, Payne *et al* has recognized:

- Process parameters controlled directly: e.g. spray time, melt temperature and GMR;
- Indirectly controllable process parameters: e.g. exhaust gas temperatures, deposit surfaces, roughness and porosity.

The multi-coupled simulation of turbulent dispersed multiphase flow, containing gas as a continuous phase and droplets as a dispersed phase, is based on two modeling concepts:

- Eulerian/Lagrangians approach

This approach is related to direct intuitive approach which is applied in the analysis of the behavior of dispersed multiphase flow. In this individual particle is under the scanner of study and its interaction with local surroundings are analyzed on the scale of droplets size. **Crowe et al (1977)**, **Grant et al (1993)**, **Bergmann et al (1995)** were the researchers who published several models within spray formings application based on this approaches.

- Eulerian/Eulerians approach

In this the dispersed phase is considered to be as a quasi-second fluid with spatially averaged properties. Based on this approach derivation of the spray structure within the spray forming process has been done by **Liu (1990)** and **Fritsching et al (1991)**.

### 3. Particle Movement

A fundamental description of the behavior of droplets in gas, the flow around gas atomized droplets and their analysis is given in **Clift et al (1978)**, **Crowe et al (1998)**, **Sadhal et al (1997)** and **Sirignano (1999)**.

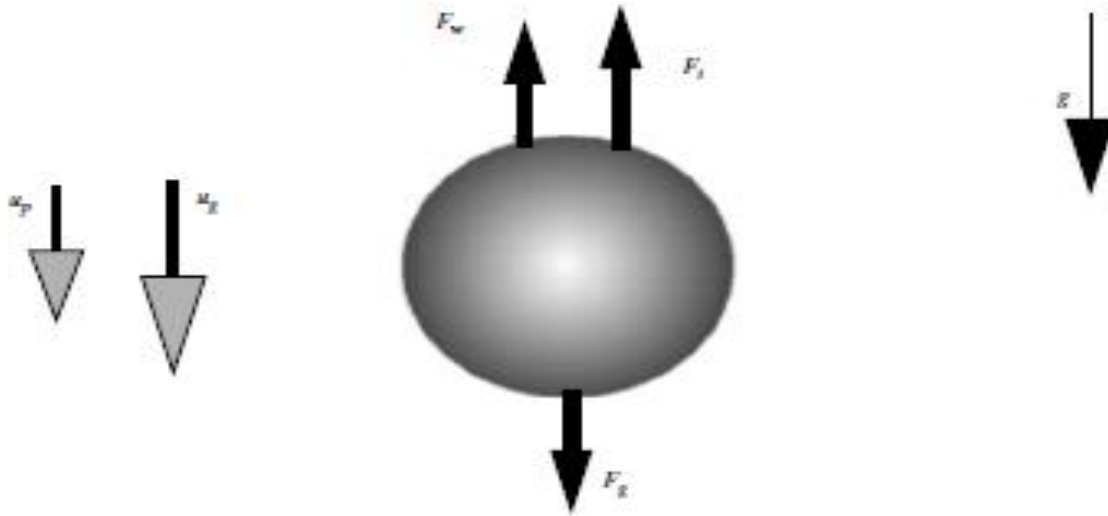
The various forces exerted on individual spherical particles are listed in table 3.1.

(1) inertial force	$F_i = -\rho_p V \frac{dv_p}{dt}$
(2) field force	
• gravity force	$F_g = \rho_p V g$
(3) pressure forces	
• buoyancy force	$F_b = -\rho_g V g$
• pressure gradients	$F_p = -\rho_g \frac{dv_g}{dt} V$
(4) fluid mechanics forces	
• resistance force	$F_w = -\frac{1}{2} \rho_g A_p c_w(Re)  v_p - v_g  (v_p - v_g)$
• added mass	$F_m = -\frac{1}{2} \rho_g V \left( \frac{dv_p}{dt} - \frac{dv_g}{dt} \right)$
(5) other forces	
• Basset history integral	$F_b = \frac{3}{2} d^2 \sqrt{\frac{\rho_g \mu}{\pi}} \left( \int_{-\infty}^t \frac{\frac{dv_p}{dt} - \frac{dv_g}{dt}}{(t-\tau)^{3/2}} d\tau + \frac{(v_p - v_g)_0}{\sqrt{t}} \right)$

**TABLE 3.1: Various forces acting on droplets**

The spherical droplet trajectory is derived from:  $\sum F=0$

The added-mass term describes the involvement of the surrounding gas, which gets accelerated together with the particle in the boundary layer of the particle. The last term of Basset history integral has been discovered by **Reeks and McKee (1984)** for the finite particle starting velocity.



**FIGURE 3.3** Coordinate system for force-balancing for spherical droplet

In the analysis of gas atomized droplets, the density ratio of gas to the particles is negligible ( $\rho_g/\rho_p < 10^{-3}$ ). The particle trajectory equation can be simplified:

$$m_p \frac{\partial u_p}{\partial t} = m_p g + \frac{1}{2} \rho_g I u_g - u_p I (u_g - u_p) C_d A_p \quad (3.1)$$

The force balance taken into account are force due to inertia, gravity and resistance. The resistance drag force coefficients  $c_d$  is described in the range of Reynolds number.

$Re < 800$

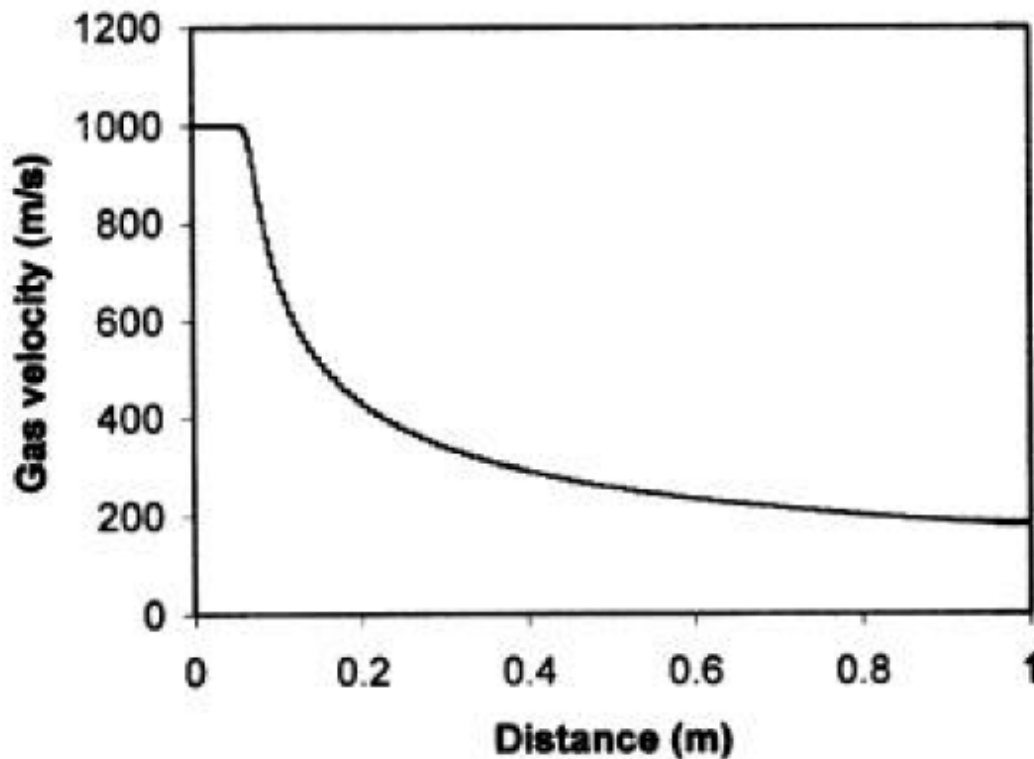
$$C_d = \frac{24}{Re} (1 + 0.15 Re^{0.687}), \quad Re < 800 \quad (3.2)$$

**Cliff *et al* (1978)** found that in the area of stokes flow  $Re < 1$ ,

$$C_d = \frac{24}{Re} \left( \frac{1 + \frac{2}{3} \mu}{1 + \mu} \right) \quad Re < 1 \quad (3.3)$$

**N S MAHESH *et al* (2002)** investigated the influences of dynamics of the droplets and temperature variations on the microstructures of final products. For this analytical models were constructed taking into consideration higher Reynolds number leading to supersonic flow of gases. The nozzles were designed so as to develop Mach no 3. Figure 2.4 describes the variation of velocity profile with flight distance. Initial gas velocity was put = 1000.00 m/s. It was seen that the gas velocity decays exponentially with respect to flight distance and reaches 200 m/s at a distance of 0.7 m from the region of atomization. Although it was not enough to provide information on the impact velocity of the droplet but it was the first step for computing droplet velocity. In the present study, instead of considering a constant velocity (or average velocity), instantaneous gas velocity obtained from gas velocity plot was used to obtain

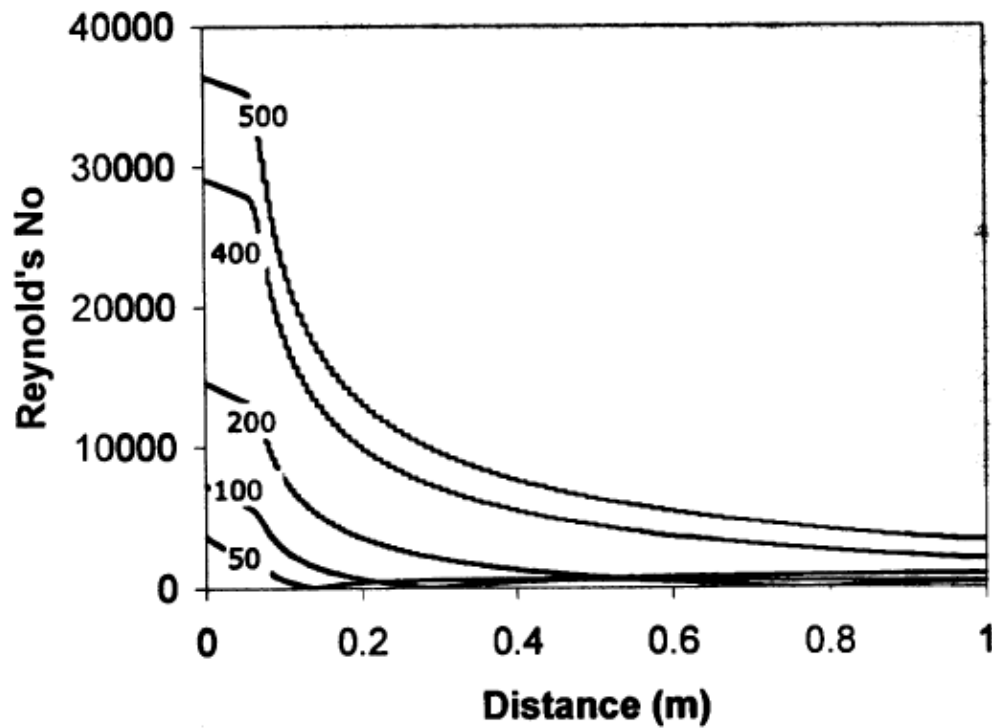
droplet velocity profile for different size droplets. This provided more realistic droplet velocity and increases the accuracy of the model.



**FIGURE 3.4** Variation of gas velocity with respect to the flight distance

Figure 3.5 shows the graph between Reynolds number and the flight distance for different droplets sizes computed based on the relative velocity of the gas and droplets. It is obvious from the graph that the Reynolds number for the larger droplets is more predictable, as the Reynolds number is directly proportional to the droplet diameter. Reynolds number for the entire chosen droplet sizes was more than 4000 in the present study.

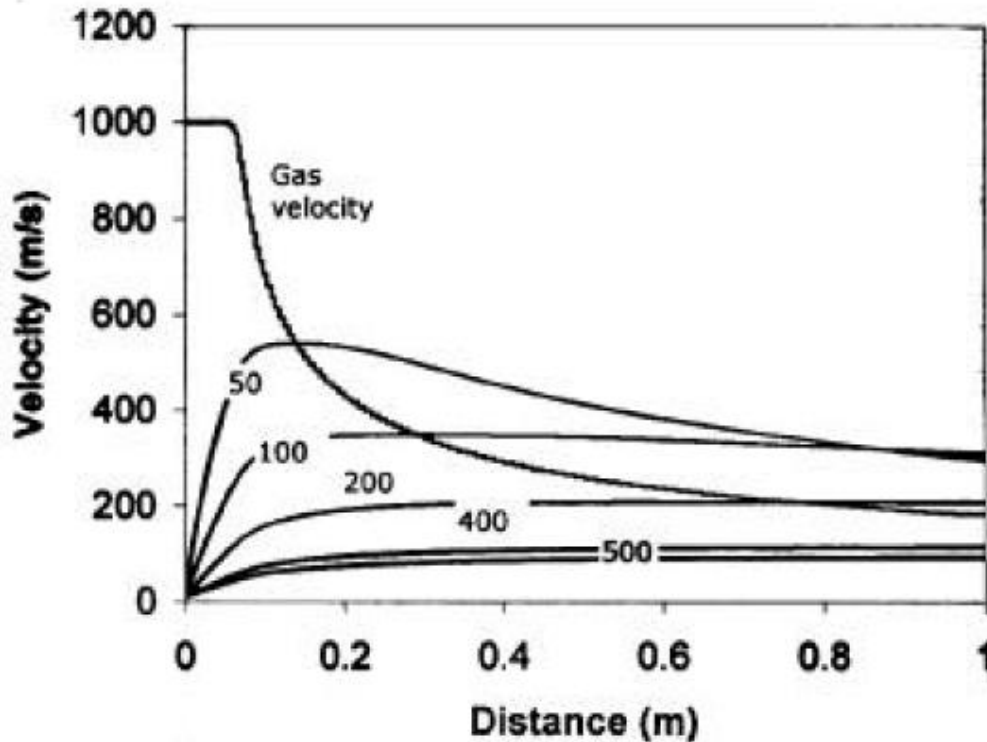
$$Re = \rho \cdot u \cdot d / \mu$$



**FIGURE 3.5** Variation of Reynolds number for different droplet size

Figure 3.6 shows the droplet's and gas velocity profile for varying sized droplets with respect to flight distance. It is obvious from the graph that at the exit of the nozzle the droplets have very less velocity (equal to acceleration due to gravity) and during the flight they gain velocity owing to the momentum transfer from the atomizing gases. The smallest droplet attains highest velocity during the flight and *vice versa*.

The relative velocity of gas and droplet becomes zero as the flight distance increases and is equivalent to Reynold numbers variation.



**FIGURE 3.6 Droplet's and Gas Velocity Profile for Varying Sized Droplets With respect to Flight Distances**

The smaller droplets moves faster than atomizing gas and attain maximum velocity in minimum time. As the Reynolds number for smaller droplets are extremely small, the drag forces are large. As a result smaller droplets are decelerating faster and show noticeable peak velocity. On the other hand, the drag coefficients for the larger droplets is approximately constant after the peak velocity due to their high inertia forces and thus no deceleration happens. Most of the droplets are at considerably high velocity ( $> 100$  m/s) while they impinge to the substrate. It has been proposed by various investigators that dendrite fragmentation mechanism is best to explain equiaxed grain morphology since mushy (semi-solid/semi-liquid) droplet reach the substrate with considerable velocity. In the present analysis a possibility for dendrite fragmentations are evident from the droplet-velocity plots.

#### 4. Heat transfer and Cooling of the droplet

The microstructure and the properties of sprayed alloy or of the final product can be known approximately by calculating the droplet thermal histories (Gutierrez *et al* 1988; Lavernia *et al* 1988). The cooling due to convection is largely responsible for heat transfer in metal droplets because of a large temperature differences between molten metal droplets and cool atomizing gas. As a result for liquid metal droplets during atomization, convective cooling dominates over radiative cooling and hence radiation effect can be neglected (Lavernia *et al* 1988; Mathur *et al* 1989; Grant *et al* 1993; Eon-Sik Lee and Ahn 1994). However, since the heat extractions from a droplets surface depends on the relative velocity between the cooling gas and the droplet itself, it is necessary to estimate droplet and gas velocities as discussed by Lavernia *et al* (1988).

Most of the researchers have adopted lumped parameter models (LPM) for calculation of heat transfer in gas atomized droplets (Lavernia *et al* 1988; Mathur *et al* 1988; Gutierrez *et al* 1989; Grant *et al* 1993; Eon-Sik Lee and Ahn 1994; Dimos and John 1997). Moreover, Levi and Mehrabian (1982) shows that LPM give needed results when the temperature gradient inside the droplet is very large. The LPM is used for the simplicity of computation, since only first order ordinary differentials equations are to be solved. The small size of the droplets play a significant role in neglecting the heat conduction within

the droplets i.e. **the droplet temperature is considered uniform (Lavernia *et al* 1988; Grant *et al* 1993; Eon/Sik Lee and Ahn 1994).**

The process of conduction freezing using LPM as well as radially symmetric non-isothermal models have been analyzed by **(Bayazitoglu and Cerny 1993)**. In this not only the radial symmetry was imposed on the droplet but also the presence of recalescence resulting from severe undercoolings and phenomena of non-equilibrium was neglected. The LPM is accurate and also the assumption of uniform temperature inside the droplet is justified when the cooling rate was 104K/s. This follows the Newtonian cooling and gives rise to LPM.

Now equating the rate of change in surface of the sensible heat contained in the droplets to the rate of heat extraction through the outer surface of the droplets **(Lavernia *et al* 1988)**,

$$m_p c_p \frac{dT_p}{dt} = Nu \lambda_g \pi d_p (T_g - T_p) \quad (4.1)$$

Equation (4.2) can be readily integrated if heat transfer coefficient,  $h$ , is assumed to be constant. But heat transfer coefficients could not be considered to be a constant since the velocity of the gas decreases and that of the droplets increases. Since radiation effects can be neglected, the heat transfer coefficient ' $h$ ' is calculated using **(Ranz and Marshall 1952)**.

$$Nu = 2 + 0.6 Re^{0.5} Pr^{0.33} \quad (4.2)$$

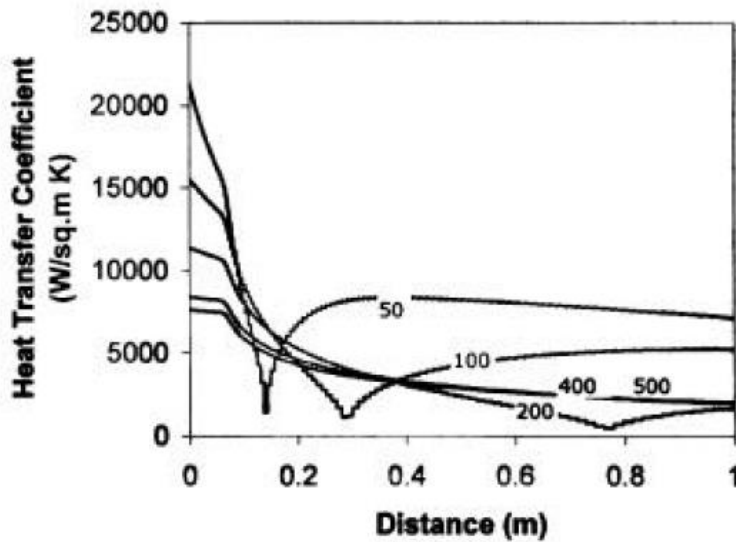
$$Pr = \frac{C_g \mu_g}{K_g} \quad (4.3)$$

Where,  $C_g$  is the gas specific heat,  $\mu_g$  the absolute viscosity of gas and  $K_g$  the gas thermal conductivity

Equation (4.2) represents Nusselt numbers given by (Ranz and Marshall 1952) correlation for laminar convection from a solid sphere. The Nusselt numbers is depends on droplet diameter, the surface averaged heat transfer coefficient between the gas and the droplets and the free-stream thermal conductivity. The Prandtl numbers is that of the gas at free-stream conditions. The Reynolds number is based on the relative velocity between the droplets and the free-stream. Here it is important to note that the Ranz and Marshall correlation used by many researchers **(Lavernia *et al* 1988; Mathur *et al* 1989; Grant *et al* 1993; Eon/Sik Lee and Ahn 1994)** has limited validity **(Dimos and John 1997)**. As the Ranz and Marshall's correlation for ' $h$ ' is correct when the Reynolds number lies in the range of 0.1 to 4000. For supersonic gas atomization when Remore than 4000 Whitaker's (1972) correlation is used:

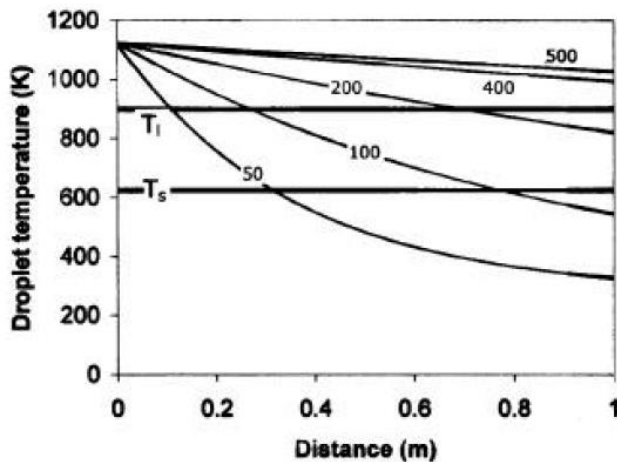
$$Nu = \frac{hD}{K} = 2 + (0.4 Re^{1/2} + 0.06 Re^{2/3}) Pr^{0.4} \left( \frac{\mu_{00}}{\mu_s} \right) \quad (4.4)$$

Heat transfer coefficient with the function of flight distanced is to be known first before predicting the thermal states of droplets. For this Whitaker's correlation for heat transfer from isothermal spherical surface was incorporated in the software code to obtain heat transfer coefficient plots. From figure 7 it can be shown that the smaller droplets would have larger heat transfer rate since they have larger surface area to volume ratio. The instantaneous heat transfer coefficients was used for obtaining thermal history of droplet.



**FIGURE 4.1 the variations in heat transfer coefficients for different droplet size with the flight distance**

Figure 4.2 shows temperature variation for different droplet sizes as a functions of flight distance. The solidus and liquidus temperature are illustrated to identify the physical state of the droplets based on their size when they reach the substrate. We know that mushy droplets provide best quality preform hence it is important to know which droplet size strike the substrate in mushy zone and it was done by determining solid fraction of droplet.



**FIGURE 4.2 temperature variation for different droplet sizes as a function of flight distances**

Figure 4.3 depicts percentage of solid in the droplets versus flight distance. It is seen from the figure that smaller droplets solidify completely at a distance from 0.2 to 0.6 m. The droplets of more than that of 100  $\mu\text{m}$  sizes would be in semi solid/semi liquid state for a longer time. This analysis helps in optimizing the stand-off distances for given set of atomization parameters and for a particular metal and its alloys system. From this analysis it was found that the standoff distance of 0.6 to 0.7 m is suitable for obtaining preform in Al-Si-Mg alloy during the deposition trials. At this standoff distance it was anticipated that the droplets of size variety between 100 and 500  $\mu\text{m}$  possesses 90% to 15% solid fractions respectively. The parameters in spray casting be set up in such a way that the spray has more volume fraction of mushy droplets i.e. the droplets of size around 200–300  $\mu\text{m}$ .

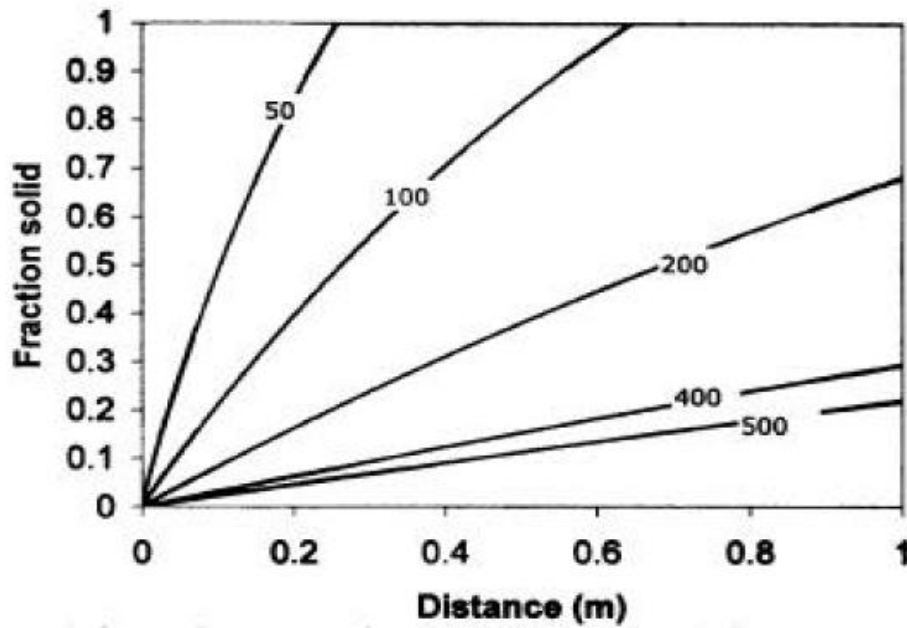


FIGURE 4.3 percentage of solid in the droplets versus flight distances

Figure 4.4 shows the rate of cooling in the droplets. From the figures it is evident that the cooling rate is very high for almost all the sizes of droplets. Cooling rate for smaller droplets were more as they lose heat faster.

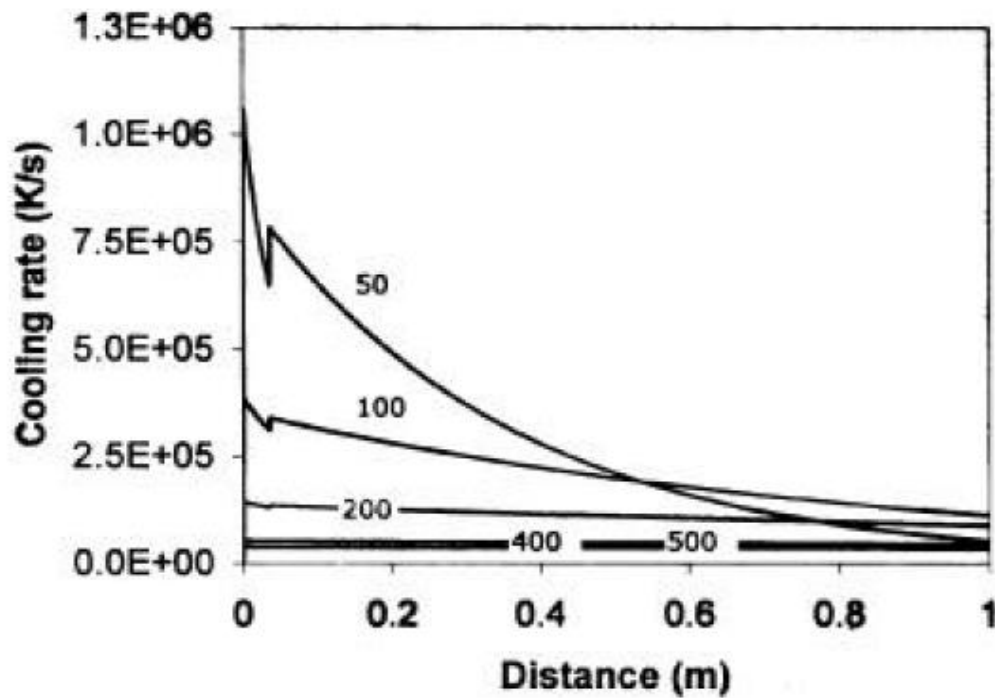


FIGURE 4.4 the rate of cooling in the droplets.

### 5. Solidifications of gas atomized droplets

Nucleation and growth of the crystal describes the solidification behavior of gas atomized droplets. Initially the solidification process is described by a homogeneous nucleation with slow cooling rates and thus without under-cooling for pure metals. Here it is implicit that the superheated melt droplet while cooling to the phase change temperature releases the latent heat and transfers it across the surface. After solidification the particle mass cools down further. In the heterogeneous cooling model the foreign particles initiate the cooling process. In this model, upon reaching the solidification temperature, a balance exists between the released latent heat and the heat convectively transferred across the surface of the droplet and thus the temperature of the droplet remains constant during solidification. These solidification models have been used in spray forming, for example, by **Zhang (1994)** and **Liu (1990)**.

The solidification model described here (**Bergmann, 2000**) was developed for low carbon steel C30 (0.30 wt. % C), but may be easily adapted to other material compositions.

The solidification model explained here is developed for low carbon steel C30 (0.30 weight% C) but is easily modified to other material compositions. Figure 2.10 shows part of the iron-carbon phase diagram, where the area for C30 is marked. For low cooling rates, temperature with respect to time curve can be drawn using this phase diagram. As in spray forming the cooling rate immediately after atomizations is very high hence there is a chances of undercooling even before the nucleation starts.

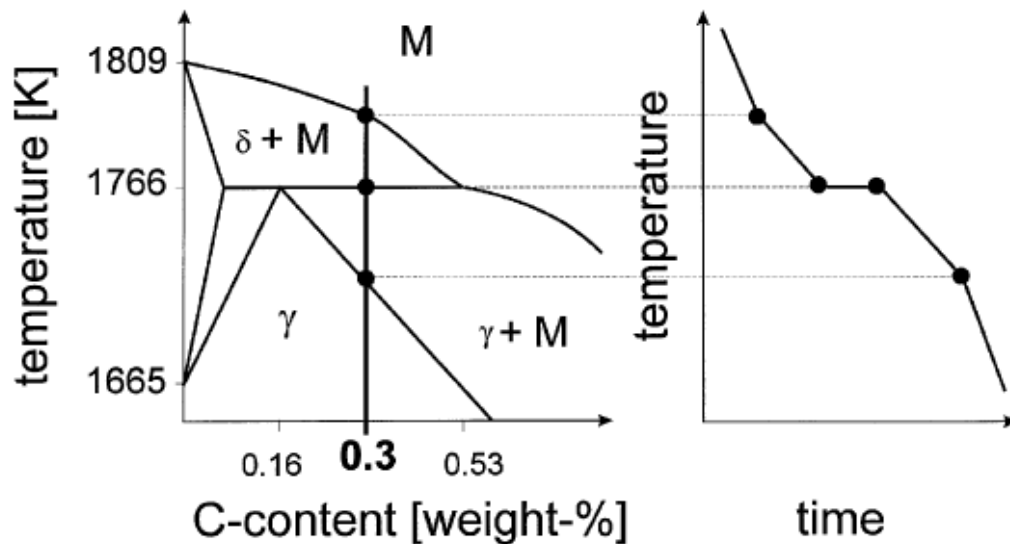


FIGURE 5.1 Phase Diagram of the Fe-C and the corresponding variation in phases with time

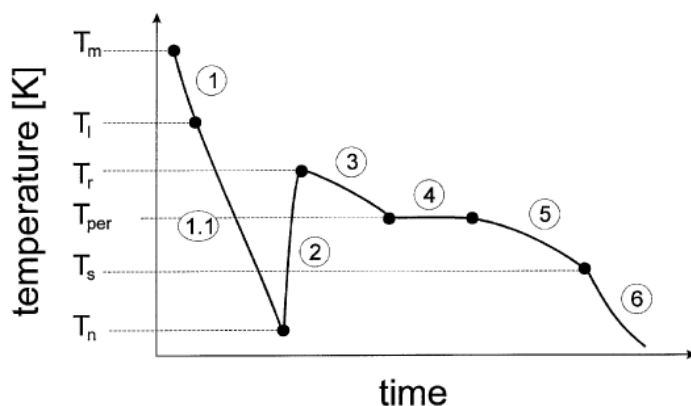


FIGURE 5.2 Temperature variation of gas atomized droplets with respect to time.

Starting with the superheated temperature  $T_m$ , the droplet cools down to liquidus temperature  $T_l$ . If the cooling rate is high droplet may undercool until nucleation starts on reaching the nucleation temperature. As there is release in latent heat of fusion during recalescence, the droplet temperature increases until it reaches a local maximum in the cooling curve at  $T_r$ . Later on it follows segregated solidification, as the temperature keeps on decreasing. At temperature  $T_{per}$ , the peritectic transformations takes place at constant droplet temperature. As the peritectic transformation ends up, segregated solidification starts again until the droplet is completely solidified at  $T_s$ . After this in solidified state itself the droplet cooling continues.

Separate analysis of droplet cooling and solidification:

## 6. Cooling in the liquid state

For a spherical droplet, the change of internal heat content according to convection and radiation heat transfer can be expressed by:

$$C_{d,l} \frac{dT_d}{dt} = - \frac{6h}{\rho_d d_d} (T_d - T_g) - \frac{6\varepsilon\sigma}{\rho_d d_d} (T_d^4 - T_w^4) \quad (6.1)$$

where  $T_d$  = droplet temperature,  $T_g$  = gas temperature and  $T_w$  = temperature of the surrounding walls. The specific heat capacity of the liquid droplet material is  $c_{dl}$ ;  $h$  is the heat transfer coefficient,  $\varepsilon$  and  $\sigma$  are the emissivity and Stefan–Boltzmann constants,  $\rho_d$  and  $d_d$  are the droplet's density and diameter, respectively.

### 6.1 Undercooling:

The solidification process does not start immediately after liquidus temperature but the solidification depends on the cooling rate and on the size of the droplet. Nucleation temperature can be much lower than the liquidus temperature. The nucleation temperature for continuous cooling is defined as the temperature, where the number of nuclei  $N_n$  in the droplet volume  $V_d$  is identical to one:

$$N_n = V_d \int_{T_l}^{T_n} \frac{J(T)}{\dot{T}} dT = 1 \quad (6.2)$$

Heterogeneous nucleation minimizes the degree of undercooling. The maximum undercooling for iron based alloys is 295 Kelvin and a minimum undercooling of 3 Kelvin is assumed.

### 6.2 Recalescence:

As the solidification starts there is an increase in the temperature of droplet due to release of latent heat of fusion. The conservation equation for the droplet thermal energy is extended to:

$$C_{d,l} \frac{dT_d}{dt} = \Delta h_f \frac{df_s}{dt} - \frac{6h}{\rho_d d_d} (T_d - T_g) - \frac{6\varepsilon\sigma}{\rho_d d_d} (T_d^4 - T_g^4) \quad (6.3)$$

where  $f_s$  as fraction solid ( $f_s = 0$  droplet is completely liquid;  $f_s = 1$  droplet is completely solid) and the specific heat capacity of the droplets  $c_d$  as the average of the solid and liquid contents:

$$C_d = f_s C_{ds} + (1 - f_s) C_{d,l} \quad (6.4)$$

The phase of recalescence ends, when the production rate of internal heat equals the heat transfer from the droplets surface. Here, the cooling curve of a droplets reaches a local maximum and the droplet temperature equals  $T_r$ :

$$\Delta h_f \frac{df_s}{dt} = \frac{6h}{\rho_d d_d} (T_r - T_g) - \frac{6\varepsilon\sigma}{\rho_d d_d} (T_r^4 - T_w^4) \quad (6.5)$$

### 6.3 Segregated solidification 1:

The heat conservation equation in this stage is described by:

$$\frac{dT_d}{dt} (c_d + \Delta h_f \frac{df_s}{dT_d}) = \frac{6h}{\rho_d d_d} (T_d - T_g) - \frac{6\epsilon\sigma}{\rho_d d_d} (T_d^4 - T_w^4) \quad (6.6)$$

### 6.4 Peritectic transformation:

When the droplet temperature reaches the peritectic temperature, it remains at a constant value until this phase transformation got completed. The change in solid fraction during peritectic solidification is described by:

$$\Delta h_f \frac{df_s}{dt} = - \frac{6h}{\rho_d d_d} (T_d - T_g) - \frac{6\epsilon\sigma}{\rho_d d_d} (T_d^4 - T_w^4) \quad (6.7)$$

Peritectic solidification gets completed, when the composition of the remaining liquid reaches the appropriate concentration.

### 6.5 Segregated solidification 2:

Segregated solidification again come into picture after peritectic transformation.

### 6.6 Cooling in the solid state:

Further cooling of droplet takes place after solidification. This process can be evaluated from the following equation:

$$c_{ds} \frac{dT_d}{dt} = - \frac{6h}{\rho_d d_d} (T_d - T_g) - \frac{6\epsilon\sigma}{\rho_d d_d} (T_d^4 - T_w^4) \quad (6.8)$$

with  $c_{ds}$  as the specific heat capacity of the solid materials.

## 7. Solidification behavior inside the melt particles

The temperature variation inside a single spherical droplet during solidification has been studied numerically by **Kallien (1988)** and **Hartmann (1990)**. The simulation program was developed for solidification during metals casting.

It includes undercooling thus calculates three-dimensional temperature variation in gas atomized droplet. The model is based on Fourier law for transient heat conduction in three-plane (Cartesian) coordinates as:-

$$\rho c_p \frac{\partial T}{\partial t} = \frac{\partial}{\partial x} (\lambda \frac{\partial T}{\partial x}) + \frac{\partial}{\partial y} (\lambda \frac{\partial T}{\partial y}) + \frac{\partial}{\partial z} (\lambda \frac{\partial T}{\partial z}) \quad (7.1)$$

where conductivity  $\lambda$ , density  $\rho$  and heat capacity  $c_p$ , depend on location and temperature.

A modified temperature is introduced to achieve linear differentials equation:

$$\Theta = \frac{1}{\lambda_0} \int_0^T \lambda dT \quad (7.2)$$

and thus linear differential equation was :

$$\frac{\rho c_p}{\lambda_0} \frac{\partial T}{\partial t} = \frac{\partial^2 \theta}{\partial x^2} + \frac{\partial^2 \theta}{\partial y^2} + \frac{\partial^2 \theta}{\partial z^2}$$

(7.3)

Finite difference method was used to solve this equation on an orthogonal-plane three dimensional grid.

The assumed boundary conditions are:

- The surrounding gas is assumed to be at constant temperature,
- Constant heat transfer coefficients across the whole surface of the droplet.
- At preselected nucleation temperature the solidification was initiated and nucleation was considered to take place at either at single point or at number of grid cells.

A six stages approach for the particle solidification was assumed:

- (1) Cooling of the melts from superheating until the nucleation temperature is reached,
- (2) Attaining the highest undercoolings,
- (3) Solidification and recalescence,
- (4) Cooling and solidification in the melt temperature range between solidus and liquidus,
- (5) end of solidifications,
- (6) Cooling of the solidified particles.

For the recalescence phase, the releasing velocity of latent heat depend on undercooling  $\Delta T$ :

$$v = K \Delta T$$

As soon as the grid cells solidifies completely the adjacent cells begin to release the latent heat. Degree of undercooling controls the velocity of solidification.

The heat transfer coefficient was taken as  $h = 20\,000 \text{ W/m}^2 \text{ K}$  and the undercooling prior to nucleations was considered to be 50 K.

The solidification process initiates at a single point on the surface of the particle in a plane inside the particles. As there is release of latent heat, the interior of the particle gets heated up. For a 10% solidification rate, movement of the solidification front is visible, which raises the temperature of the surrounding grid cells close to the liquidus temperature.

As Biot number is very less temperature variation inside the spherical droplets are neglected. Thus this behavior necessitates for refined modeling in order to obtain realistic spray formings modeling results.

### Conclusion

It has been suggested in this paper that there are many reasons why a problem-solving approach can contribute significantly to the outcomes of a mathematics in spray formings. A problem solving approach can provide vehicle to researchers to construct their own ideas about mathematics and to take responsibility for their own learning. There is little doubt that the mathematics program can be enhanced by the establishment of an environment in which researchers are exposed to oppose to more traditional models of research about problem solving. The challenge for researchers at all levels, is to develop the process of mathematical thinking alongside the knowledge and to seek opportunities to solve spray formings tasks in problem-solving contexts.

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# AGE RANK DETECTION USING GENERALIZED FEED FORWARD (GFF) NEURAL NETWORK

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**Abstract**— In this paper a new classification algorithm is proposed for the Classification of Age rank both in male and female. In order to develop algorithm 125 camera captured images of seven male and seven female in different angles images. With a view to extract features from the Captured images after image processing, an algorithm proposes (FFT) Fast Fourier Transform coefficients. The Efficient classifiers based on Generalized feed forward (GFF) Neural Network. A separate Cross-Validation dataset is used for proper evaluation of the proposed classification algorithm with respect to important performance measures, such as MSE and classification accuracy. The Average Classification Accuracy of GFF Neural Network comprising of one hidden layers with 2 PE's organized in a typical topology is found to be superior for Training. Finally, optimal algorithm has been developed on the basis of the best classifier performance. The algorithm will provide an effective alternative to traditional method of Age rank detection using captured image analysis for deciding the age in male and female.

**Keywords**— *Matlab, NeuroSolution, Microsoft excel, camera captured images, GFF networks, learning rules.*

## INTRODUCTION

Face images convey a significant amount of knowledge including information about the identity, emotional state, ethnic origin, gender, age, and head orientation of a person shown in a face image. This type of information plays a significant role during face-to-face communication between humans. Current trends in information technology dictate the improvement of the interaction between humans and machines, in an attempt to upgrade the accessibility of computer systems. As part of this effort, many researchers have recently directed their research effort toward age estimation problem. Age estimation is the determination of a person's age based on biometric features. Although age estimation can be accomplished using different biometric traits, this research focus on facial age estimation that relies on biometric features extracted from a person's face. The process of age determination could figure in a variety of applications ranging from age-based access control, age adaptive human machine interaction., age invariant person identification and data mining and organization.

In addition to problems encountered in other typical face image interpretation tasks such as face detection, face recognition, expression and gender recognition, age estimation displays additional unique challenges due to the complex variations, including cosmetics usage, personal specialties, living conditions, gender and ethnic differences.

In this research, we try to prove that computer can estimate/classify human age according to features extracted from human facial image using Artificial Neural Network (ANN). Artificial neural networks (ANN) are parallel computational models, comprising closely interconnected adaptive processing units. The important characteristic of neural networks is their adaptive nature, where 'learning by example replaces programming'. This feature makes the ANN techniques very appealing in application domains for solving highly nonlinear phenomena. ANN have been applied successfully to many application. Most of these applications are based on statistical estimation, optimization and control theory such as speech recognition, image analysis and adaptive control. A Multi-layer neural network can approximate any smooth, measurable function between input and output vectors by selecting a suitable set of connecting weight and transfer functions.

In our research, we devote our study to produce a system which is capable for estimating the age of a person as reliably as humans. To achieve this goal we follow a research methodology that consists of the following steps: First we capture a real human face image from people around (friends and family). Second we use matlab tool to locate and extract the face features. Third we preprocess and prepare the

data for ANN training. Finally we apply our experiments and analyze the results.

## RESEARCH METHODOLOGY

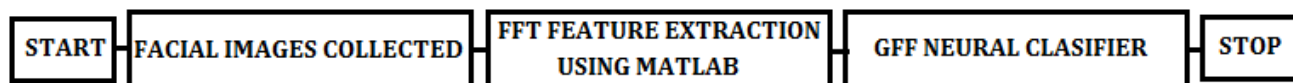


Figure2.1 Methodology of work

It is proposed to study age rank Recognition Using Neural Network Approaches.. Data acquisition for the proposed classifier designed for the Recognition of Human Age shall be in the form of facial images. Image data will be Collected from the different- different Faces .The most important un correlated features as well as coefficient from the images will be extracted .In order to extract features, statistical techniques, image processing techniques, transformed domain will be used.

## NEURAL NETWORKS

Following Neural Networks are tested:

### Feed-Forward Neural Networks

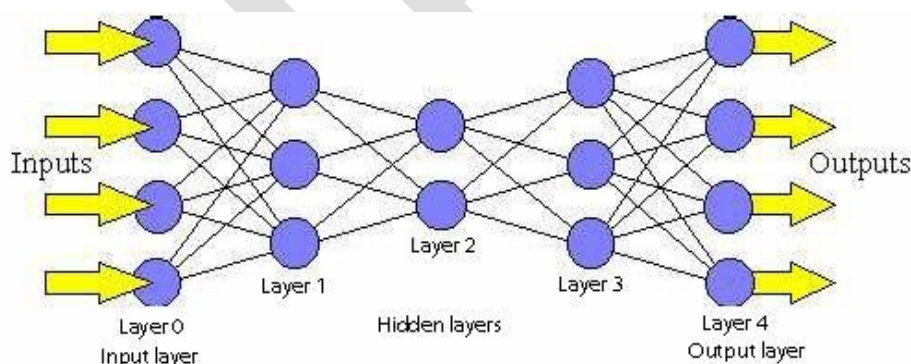


Figure 3.1 feed-forward network.

Feed-forward networks have the following characteristics:

1. Perceptrons are arranged in layers, with the first layer taking in inputs and the last layer producing outputs. The middle layers have no connection with the external world, and hence are called hidden layers.

2. Each perceptron in one layer is connected to every perceptron on the next layer. Hence information is constantly "fed forward" from one layer to the next., and this explains why these networks are called feed-forward networks.
3. There is no connection among perceptrons in the same layer.

A single perceptron can classify points into two regions that are linearly separable. Now let us extend the discussion into the separation of points into two regions that are not linearly separable. Consider the following network:

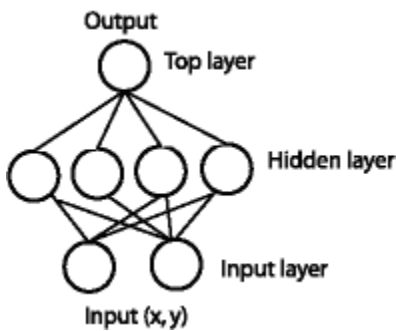


Figure. 3.2 A feed-forward network with one hidden layer.

The same  $(x, y)$  is fed into the network through the perceptrons in the input layer. With four perceptrons that are independent of each other in the hidden layer, the point is classified into 4 pairs of linearly separable regions, each of which has a unique line separating the region.

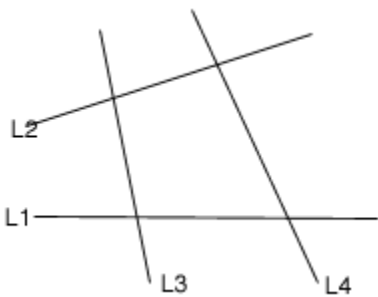


Figure 3.3 lines each dividing the plane into 2 linearly separable regions.

The top perceptron performs logical operations on the outputs of the hidden layers so that the whole network classifies input points in 2 regions that might not be linearly separable. For instance, using the AND operator on these four outputs, one gets the intersection of the 4 regions that forms the center region.

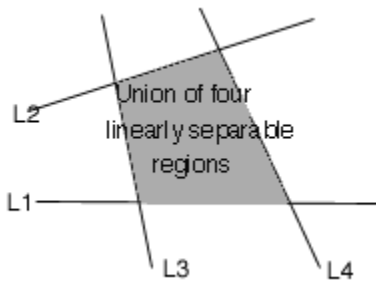


Figure 3.4 Intersection of 4 linearly separable regions forms the center region.

By varying the number of nodes in the hidden layer, the number of layers, and the number of input and output nodes, one can classification of points in arbitrary dimension into an arbitrary number of groups. Hence feed-forward networks are commonly used for classification.

### Learning Rules used:

#### ➤ Momentum

Momentum simply adds a fraction  $m$  of the previous weight update to the current one. The momentum parameter is used to prevent the system from converging to a local minimum or saddle point. A high momentum parameter can also help to increase the speed of convergence of the system. However, setting the momentum parameter too high can create a risk of overshooting the minimum, which can cause the system to become unstable. A momentum coefficient that is too low cannot reliably avoid local minima, and can also slow down the training of the system.

#### ➤ Conjugate Gradient

CG is the most popular iterative method for solving large systems of linear equations. CG is effective for systems of the form  $Ax=b$  (1) where  $x$  is an unknown vector,  $b$  is a known vector, and  $A$  is a known, square, symmetric, positive-definite (or positive-indefinite) matrix. (Don't worry if you've forgotten what "positive-definite" means; we shall review it.) These systems arise in many important settings, such as finite difference and finite element methods for solving partial differential equations, structural analysis, circuit analysis, and math homework.

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from  $u_i$  to  $u_j$  is given by:  $\Delta u_{ij} = \eta \cdot a_i \cdot e_j$ , where  $\eta$  is the learning rate,  $a_i$  represents the activation of  $u_i$  and  $e_j$  is the difference between the expected output and the actual output of  $u_j$ . If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

It has been shown that for networks with linear activation functions and with no hidden units (hidden units are found in networks with more than two layers), the error squared vs. the weight graph is a paraboloid in  $n$ -space. Since the proportionality constant is negative, the graph of such a function is concave upward and has a minimum value. The vertex of this paraboloid represents the point where the error is minimized. The weight vector corresponding to this point is then the ideal weight vector.

#### ➤ Quick propagation

Quick propagation (Quickprop) [1] is one of the most effective and widely used adaptive learning rules. There is only one global parameter making a significant contribution to the result, the  $\epsilon$ -parameter. Quick-propagation uses a set of heuristics to optimise Back-propagation, the condition where  $\epsilon$  is used is when the sign for the current slope and previous slope for the weight is the same.

#### ➤ Delta by Delta

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from  $u_i$  to  $u_j$  is given by:  $\Delta w_{ij} = r * a_i * e_j$ , where  $r$  is the learning rate,  $a_i$  represents the activation of  $u_i$  and  $e_j$  is the difference between the expected output and the actual output of  $u_j$ . If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

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#### ACKNOWLEDGMENT

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#### CONCLUSION

This paper demonstrated how artificial neural networks(ANN)could be used to build accurate age estimator. In order to train the neural network we extract shape features from real human face images that we captured at earlier time. We use Generalized Feed-Forward Network as classification. The result show that in training 45 year male is identify 88.88% or 25 year female is 80% and rest of 100% accuracy but in cross-validation result is not good.

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# CHARACTERIZATION OF FLUIDS USING OSCILLATORY MEASUREMENTS

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**Abstract**— Fracturing fluid has a very important role in hydraulic fracturing treatment. Viscosity of hydraulic fracturing fluid affects transporting, suspending, and deposition of proppant, as well as flow back after treatment. It should also be capable of developing the necessary fracture width to accept proppants or to allow deep acid penetration. Compatibility with formation fluids and material has to be taken into account [11].

Rheology of the fracturing fluid is fundamental for hydraulic fracturing design, i.e. prediction of fracture growth and geometry. Accurate measurements and a good understanding of rheological properties of hydraulic fracturing fluids are essential for designing and executing an optimum treatment. Failure in the selection of fracturing fluid will result in unsuccessful treatment in term of reservoir conditions, oil production, and net present value.

Borate cross-linked fluids have been widely used as a fracturing fluid in the oil industry. An experimental study has been conducted to investigate the rheological properties of borate cross-linked fluids and the results are presented in this paper.

Many oscillatory measurements have been conducted to investigate the behaviour of the rheological properties of the fracturing fluid samples under different conditions and the possible relationship among them. Results of the oscillatory measurements of certain borate cross-linked fluids are shown in this paper. It was demonstrated that the linear-viscoelastic limit and flow-point frequency are dependent on temperature.

**Keywords**— Stimulation, Acid, Hydraulic Fracturing, Matrix acidizing, Polymer Concentration, Time test oscillation, Amplitude sweep, Frequency sweep, Temperature test oscillation.

## INTRODUCTION

Reservoir stimulation and artificial lift are the two main activities of the production engineer in the petroleum and related industries. The main purpose of stimulation is to enhance the property value and/or to increase ultimate economic recovery. The stimulation treatments are intended to remedy, or even improve, the natural connection of the wellbore with the reservoir [5].

Materials in this chapter were taken from [27], [6], [5], [4].

## Methodology

### 1.1. Reservoir Justification of Stimulation Treatments

There are two main areas of interest for a stimulation treatment:

1. Wellbore zone and its proximity
2. Rest of a reservoir

Different kinds of stimulation technology are generally used depending on the area of interest:

1. Acid washing
2. Matrix acidizing
3. Acid fracturing
4. Hydraulic fracturing

Stimulation is needed to remove skin zones around the wellbore. The total skin effect is a composite of a number of factors that can be divided into pseudoskin and formation damage as shown in Fig. 1.

Pseudoskin effects are defined as skins that appear due to 1) limited entry; 2) off-centered well; 3) gas blockage; 4) turbulent flow in the vicinity of a well; 5) collapsed tubing; or 6) poor isolation due to poor cementation.

Formation damage is a result of the following failures:

Drilling damage due to drilling mud solid invasion and/or drilling filtrate invasion:

- Cementing damage due to cement slurry invasion
- Perforation damage
- Damage during production due to precipitation of organic/inorganic material, bridging, and blocking
- Damage during stimulation treatment

Skin analysis has to be performed prior to stimulation treatment.

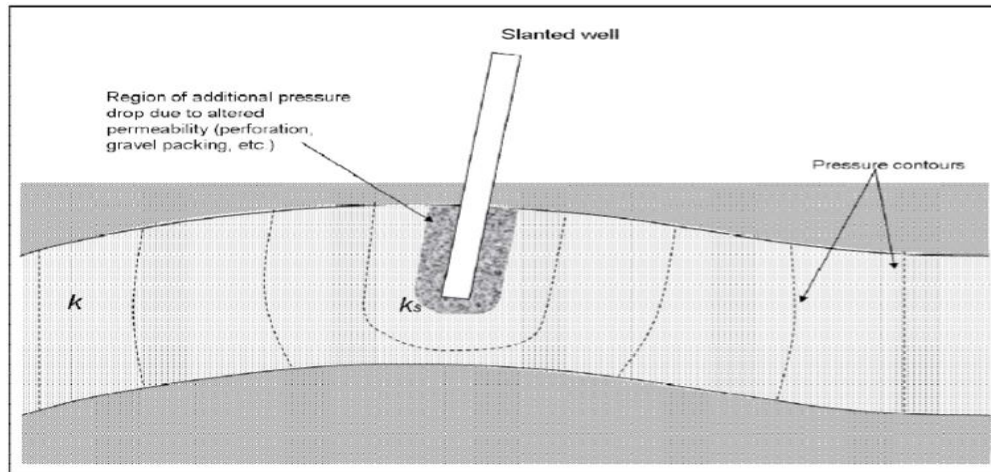


Figure 1 Skin effect due to converging of flow lines and near wellbore permeability impairment (Zolotukhin et al. 2005)

## 1.2. Types of Stimulation Treatment:

There are several types of stimulation treatment that can be conducted to remove the skin effect.

**Acid washing** is a type of stimulation to remove acid soluble scales present in the wellbore or to open perforations. Acid washing is the least expensive of all the near wellbore treatment techniques. A small quantity of acid delivered to the desired position in the wellbore reacts with scale deposits or the formation. Acid may be circulated back and forth across the perforations or formation face.

**Matrix acidizing** is a type of stimulation to remove near-wellbore damage by injecting acid into the formation. The objective of matrix acidizing is to recover the original reservoir permeability or even create additional permeability (e.g. in carbonate formation). In sandstone formations, the acid attacks the clogging particles. Normally, sandstone formations are treated with hydrochloric/hydrofluoric (HCl/HF) mixtures. In carbonate formations (limestone and dolomite), the acid mainly attacks the matrix itself which creates secondary permeability. Hydrochloric acid is usually used in stimulation treatment of carbonate formations.

**Hydraulic fracturing** is stimulation treatment by creating fractures to connect the wellbore with the undamaged reservoir. Hydraulic fracturing is usually carried out in formations with low permeability whereas matrix acidizing is performed in medium to high permeability formations ( $k > 10$  MD). Matrix acidizing treatment is regarded as inexpensive operation as compared to hydraulic fracturing in vertical wells but this is not true for horizontal wells.

## 2. FRACTURING FLUIDS AND ADDITIVES

The materials in this section were taken from [9], [6], [4], and [5].

The fracturing fluid is a critical component of the hydraulic fracturing treatment. Its main functions are to open the fracture and to transport proppants along the length of the fracture.

Consequently, the viscous properties of the fluid are usually considered the most important. However, successful hydraulic fracturing treatments require that the fluids have other special properties. In addition to exhibiting the proper viscosity in the fracture, they should break and clean up rapidly once the treatment is over, provide good fluid-loss control, exhibit low friction pressure during pumping and be as economical as is practical [5].

More than 90% of fracturing fluids are water-based according to [6]. The obvious reason is that aqueous fluids are cheaper and can provide control of a broad range of physical properties as a result of additives developed over the years.

The main purposes of additives for fracturing fluids are to enhance fracture creation and proppant-carrying capability and to minimise formation damage.

### 2.1. Properties of a Fracturing Fluid

The fracturing fluid must have certain physical and chemical properties to achieve successful stimulation.

- It should be compatible with the formation material.
- It should be compatible with the formation fluids.
- It should be capable of suspending proppants and transporting them deep into the fracture but should not carry it back during flow back.
- It should be capable, through its inherent viscosity, to develop the necessary fracture width to accept proppants or to allow deep acid penetration.
- It should be an efficient fluid (i.e., have a low fluid loss).
- It should be easy to remove from the formation.
- It should have low friction pressure.
- Preparation of the fluid should be simple and easy to perform in the field.
- It should be stable so that it will remain its viscosity throughout the treatment.
- The fracturing fluid should be cost-effective.

## 2.2. Types of Fracturing Fluids

Many different types of fluids have been developed to provide the properties described above because reservoirs to be stimulated vary in temperature, permeability, rock composition, and pore pressure [5].

Table-1 various types of hydraulic fracturing fluids and techniques

Type	Remark
Water base fluid	Predominant
Oil base fluid	Water sensitive; increase the hazard
Alcohol base fluid	Rare
Emulsion fluid	High pressure, low temperature
Foam base fluid	Low pressure, low temperature
Noncomplex gelled water fracture	Simple technology
Nitrogen foam fracture	Rapid cleanup
Complexed gelled water fracture	Often the best solution
Premixed gel concentrates	Improve process logistics
In situ precipitation technique	Reduce the concentration of the scale-forming ingredients

## 3. RESULTS AND DISCUSSION

### 3.1. Amplitude Sweep

In this series of measurements, the fracturing fluids were subjected to an angular frequency ( $\omega$ ) of 10 1/s based on [18]. The typical result from this measurement can be seen in Fig. 2 where amplitude strain  $\gamma$  (in the fraction) is plotted on the x-axis while both  $G'$  and  $G''$  are plotted on the y-axis with both axes in a logarithmic scale. Later on, all amplitude strain values on the chart are presented in a fraction. It is noticeable from Fig. 2 that both curves are increasing from linear before decreasing. This indicates an increasing proportion of the deformation energy (loss modulus  $G''$ ) is being used up to change the structure before the final breakdown takes place [16]. Increasing values in  $G'$  curve could be a counter to maintain the structure from increasing proportion of the deformation energy.

It can be seen from Fig. 2, the  $G''$  curve is considered linear until 100% strain (as a reminder: strain values on the chart are in a fraction; 1 in fraction equal to 100% in percentage). The  $G''$  curve deviated to non-linear at strain approximately 118%. Based on those, it can be concluded for this fracturing fluid under measurement conditions the limit of the LVE range  $\gamma_L=118\%$  below which the structure of the fracturing fluid is stable.

Further measurement was immediately performed for the same fracturing fluid presented in Fig. 2 with exactly the same setting configuration to get more information whether the limit of the LVE range was already exceeded. The results, gathered in Fig. 3, demonstrate that the limit of the LVE range has been exceeded since the curves were different. The 'increasing section' on the storage modulus curve after deformation does not appear in Fig. 3 as in Fig. 2. This could be because of the limit of the LVE range has been exceeded and the structure of the fracturing fluid sample has already been completely destroyed. This condition results in no counter act to maintain the structure from increasing proportion of the deformation energy.

In addition, it can be seen from Fig. 10 and 11 that this fracturing fluid has a gel character ( $G' > G''$ ) under measurement conditions. Here, the elastic behavior dominates over the viscous behavior [16].

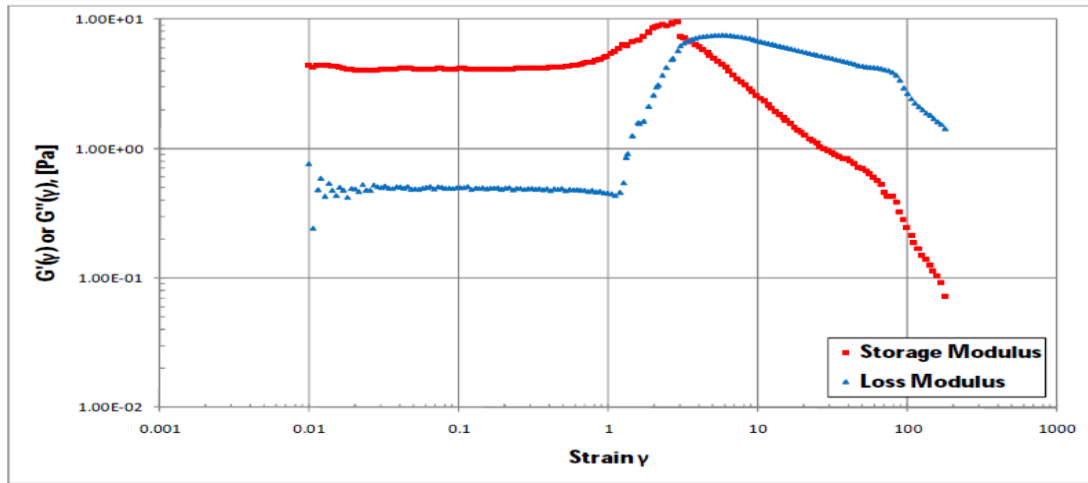


Figure 2 Typical  $G'$  (storage modulus) and  $G''$  (loss modulus) curves from amplitude sweep measurement. Here for fracturing fluid 2 at 20°C.

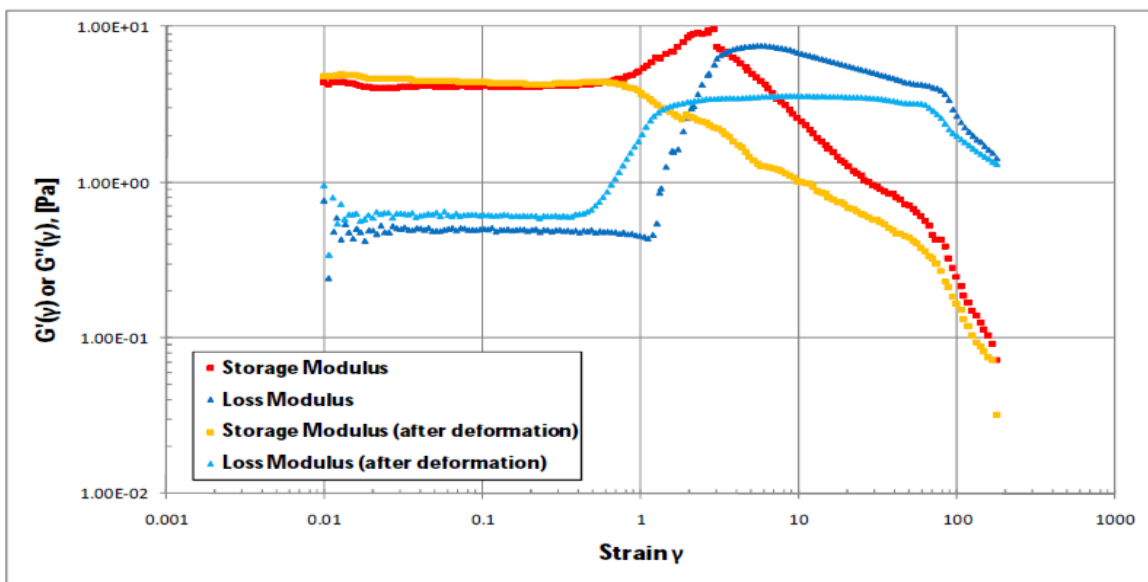


Figure 3  $G'$  (storage modulus) and  $G''$  (loss modulus) curves from before and after deformation. Here for fracturing fluid 2 at 20°C.

### 3.2. Effect of Temperature and Polymer Concentration

The effect of temperature on limit of the LVE range for fracturing fluid 1 and 2 can be seen in Fig. 4 and 5, respectively. In Fig. 4 and 5,  $G'$  and  $G''$  are plotted versus strain at different temperature conditions. As the temperature increased, the limit of the LVE range also increased.

The effect of temperature and polymer concentration on the limit of LVE range may be better described in Fig. 6 and 7. In Fig. 6, the  $G'(\gamma)$  function is taken for the analysis for determining the limit of the LVE range. In this method, limit of the LVE range is strain value at which  $G'$  started increase continuously before decreasing. In the other hand, the  $G''(\gamma)$  function is taken for the analysis for determining the limit of the LVE range presented in Fig. 7. In this method, limit of the LVE range is strain value at which  $G''$  started increase or decrease continuously. The results depicted in Fig. 6 and 7 show that the limit of the LVE range increases when increasing the temperature but decreases when increasing the polymer concentration.

In the view of Fig. 6 and 7, it is noticeable that the plot of the limit of the LVE range (logarithmic scale) versus temperature (linear scale) in the semi-logarithmic diagram is a reasonably straight line.

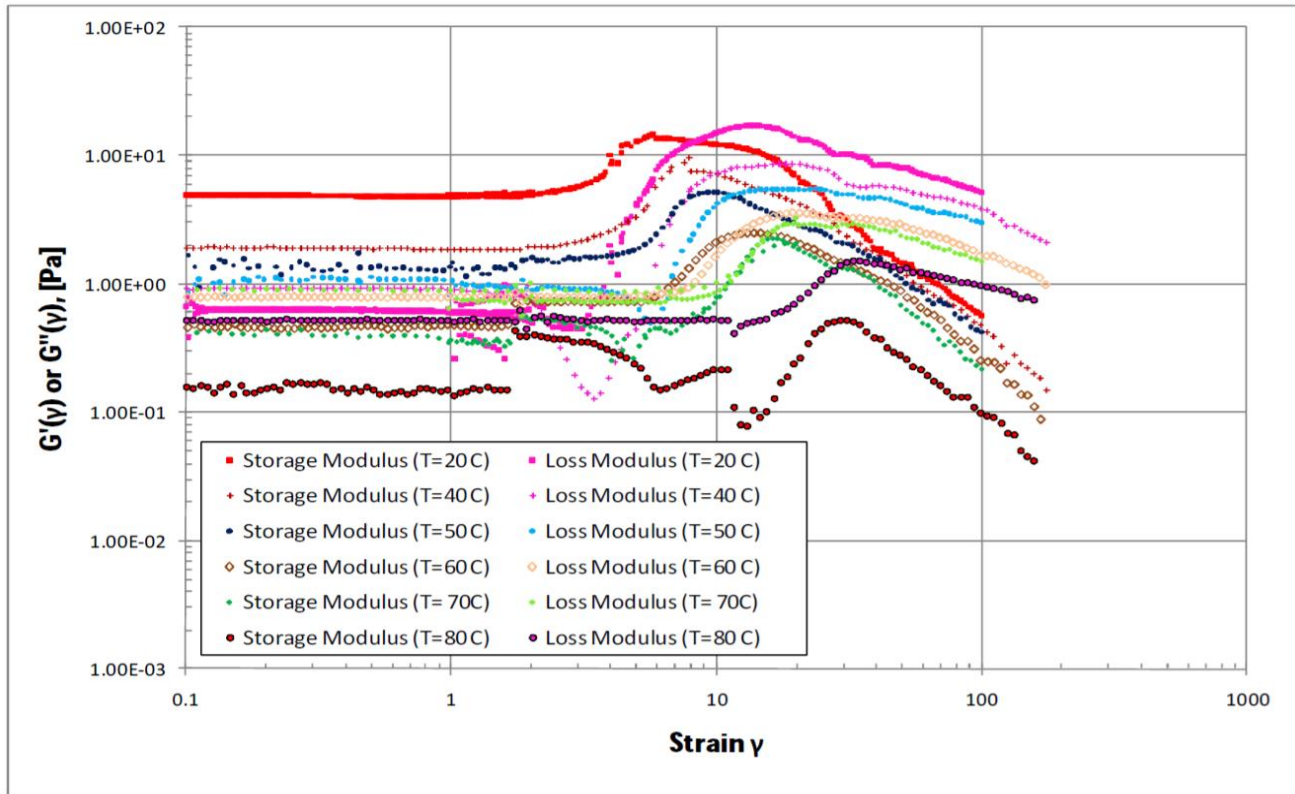


Figure 4  $G'$  and  $G''$  versus strain for fracturing fluid 1 at different temperature

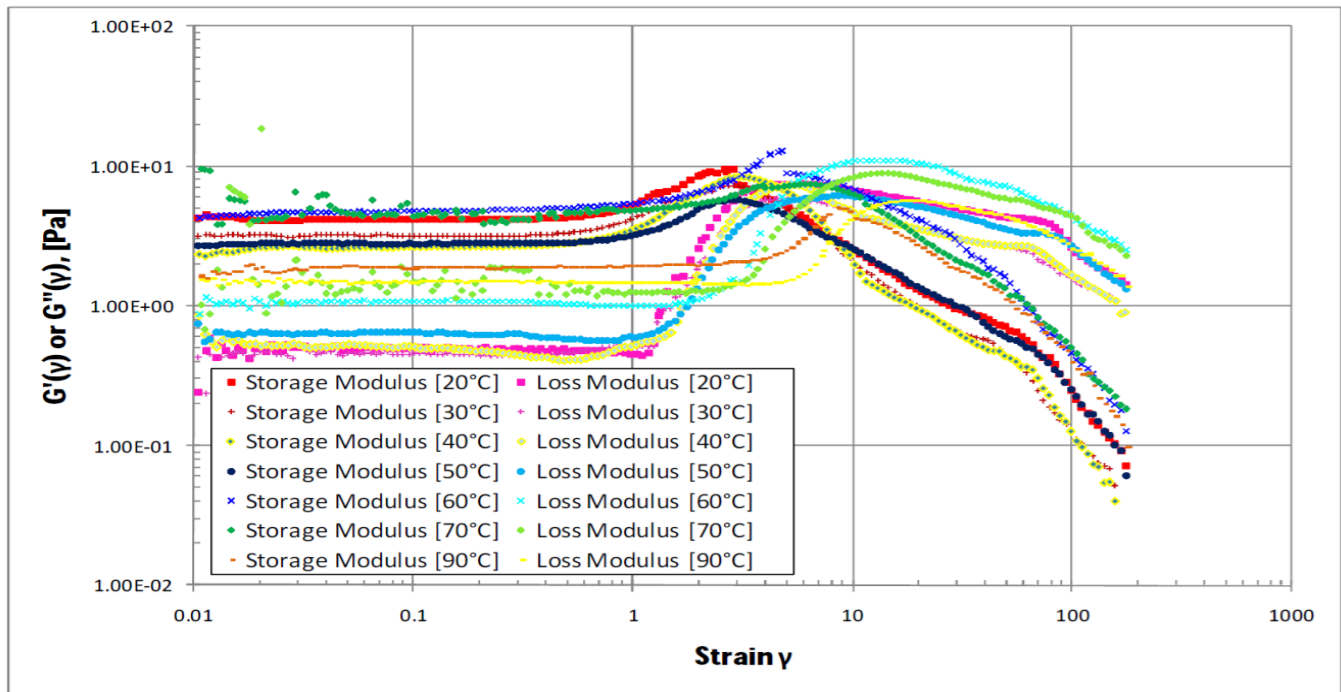


Figure 5  $G'$  and  $G''$  versus strain for fracturing fluid 2 at different temperature

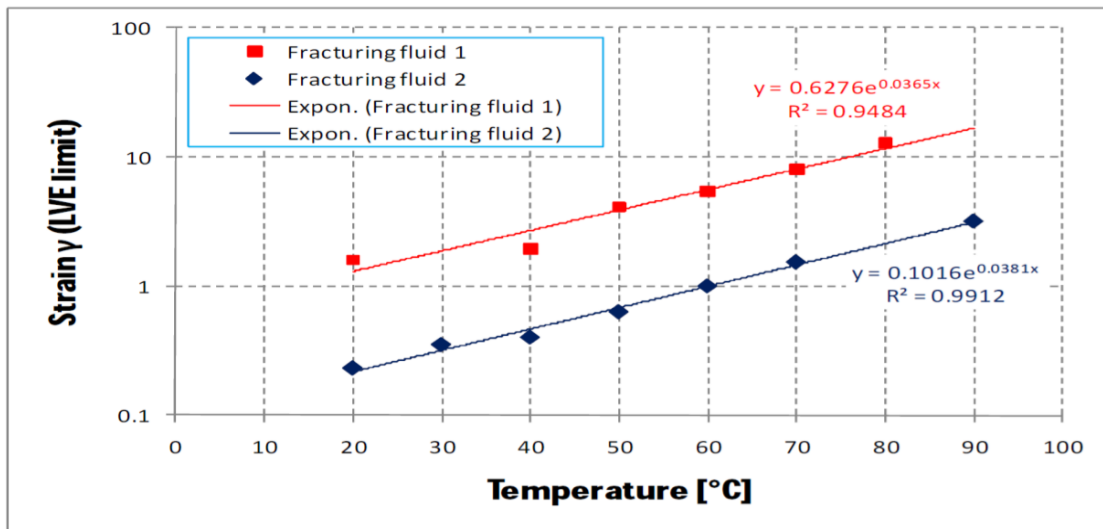


Figure 6 Limit of the LVE range and polymer concentration versus temperature. Here the  $G'$  ( $\gamma$ ) function is taken for the analysis for determining the limit of the LVE range. The data fall approximately in straight line.

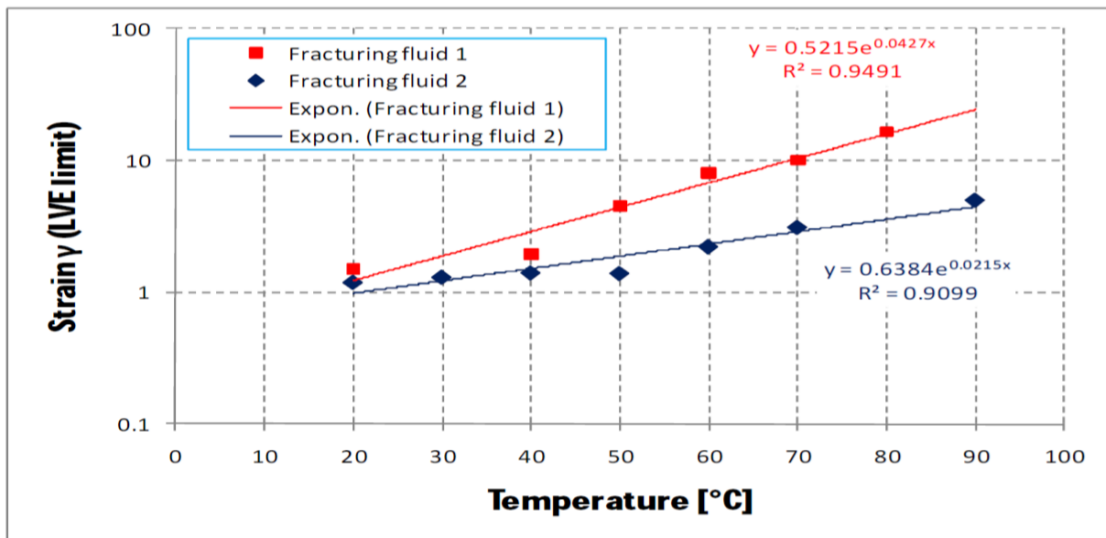


Figure 7 Limit of the LVE range and polymer concentration versus temperature. Here the  $G''$  ( $\gamma$ ) function is taken for the analysis for determining the limit of the LVE range. The data fall approximately in straight line.

Observing Fig. 6 and 7, it is noticeable the dependence of the limit of the LVE range on temperature. The LVE limits for each fracturing fluid on further measurements were taken from the lowest value of the LVE limit from Fig. 6 and 7 at corresponding temperatures.

### 3.3. Time Test Oscillation

In this test, both the frequency and amplitude are set at a constant value in each individual test interval. The measuring temperature is also kept constant. In Fig. 8 the storage modulus ( $G'$ ), loss modulus ( $G''$ ), and  $\tan \delta$  are plotted versus time. In this series of measurements, fracturing fluid 1 was subjected to frequency 10 1/s at temperature 20°C. This test consists of three intervals with different amplitude strain 1%, 5%, and 10% where time duration for each interval is 120, 120, and 60 minutes respectively.

Despite the noisy data for the first interval with amplitude strain 1%, it is obvious from Fig. 8 that this fracturing fluid sample has a time-independent or stable [12] structure with constant structure strength under test conditions where the elastic behavior dominates over viscous behavior ( $G' > G''$ ).

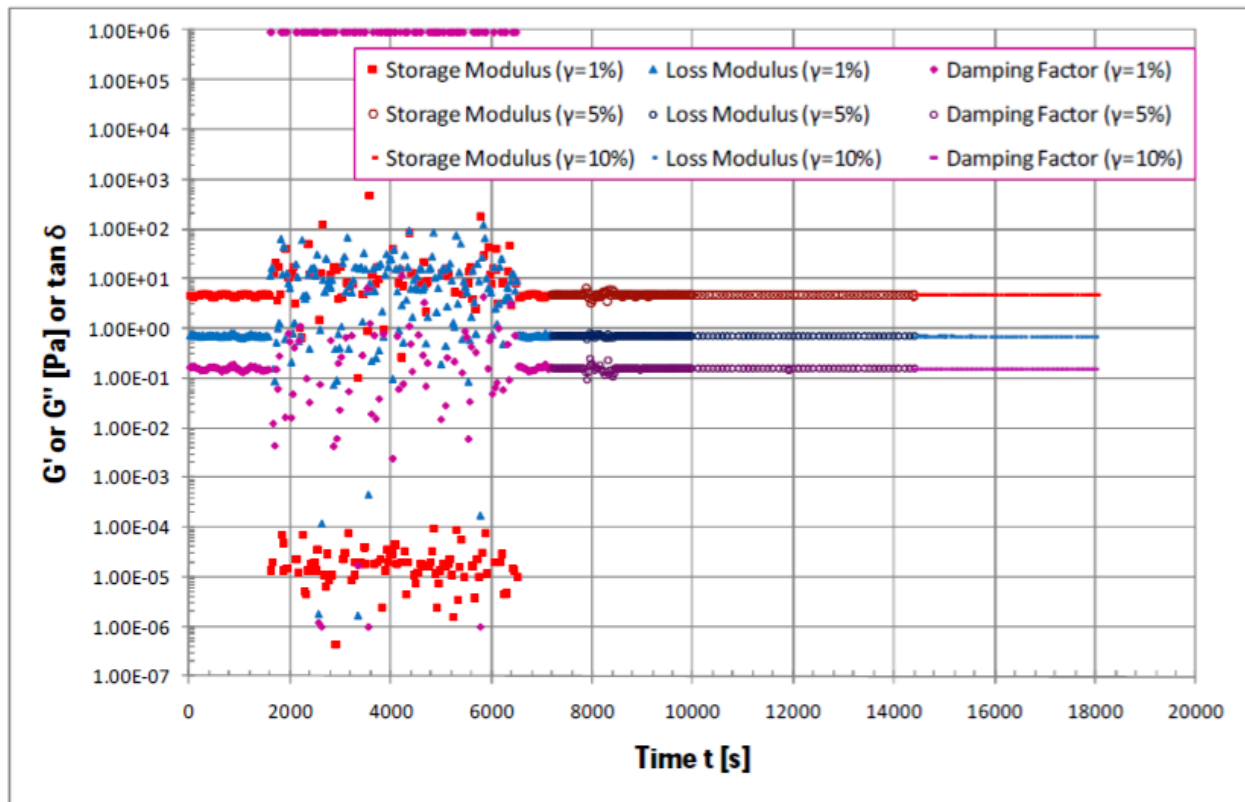


Figure 8 Time test oscillation result for fracturing fluid 1 at 20°C with variation in amplitude strain (1%, 5%, and 10%).  $G'$ ,  $G''$ , and  $\tan \delta$  versus time.

Time independent behaviour, despite variation in amplitude strain, also confirmed result regarding LVE range. It means the amplitude strain used in this test (1%, 5%, and 10%) are still within the LVE range.

### 3.4. Temperature Test Oscillation

Two measurements were conducted with fracturing fluid 1. In these measurements, the fracturing fluid samples were subjected to angular frequency 10 1/s and steady strain of 5% and 10%, respectively. As discussed earlier, the difference in amplitude strain should not affect the results as long as within the LVE range. The results gathered in Fig. 9, show that the curves are fit enough (as was expected) until temperature 74°C after which the  $G'$  curves are different. This deviation could be due to the instability of the measuring environment.

Observing Fig. 9, the 'reaction temperature' at which the chemical reaction with crosslinking or hardening begins can be obtained. At this conditions, the  $G'$  curve shows minimum values [18]. In the view of Fig. 28, the reaction temperature for this fracturing fluid is approximately 74°C. With further heating, the  $G'$  (T) and  $G''$  (T) curves both increases. At higher temperatures, it can be expected to show a little softening ( $G'$  and  $G''$  curves decrease with slightly slope) due to heating up of the already hardened sample [18]. However, it cannot be shown here due to temperature limitation of the measuring device.

From Fig. 9, it can be seen that the fracturing fluid is in gel state (solid state, with  $G' > G''$ ) below 60°C. Above 60°C, the fracturing fluid is in sol state (liquid state, with  $G'' > G'$ ). The fracturing fluid shows sol state only until 78°C above which it turns to a gel state. The temperature at which the  $G'$  and  $G''$  curves intersect is called the sol/gel transition temperature or gel temperature or gel point [18]. The sol/gel transition temperature for fracturing fluid 1 is approximately 78°C. At this temperature  $G' = G''$  or  $\tan \delta = 1$ . The melting temperature at approximately 60°C is also noticeable in Fig. 9.

Another information from this measurement is temperature-dependent complex viscosity  $|\eta^*(T)|$  of the fracturing fluid sample which is presented in Fig. 10. It can be seen from Fig. 10 that the viscosity minimum  $|\eta^*_{\min}|$  of fracturing fluid 1 is approximately 5.5E-2 Pas at temperature 74°C.

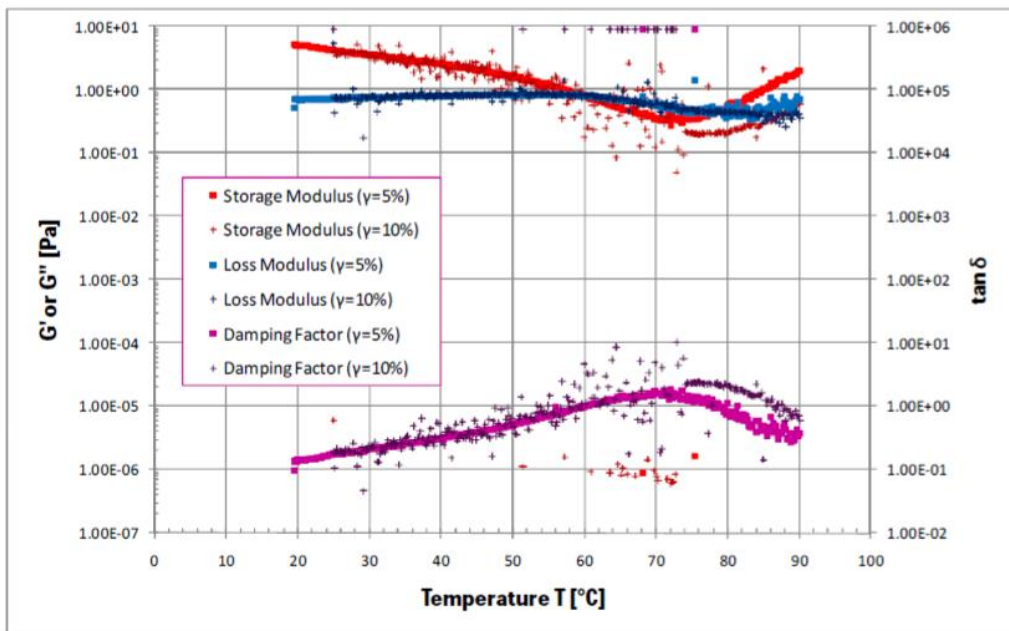


Figure 9 Temperature test oscillation result for fracturing fluid 1 at angular frequency 10 1/s and amplitude strain of 5% and 10%.  $G'$ ,  $G''$ , and  $\tan \delta$  versus temperature.

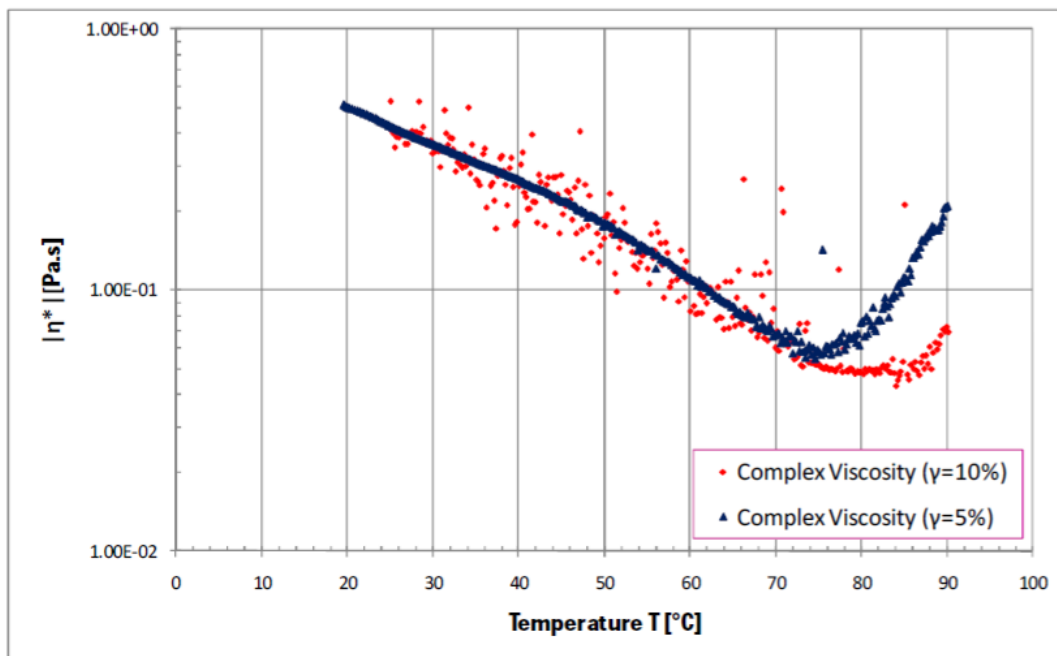


Figure 10 Complex viscosities versus temperature for fracturing fluid 1.

Temperature test oscillation measurements have also been performed for fracturing fluid 2 with two intervals where amplitude strains were 5% and 10%, respectively. In those measurements, the fracturing fluid samples were subjected to angular frequency 10 1/s. The results from those measurements gathered in Fig. 11; show that the curves are fit enough as was expected.

It can be seen from Fig. 11, there is no intersection between  $G'$  and  $G''$  curves or the sol/gel transition temperature. However, in the view of Fig. 11, the hardening could happen when  $G'$  displays sudden rise after 50°C [20]. At this temperature, the  $G'$  curve shows minimum values. Further heating at a temperature above 65°C, it can be seen a little softening ( $G'$  and  $G''$  curves decrease with slightly slope) due to heating up of the already hardened sample [18].

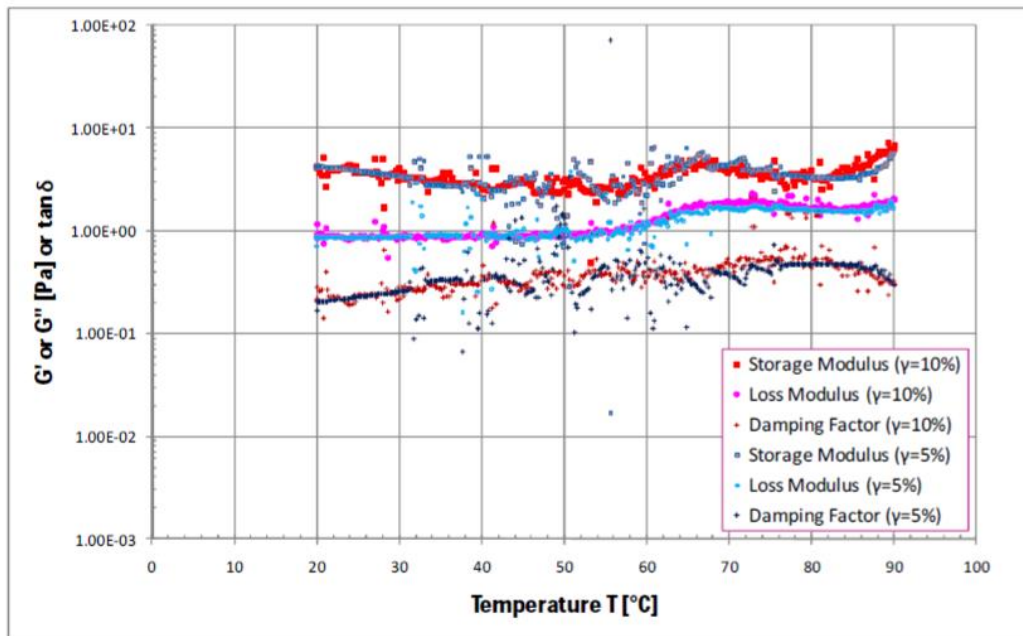


Figure 11 Temperature test oscillation result for fracturing fluid 2 at angular frequency 10 1/s and amplitude strain of 5% and 10%.  $G'$ ,  $G''$ , and  $\tan \delta$  versus temperature.

In Fig. 12, the complex viscosity is plotted versus temperature. It can be observed from Fig. 12 that the viscosity minimum  $|\eta^*_{\min}|$  of fracturing fluid 2 is approximately  $2.4\text{E-}1$  Pas at temperature  $55^\circ\text{C}$ .

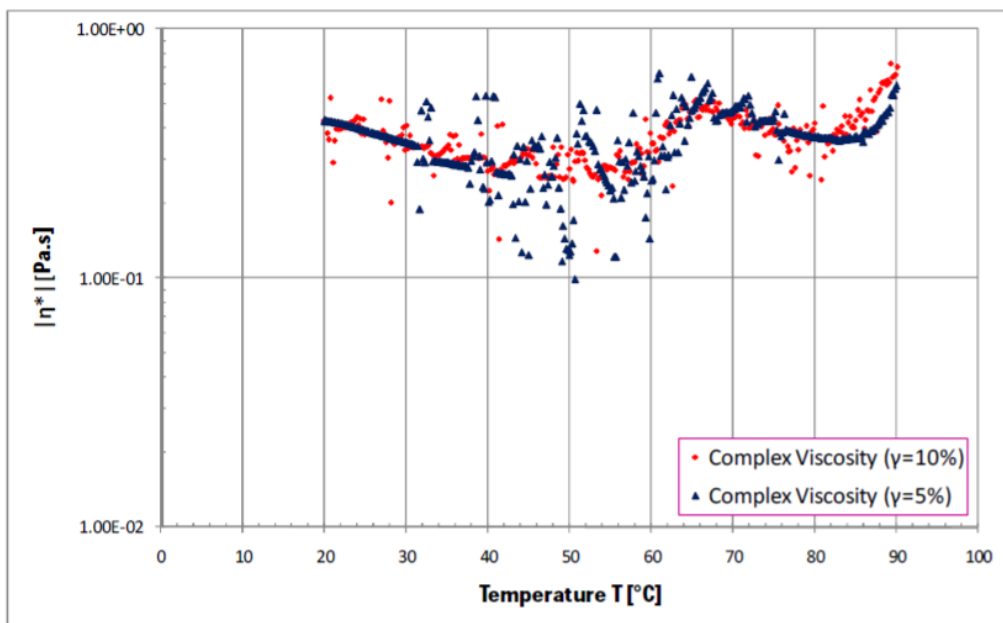


Figure 12 Complex viscosities versus temperature for fracturing fluid 2.

Nevertheless, it is important to mention the limitations and conditions that might affect the experiment. The experiments were performed in 'open system' that could be affected by outside temperature. It is suggested to perform the experiment in 'close system' if possible.

The fracturing fluids in this experiment might undergo chemical modification with time. One of these chemical instabilities is known as syneresis. Syneresis causes shrinkage in gel volume and consequently, water is expelled from the gel structure [21]. This could result in non-homogeneous in the sample mixture. There were also lumps observed in the sample.

#### ACKNOWLEDGMENT

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#### CONCLUSION

Oscillatory measurements have been performed to investigate the behavior of the rheological properties of the borate cross-linked fracturing fluids and the possible relationship among them. The main results are as follows:

- The amplitude sweep measurements show the temperature-dependence of the LVE limit. The plot of the LVE limit versus temperature in the semi-logarithmic diagram is a reasonably straight line.
- The storage modulus and loss modulus are independent of amplitude strain at LVE region.
- It was demonstrated that frequency sweep can differentiate a number of specific regions of the fracturing fluids in the viscoelastic spectrum (the viscous or terminal region, the transition to flow region, the rubbery or plateau region, the leathery or higher transition crossover region, and the glassy region).
- The flow-point frequency of the fracturing fluids is dependent on temperature. It increases exponentially with temperature.
- The gel points (time and temperature) are observable using time and temperature test oscillation.
- Additional information on the structural character of fracturing fluid can be obtained from  $G'$  and  $G''$  curves. It means that viscosity is inadequate in describing fracturing fluids.

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## Real Time Traffic Light and Sign board Detection

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**Abstract**— Traffic light and sign board detection and recognition are the main features of upcoming driver assistance systems. However variations in illumination are considered as the main problem in transportation system. This method proposes traffic light and sign board detection in various illumination conditions irrespective of weather conditions. The proposed method is classified in two stages: the candidate extraction stage and the recognition stage. In extraction stage area of interest is extracted and the undesired backgrounds suppressed to highlight desired information [1]. Where as in recognition stage, based on shape, captured image is verified as traffic light or sign board. The proposed system is evaluated on video sequence, using a camera that runs at a speed of 20 frames per second. It captures images from suburban roads in varying illumination conditions and compared with the database. Depending upon the shapes recognized traffic light and traffic sign alert is provided to the driver.

**Keywords**— Traffic light recognition, traffic light detection, sign board recognition, sign board detection, real time processing, image processing, alertness.

### I. INTRODUCTION

Intelligent Transport Systems (ITS) have great potential to save time, money, lives, and also to improve our driving conditions. Detecting the state of traffic light and their semantics at interactions is essential for autonomous driving in real time situations [3]. Traffic sign boards and light detection has an important role in transportation for reducing rising accident rate. There are many detection techniques developed recently for traffic light and sign board detection. A system which involves detection process of traffic sign and light in a single system does not exist [2]. Also illumination variation effect is a serious problem in real time environment. So keeping attention towards different traffic signs are difficult task for every drivers. Illumination variation in different climatic conditions adversely affects the clear vision of traffic signs by an individual driver. So we propose a system that can be used to detect traffic light and signs under different illumination conditions.

Traffic sign and light detection is an important part of driver assistant systems. These can be designated in different colors or shapes, in high contrast background. So in order to capture these images traffic light and signs are oriented upright and facing camera [1]. Hence there will be geometric and rotational distortions. In these cases accuracy is a key consideration. One miss classified or undetected sign and lights will produce adverse impacts on driver. The basic idea of proposed system is to provide alertness to the driver about the presence of traffic light and sign at a particular distance apart. The color of a traffic sign is easily distinguishable from the colors of the environment.

In section II, previous works are explained and the improvements we made are also stated. Then in section A the used methodologies are described, which includes image capturing, recognition and detection. In section B experimental results to illustrate performance of the system is provided. Finally acknowledgment and conclusion are mentioned.

### II. RELATED WORK

Nowadays, studies on intelligent vehicles, which autonomously drive in urban environment, are becoming more popular. Detecting

the traffic light in real driving environments is not an easy task. Although many researchers make efforts to provide the reliability required by the intelligent vehicles to safely pass through intersections, most of these methods, more or less, are defective in real driving environment. Traffic symbols have several distinguishing features that may be used for their detection and identification [1]. They are designed in specific colors and shapes, with the text or symbol in high contrast to the background. In early works, a vision based method is used to detect traffic lights. However this method requires that camera equipped at fixed place nearby traffic lights and these methods cannot meet the real time processing requirement [1]. Therefore these traffic light detection methods are not applicable for intelligent vehicles. In the case of traffic sign detection majority of system make use of color information as a method for segmenting images. The performance of color based road sign detection is often reduced in scenes with strong illumination, poor lightning or adverse weather conditions [6]. The vast majority of the existing systems consist of hand label real images which are repetitive time consuming and error prone process. Information about traffic symbols, such as shape and color, can be used to place traffic symbols into specific groups; however there are several factors that can hinder effective detection and recognition of traffic signs [5]. These factors include variations in illumination occlusion of signs, motion blur, and weather –worn deterioration of signs. Road scene is also generally much cluttered and contains many strong geometric shapes that could easily be misclassified as road signs. Accuracy is a key consideration, because even one misclassified or detected sign could have an adverse impact on the driver.

### Results from Literature survey

Existing Detection Method	Advantages	Disadvantages
Vision Based Method – Camera placed at fixed distance near traffic light	User friendly Geometric distortion is limited	Cannot meet real time requirements Cannot used in intelligent vehicles
Color based road sign detection	Used in hand labeled images	Time consuming Error prone process

**Table 1 : Literature survey analysis [9]-[12]**

### A.PROPOSED SYSTEM

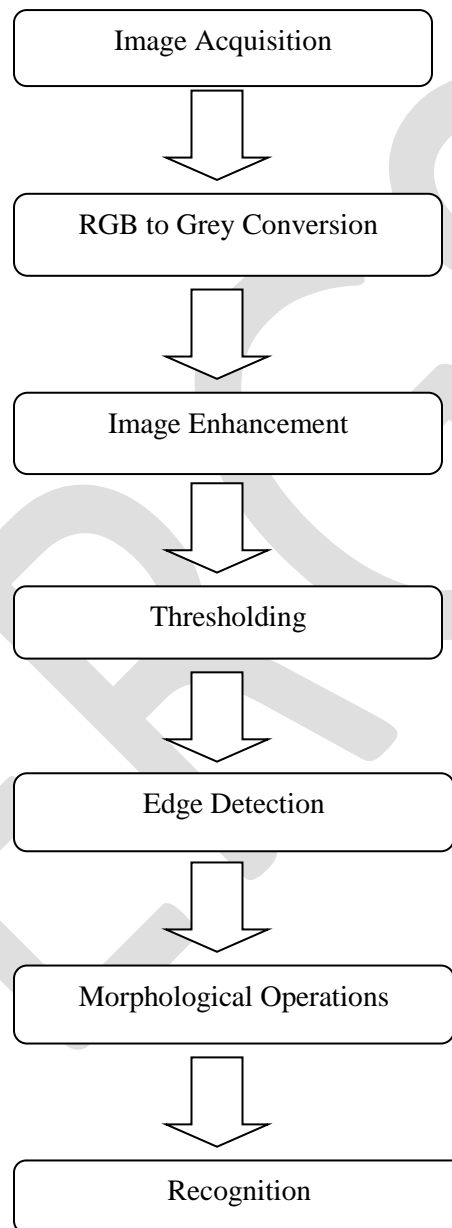
Proposed system detects and recognizes both the traffic light and traffic sign board. The proposed system consists of two stages: candidate extraction stage and the recognition stage. The detection stage identifies the region of interest and mostly performed by using color segmentation which is followed by shape recognition. Detected candidate are either identified or rejected during recognition stage using template matching. General traffic light detection method mainly focuses on locating the traffic lights in each frame and understanding their control semantics. It mainly aims to determine location of traffic light in each frame and later recognize them as different light types. The color of the emitting units will vary under dynamic light condition with video cameras.

### III. BLOCK DIAGRAM DESCRIPTION

Throughout this section paper explains the steps that are carried out for the detection and recognition process of the proposed system.

#### i. Image Acquisition:

The first step is collection of images of traffic signs, data. The collection and storing of images are referred to as image acquisition. The real time traffic lights and road sign board images are used as data. Data's that are freely available from an online are not used. These images are collected at an average speed of 20 frames per second from high speed vehicles under different illumination conditions. Captured image in RGB form is converted to grey scale image. Grey scale images measures light intensity. Since each color image has several intensity levels detection process will be complex. Hence the input images are converted to grey scale format.



**Fig I: Block diagram of proposed system**

## **ii. RGB to Gray Conversion:**

Grey scale images contain brightness information. Each pixel value corresponds to amount of light. Each pixel is represented by a byte or word. An 8 bit image have a brightness variation from 0 to 255 and 0 represents black and 1 represents white. This conversion makes calculations performed in every image simpler, it reduce complexity in performing mathematical operations in the

image.

### **iii. Image Enhancement:**

In order to extract every detail in the given image it needed to be enhanced. It improves the quality of information in every image which provided better quality to the image and can be used for many applications. Enhancement process is mainly carried by either suppressing the noise or by increasing the image contrast. Enhancement algorithms are used to sharpen or smoothen image features for analyzing. Median filter is employed in the proposed system. Each output pixel contains median value in  $M \times N$  neighborhood around the corresponding pixel in the input image. It pads the image with zeros on the edges, so the median value of points is within  $[MN]/2$ .

### **iv. Thresholding**

The enhanced image is then converted to binary image by thresholding. The process is completed by grouping pixels with same intensities. The threshold value of output image is chosen as 0.1 by trial and error method. The input image with luminance greater than the level of 0.1 is treated as 1 and below 0.1 is treated as 0. That is now the image has been converted to binary image, pixels with combination 0 and 1. This converted image is then made set for morphological operations to extract the required area of interest. Here shape based detection is carried out to find whether the received image by the camera is traffic light or traffic sign board.

### **v. Edge Detection**

Required shape features are extracted by morphological operations. The proposed system detects whether the captured image is traffic light or sign by considering the shape. The captured image is checked for circular shape of required area and if system recognizes the circular region of interest of specified size, the image is recognized as traffic light else image is detected as traffic sign board. So in order to detect required shapes a flat shaped structuring element with specified radius  $R$  is created. For application purposes  $R$  is chosen as 5. Image dilation operations are also used for gray scale, binary or packed binary image returning the dilated image. Function is used to extract structural element, object or array of structuring elements are returned. In order to extract element details image should be flat as possible. So to attain that, required area is removed from binary image. All connected components that are fewer than 300 pixels produce another image, by area opening.

### **vi. Morphological Operation and Recognition**

Morphological operations capture the essence of the features such as shape in an image. These operations remove unwanted pixels and highlight the required operations of the image. Every image has a background information as well as region of interest. These morphological operations are used to extract the required region.

## **B.EXPERIMENTAL RESULTS**

Here we conducted limited number of experiments to understand the performance of our traffic light and sign board detection system. The test was conducted on images that are captured under different illumination conditions by camera mount on vehicle.

### **SIMULATION RESULTS**

Following shows the results of Matlab programming for the recognition and detection of traffic lights and sign board.

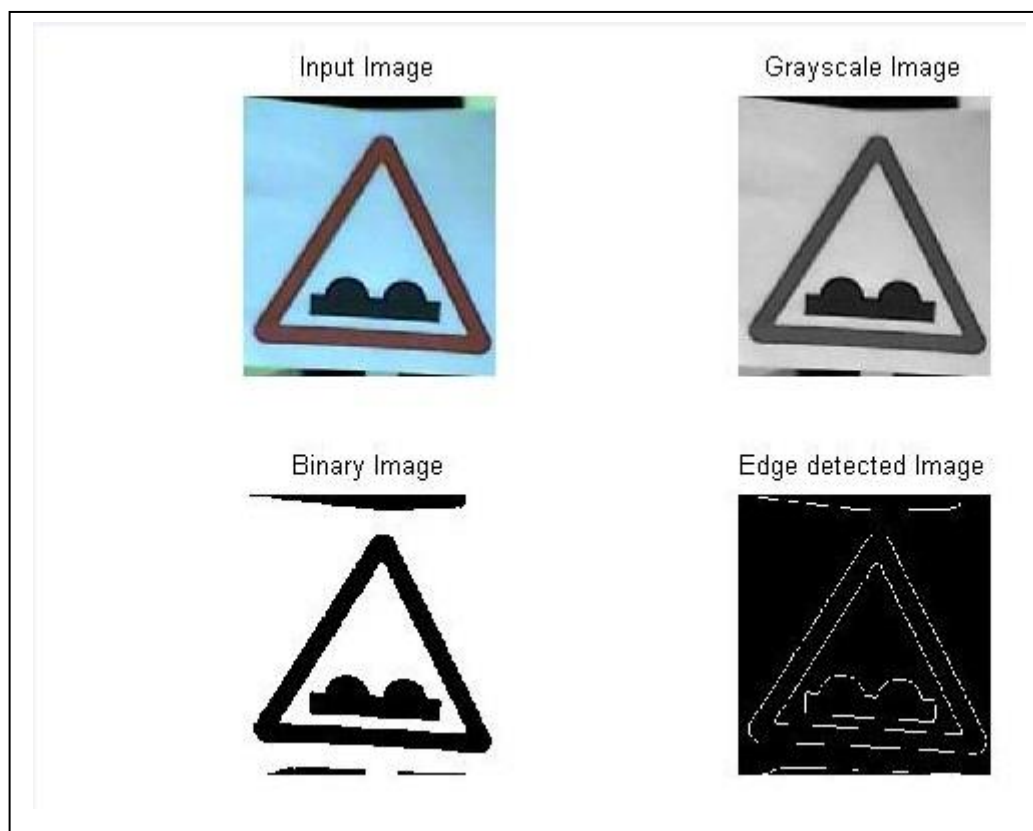


Fig II: Results of recognition of traffic sign board



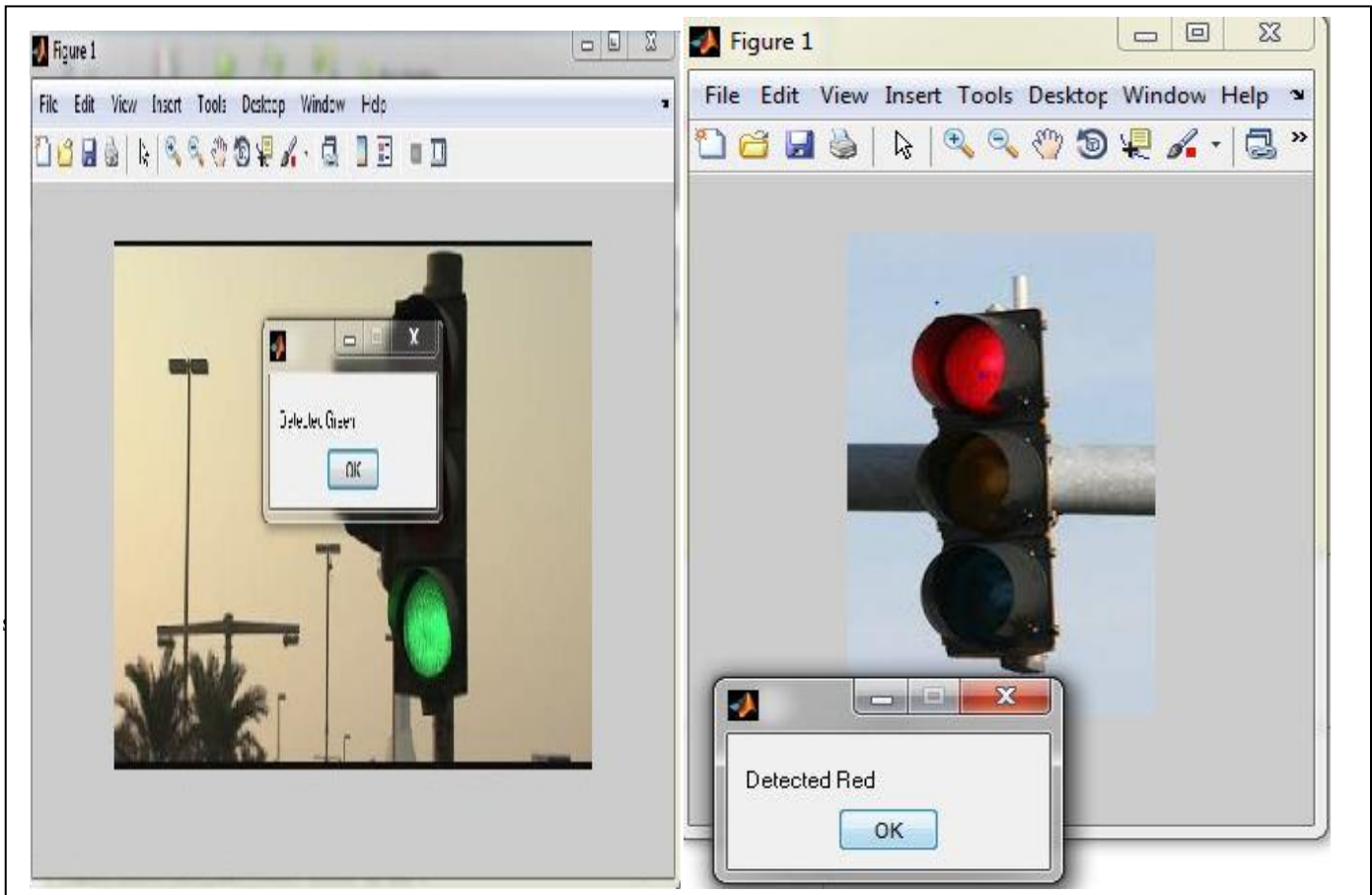


Fig IV: Results of detection of traffic lights

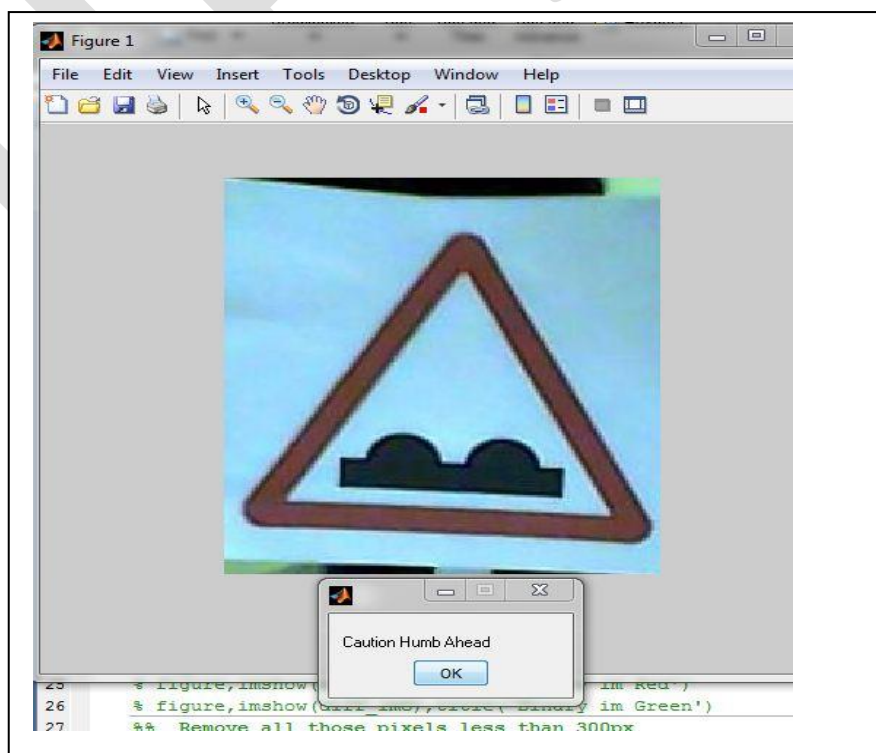


Fig V: Results of detection of traffic sign board

Sl.No:	TARGET	CAPTURE TIME	TRUE/FALSE
1	Red/Green	Midday	T
2	Red/Green	Afternoon	T
3	Red	Nightfall	T
4	Green	Nightfall	F

Table II: Details of traffic lights used for experiments and Detection results

Sl. No:	TARGET	CAPTURE TIME	TRUE/FALSE
1	Hump	Midday	T
2	Hump	Afternoon	T
3	Hump	Nightfall	T
4	Stop	Afternoon	F

Table III: Details of traffic sign boards used for experiments and Detection results

## CONCLUSION

We propose a vision based method for traffic light and sign board detection which can be used under different illumination conditions. The main problem of existing system like failure in recognizing traffic signs under different climatic conditions were cured by using the proposed system. Here we suppress the background by setting a threshold for required area of interest depending on

shape to detect the presence of traffic light and sign board. Experimental results provide that the method is fast and robust. The detection procedure is performed in real time. The proposed method can be implemented as hardware modules on vehicles.

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## Comparison and Analysis of Multiplicative neuron and Multilayer Perceptrons using three different datasets

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**Abstract-** In this paper, Multiplicative Neuron Models is used for classification of nonlinear problems using three different datasets, namely; Iris, Mammographic dataset and Brest Cancer Original. The conventional neuron model Multi Layer Perceptrons (MLP) is used for comparative analysis with Multiplicative Neuron Model. It is found that Multiplicative neuron model with single neuron is sufficient for classification than the conventional neuron network which require number of neurons in different hidden layers. For comparative analysis of three models, various parameters of Artificial Neural Network like learning rate, execution time, number of iteration, time elapse in training, mean square error, etc., are considered. After comparing various performance evaluation parameters, it is found that execution time, number of iteration, time elapse in training is minimum in case of Multiplicative neuron model. On the basis of results from the study, it is observed that performance of Multiplicative neuron model better than the MLP for classification.

**Keywords-** Multiplicative Neuron, Multilayer Perceptron, Classification, Iris, Mammographic Mass, Brest Cancer Original, analysis

### I. Introduction

Artificial Intelligence is the branch of the computer science concerned with the study and creation of computer systems that exhibit some form of intelligence: System that learns new concepts and tasks, system that can reason and draw useful conclusion about the world around us, System that can understand a natural language or perceive and comprehend a visual sense, and system that perform other types of feats that require human types of intelligence [1]. The Artificial Neural Networks is one stream of Artificial Intelligence.

Artificial Neural Networks is the mathematical model of biological neurons. Although all these models were primarily inspired from biological neuron. Every processing element of model bear a direct analogy to the actual constituents of biological neuron and hence is termed as artificial neuron[3]. After giving the so many contributions by plenty of researchers still a gap between philosophies used in neuron models for neuroscience studies and those used for artificial neural networks (ANN). Some of neural network models exhibit a close correspondence with their biological counterparts while other far away with their counterparts. It is being contributed by several scientists that gap between biology and mathematics can be minimized by investigating the learning capabilities of biological neuron models for use in the applications of classification, time-series prediction, function approximation, etc. In this paper, it is being taken a single Multiplicative Neuron (MNM), compared with Multilayer perceptron, after analyzing the results, it can be reached to conclusion that which one is the better model in context of various parameters of Artificial Neural Network like Learning Rate, Execution Time, Number of Iterations, Time Elapse in training etc.

In the initial study of Artificial Neural networks, the first artificial neuron model was proposed by McCulloch and Pitts [7] in 1943. They developed this neuron model based on the fact that the output of neuron is 1 if the weighted sum of its inputs is greater than a threshold value, and 0, otherwise. In 1949, Hebb [8] proposed a learning rule that became initiative for ANNs. He postulated that the brain learns by changing its connectivity patterns. Widrow and Hoff [9] in 1960 presented the most analyzed and most applied learning rule known as least mean square rule. Later in 1985, Widrow and Sterns [10] found that this rule converges in the mean square to the solution that corresponds to least mean square output error if all input patterns are of same length. A single neuron of the above and many other neuron types proposed by several scientists and researchers are capable of linear classification [11]. Further many scientists have used single neuron model for nonlinear classification. Multiplicative neural networks learning methodology has been provided by the authors in [12, 13]. It has been experienced that increasing number of terms in the high order expression, it is exceedingly difficult to train a network of such neurons. That is the main inspiration to choose simpler model for the high order expression with a well defined training procedure based on the back propagation. Section II, describes the models have been taken in the paper. Section III details about the datasets being taken in the paper, section IV discusses the results and section V provides concluding remarks of the paper.

## II Material and Methods

### A. Biological Neural Model

The elementary nerve cell, called a neuron, is the fundamental building block of the biological neural network. A typical cell has three major regions: the cell body, which is also called the soma, the axon, and the dendrites. Dendrites form a dendritic tree, which is a very fine bush of thin fibers around the neuron's body. Dendrites receive information from neurons through axons-long fibers that serve as transmission lines. An axon is a long cylindrical connection that carries impulses from the neuron. The end part of an axon splits into a fine arborization. Each branch of it terminates in a small end bulb almost touching the dendrites of neighboring neurons. The axon-dendrite contact organ is called a synapse. The synapse is where the neuron introduces its signal to the neighboring neuron. The signals reaching a synapse and received by dendrites are electrical impulses. The interneuronal transmission is sometimes electrical but is usually effected by the release of chemical transmitters at the synapse. Thus, terminal boutons generate the chemical that affects the receiving neuron. The receiving neuron either generates an impulse to its axon, or produces no response [2].

### A. Multiplicative Neuron Model

Only single neuron of this model is used for the classification task. In this model, aggregation function is based upon the multiplicative activities ( $\Omega$ ) at the dendrites, given in the Fig. 2.

$$\Omega(\mathbf{x}, \boldsymbol{\theta}) = \prod_{i=1}^n (w_i x_i + b_i) \quad (1)$$

In above given generalized equation Eq. (1) of Multiplicative neuron model,  $\Omega$  is a multiplicative operator with weights  $w_i$ , inputs  $x_i$  and biases  $b_i$ . In the given equation  $\prod$  (production) is being used instead of  $\sum$  summation. It is investigated the complexity of computing and learning for multiplicative neuron. The author in [18] used single Multiplicative neuron for time series prediction. In particular, we derive upper and lower bounds on the Vapnik- Chervonenkis (VC) dimension and pseudo dimension for various types of networks with multiplicative units [23-25]. In the Internal architecture and computation methods are different but the procedure of training; testing and prediction are same as used in Multi-Layer Perceptron model. Unlike the higher-order neuron, this model is simpler in terms of its parameters and one does not need to determine the monomial structures prior to training of the neuron model. Multiplicative Neuron Model is used for problems with high nonlinearity and it can be trained easily.

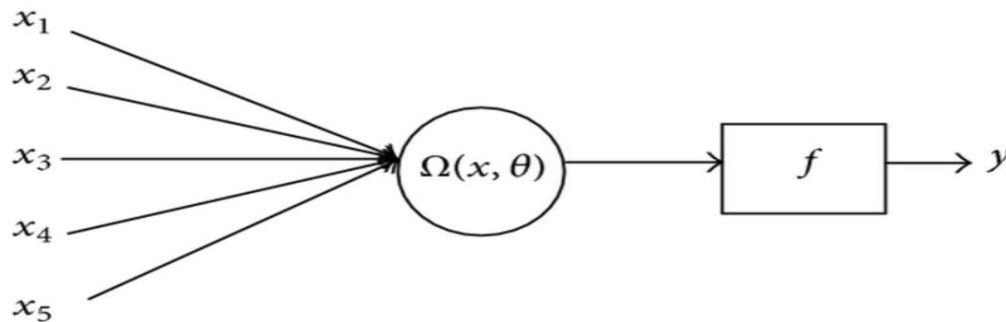


Fig.1 A Generalized Single Neuron.

### B. Learning for Multiplicative Neuron Model

Learning algorithm for the artificial neural network is a optimization techniques. In this paper, authors used most popular back propagation learning algorithm[12]. The simplicity of back propagation methods make it convenient for the models to be used in different situation, unlike the high order neuron model, which is difficult to train and is susceptible to combinatorial explosion of terms. A simple gradient descent rule, using a norm-squared error function, is described by the following set of equations[13].

#### A. Forward Pass

$$S = \prod_{i=1}^n (w_i x_i + b_i)$$

$$y = \frac{1}{1 + e^{-net}}$$

#### B. Backward Pass

$$E = \frac{1}{2N} \sum_{P=1}^N (y^P - t^P)^2 \quad (2)$$

$$\frac{de}{dy} = (y - t) \quad (3)$$

$$\frac{dy}{dnet} = y(1 - y) \quad (4)$$

$$\frac{dnet}{dw_i} = \frac{net}{(w_i x_i + b_i)} x_i \quad (5)$$

$$\frac{de}{dw_i} = \frac{de}{dy} \frac{dy}{dnet} \frac{dnet}{dw_i} \quad (6)$$

$$\frac{de}{dw_i} = (y - t) * y * (1 - y) * \frac{net}{(w_i x_i + b_i)} x_i \quad (7)$$

$$\frac{de}{db_i} = \frac{de}{dy} \frac{dy}{dnet} \frac{dnet}{db_i} \quad (8)$$

$$\frac{dnet}{db_i} = \frac{net}{(w_i x_i + b_i)} \quad (9)$$

$$\frac{de}{db_i} = (y - t) * y * (1 - y) * (w_i x_i + b_i) \quad (10)$$

$$w_{i(new)} = w_{i(old)} - \frac{de}{dw_i} * \eta \quad (11)$$

$$b_{i(new)} = b_{i(old)} - \frac{de}{db_i} * \eta \quad (12)$$

In the Eq. (2) simple steepest descent methods applied to reduce deviation between actual values (y) and target values (t). Where  $\eta$  ( $\Gamma$ ) is learning rate which can be assigned a value on the heuristics basis. Eq. (3-8) weights modifying process to minimize the error. On the other hand, Eq. (8-10) biases modifying. Weights and biases, parameters update rules are exhibited in the Eq. (11-12) after every epoch. Using the back propagation learning method, it being solved some most popular classification problem in next section.

### C. Multilayer Perceptron Model

It is a very well known conventional model. The adapted perceptrons are arranged in layers and so the model is termed as multilayer perceptron. This model has three layers: an input layer, an output layer, and a layer in between, not connected directly to the input or output, and hence called the hidden layer. For the perceptrons in the input layer, linear transfer function is used, and for the perceptrons in the hidden layer and the output layer, sigmoidal or squashed-S functions is used. The input layer serves to distribute the values they receive to the next layer and so does not perform a weighted sum or

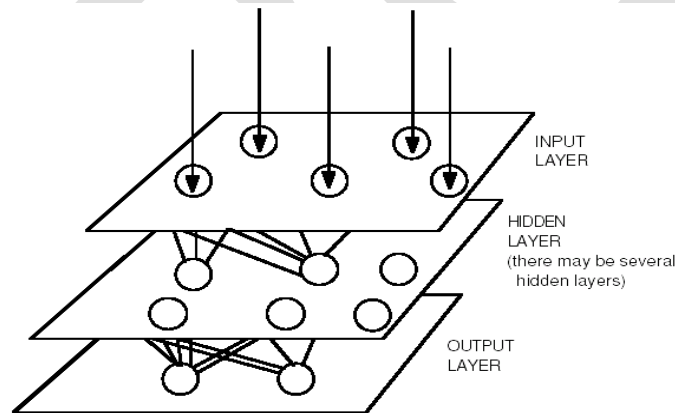


FIG.2 MULTILAYER NEURAL NETWORK.

shown in Figure1. Many capabilities of neural networks, such as nonlinear functional approximation, learning, generalization etc. are, in fact, due to nonlinear activation function of each neuron. Sigmoid Activation Function is given below:

#### A. Forward Pass

$$neth_j = \sum_{i=1}^{ni} (w_{ji} * x_i + b_i) \quad (13)$$

$$h_j = \frac{1}{1 + e^{-neth_j}} \quad (14)$$

$$nety_k = \sum_{j=1}^{nh} (w_{kj} * h_j) \quad (15)$$

$$y_k = \frac{1}{1 + e^{-\text{net}_k}} \quad (16)$$

## B. Backward Pass

$$dy_k = (y_k - t_k) \quad (17)$$

$$E = \frac{1}{2} \sum_{k=1}^N (d_{y_k})^2 \quad (18)$$

$$h_{i(\text{new})} = h_{i(\text{old})} - \frac{de}{dh_i} * \eta \quad (19)$$

$$y_{k(\text{new})} = y_{k(\text{old})} - \frac{de}{dy_i} * \eta \quad (20)$$

The activity of neurons in the input layers represents the raw information fed into the network; the activity of neurons in the hidden layer is determined by the activities of the neuron in the input layer and connecting weights between input and hidden units. Similarly, the activity of the output units depends on the activity of neurons in the hidden layer and the weight between the hidden and output layers. This structure is interesting because neurons in the hidden layers are free to conduct their own representation of the input. [2]

## D. Non linear Classification Techniques

One way to classify data is to first create models of the probability density functions for data generated from each class. Then, a new data point is classified by determining the probability density function whose value is larger than the others. Linear discriminant analysis (LDA) is an example of such an algorithm. Linear Discrimination Analysis is a technique for linear classification. For nonlinear classification there are two well known classification techniques given below:

### A. Artificial Neural Networks (ANN)

Artificial neural networks are often used to develop nonlinear classification boundaries. Reasons for their common use include their ease of application, their robustness to choices of parameter values, and their similarity to other nonlinear regression methods.

### B. Support Vector Machine (SVM)

Conventional neural networks can be difficult to build due to the need to select an appropriate number of hidden units. The network must contain enough hidden units to be able to approximate the function in question to the desired accuracy. A primary motivation behind SVMs is to directly deal with the objective of good generalization by simultaneously maximizing the performance of the machine while minimizing the complexity of the learned model.

## III. Data set used

### A. Iris dataset

This classic data of Anderson and Fisher pertains to a four-input, three class classification problem. Iris is a species of flowering plants with showing flowers. Iris data base prepared by the Fisher in 1936, and perhaps the best known database to be found in the pattern recognition literature. In Fisher's Iris database among the several species, three species of Iris plants setosa, versicolor, virginica are selected. In this dataset, Fisher taken four attributes of Iris flowers, are petals length, Petal width & sepals length, sepal width (in centimeter; cm). The data set consists of 50 samples from each of three species of Iris (Setosa, Virginica and Versicolor). Therefore there are 150 instances in the dataset, which are collected on large number of Iris flowers. The Neural network will be trained to determine specie of iris plant for given set of petal and sepal width and length. Fisher's Iris data base is available in Matlab (load fisheris) and in Internet [20].

### B. Mammographic Mass dataset

Matthias Elterand and Dr. Rudiger Schulz Wendtland efforts have made easy approachable Mammographic Mass dataset to all researchers. Mammography is the most effective method for breast cancer screening available today. However, the low

positive predictive value of breast biopsy resulting from mammogram interpretation leads to approximately 70% unnecessary biopsies with benign outcomes. To reduce the high number of unnecessary breast biopsies, several computer-aided diagnosis (CAD) systems have been proposed in the last years. These systems help physicians in their decision to perform a breast biopsy on a suspicious lesion seen in a mammogram or to perform a short term follow-up examination instead.

This data set can be used to predict the severity (benign or malignant) of a mammographic mass lesion from BI-RADS attributes and the patient's age [21]. The mammographic problem deal with the classification between benign (0) and malignant (1),

### C. Brest Cancer Wisconsin dataset

This dataset contains cases from a study that was conducted at the University of Wisconsin Hospitals, Madison, about patients who had undergone surgery for breast cancer. The task is to determine if the detected tumor is benign (2, after normalization 0.1) otherwise malignant (4 after normalization 0.9 ). To assess the data to classification process, the first attribute of the original data set (the sample code number) has been removed in this version. The dataset have 9 attributes, (excluded first attribute "Sample code number") and one class attribute. Total number of 699 instances where 16 instances having missing values. For the sake of clarity, author has removed the missing value instances. There are total 458 instances of Benign(65.5%) and 241 instances of Malignant(34.5%)[22].

## IV. Results and discussion

Two classification models have been selected and well known datasets has been taken. The experimental parameters show that multiplicative neuron and multi layer perceptron (MLP) has been trained by using three well known data sets Iris, Pima Indian Diabetes and Brest Cancer original. Whole data set is been used for training and a small subset is been used for testing. The training is continued until the network going on improving. When network trained, the training is stopped. Training can be stopped in another condition when training goal in term of MSE is met or given iteration (epoch) are completed. In both classification problems the dataset has been preprocessed. The dataset has been normalized between 0.1 and 0.9. For each simulation the minimum configurational requirement of the computer is Pentium 4 processor with 1.8 GHz and 512 MB RAM.

### A. Iris Problem

The authors compare the performance of multiplicative neural networks (MNM) with that of multi layer perceptrons (MLP). For this objective, the MLP taken with three layers, with multiple hidden neurons. The Fig. 3 shows the mean square error (MSE) versus number of epochs (Iteration) curve for training with multiplicative neuron model (MNM) and MLP while dealing with the IRIS flower classification problem. It is cleared with the curve that Multiplicative neuron model with single neuron, learns easily and minimize the error early in comparison to multilayer perceptron. Table 2 exhibit the comparison between MLP and MNM in terms of deviation of actual outputs from corresponding targets. It can be seen with the help of Table 1 that the performance of MNM is better than that of MLP. From Table 1, it is observed that the training time required by MNM is much less than MLP. It means that a single neuron in MNM is capable to learn IRIS relationship almost four times faster than MLP with 18 hidden neurons. Table shows the comparison of training and testing performance with MLP and MNM, while solving the IRIS classification problem.

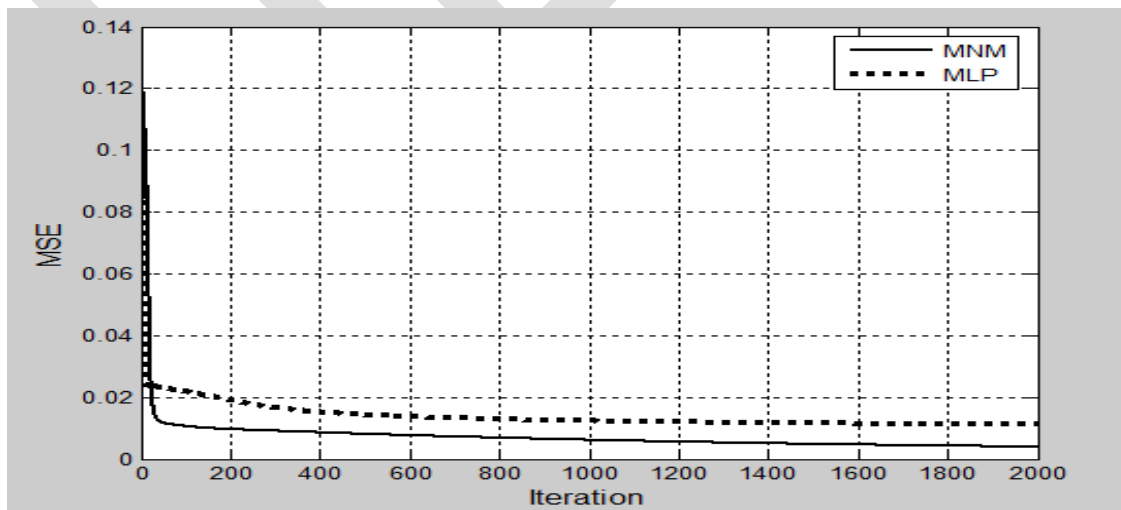


Fig.3 Mean square error vs. iteration for training for IRIS problem.

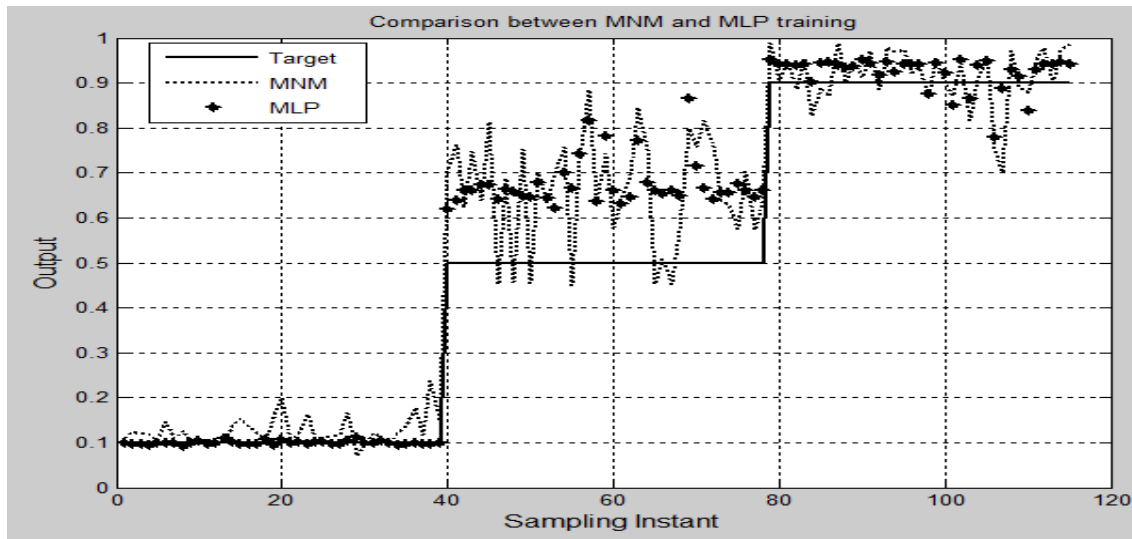


Fig.4 Comparison between MNM and MLP training.

Table.1

Comparison of training and testing performance for IRIS problem

S.No.	Parameter	MNM	MLP
Training goal, in term of MSE (error check)			
1		0.0001	0.00001
2	Iteration needed	500	4000
3	Training time in seconds	19	92
4	testing time in seconds	0	0
5	MSE for training data	0.0074	0.0058
6	MSE for testing data	0.0054	0.0033
7	RSME for training	0.858	0.0763
8	RMSE for testing	0.755	0.0572
9	Correlation coefficient	0.9682	0.9699
10	percentage of miss classification	5%	5%
11	number of neurons	1	23
12	learning late ( $\eta$ )	1.8	2.1

Table 2, shows the input values and equivalent outputs values of both models. Figure 4 and figure 5 shows the training and testing results of Iris datasets. The figures show that some marginal overlapping all three classes are clearly separable with each others.

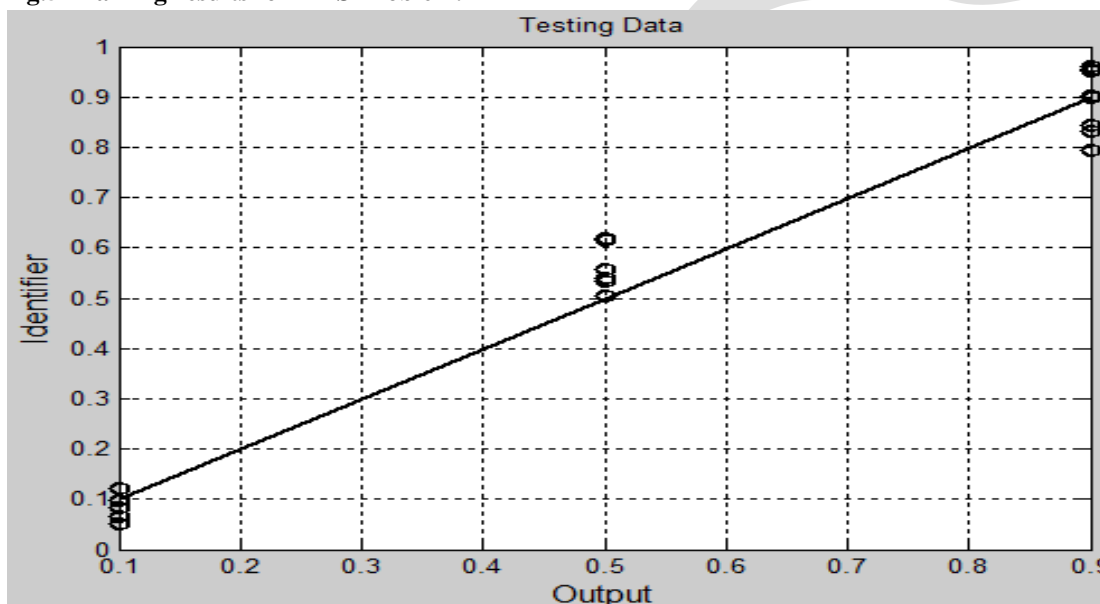
Table.2

Comparison of Output of MNM and MLP for IRIS Problem

Input	Target	Actual Output with MNM	Actual Output with MLP
0.678, 0.467, 0.656, 0.833	0.9	0.8818	0.92848
0.544, 0.567, 0.724, 0.867	0.9	0.95001	0.95041
0.167, 0.567, 0.154, 0.167	0.1	0.097149	0.092123
0.411, 0.7, 0.195, 0.167	0.1	0.15513	0.10947
0.256, 0.2, 0.412, 0.4	0.5	0.66848	0.64186
0.389, 0.267, 0.493, 0.433	0.5	0.56815	0.6241



**Fig.5 Training results for IRIS Problem.**



**Fig.6 Testing results for Iris Problem.**

## B. Mammographic Mass Dataset

The authors compared the performance of multiplicative neural networks (MNM) with that of multi layer perceptrons (MLP). Depicted in the Fig. 7 that MSE versus epochs curves for training with MNM and MLP while dealing the problem. Where MLP takes 4000 epochs to learn the pattern, on the other hand, MNM takes only 1000 epochs. From the Table 3, it is observed that the training time required by MLP is much more than MNM. It means that a single neuron of MNM is capable to learn mammographic mass pattern, where MLP model required 31 neurons.

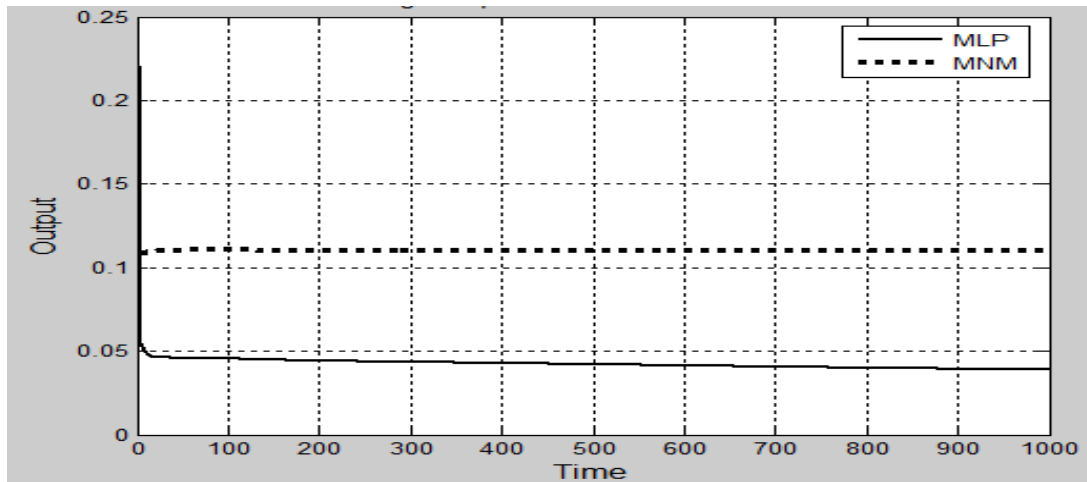


Fig.7 MSE vs. iteration for training for Mammographic Mass problem.

Table.3

Comparison of training and testing performance for Mammographic Mass problem

S.No.	Parameter	MNM	MLP
Training goal, in term of MSE (error check)			
1		0.0001	0.00001
2	Iteration needed	1000	4000
3	Training time in seconds	106	214
4	testing time in seconds	0.18	0.02
5	MSE for training data	0.0606	0.0363
6	MSE for testing data	0.0663	0.0442
7	RSME for training	0.2462	0.1904
8	RMSE for testing	0.2575	0.2103
9	Correlation coefficient	0.5711	0.7509
10	percentage of miss classification	23%	13%
11	number of neurons	1	31
12	learning late (l)	0.77	0.85

Table 4 exhibits the comparison between MNM and MLP in terms of deviation of actual output from corresponding targets. In context of Mammographic Mass Problem results are not very good as IRIS problem or Brest Cancer original but shows a clear classification and reveal deference between the MLP and MNM models.

Table.4

Comparison of Output of MNM and MLP for Mammographic Mass Problem

Input	Target	Actual Output with MNM	Actual Output with MLP
0.172, 0.5, 0.1, 0.9, 0.633	0.9	0.83568	0.94885
0.172, 0.694, 0.1, 0.7, 0.633	0.9	0.63788	0.87049
0.158, 0.284, 0.633, 0.1, 0.633	0.1	0.14166	0.1139
0.158, 0.580, 0.366, 0.1, 0.366	0.1	0.15231	0.10555



Fig. 8 Training results for Mammographic Mass Problem.

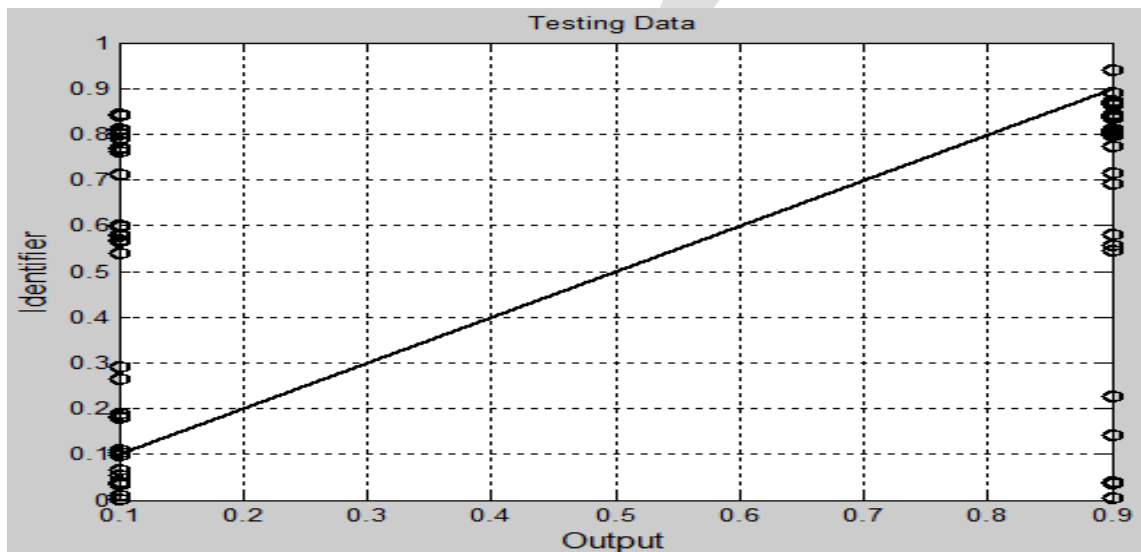


Fig.9 Testing results for Mammographic Mass Problem.

### C. Breast Cancer winconsin Original Problem

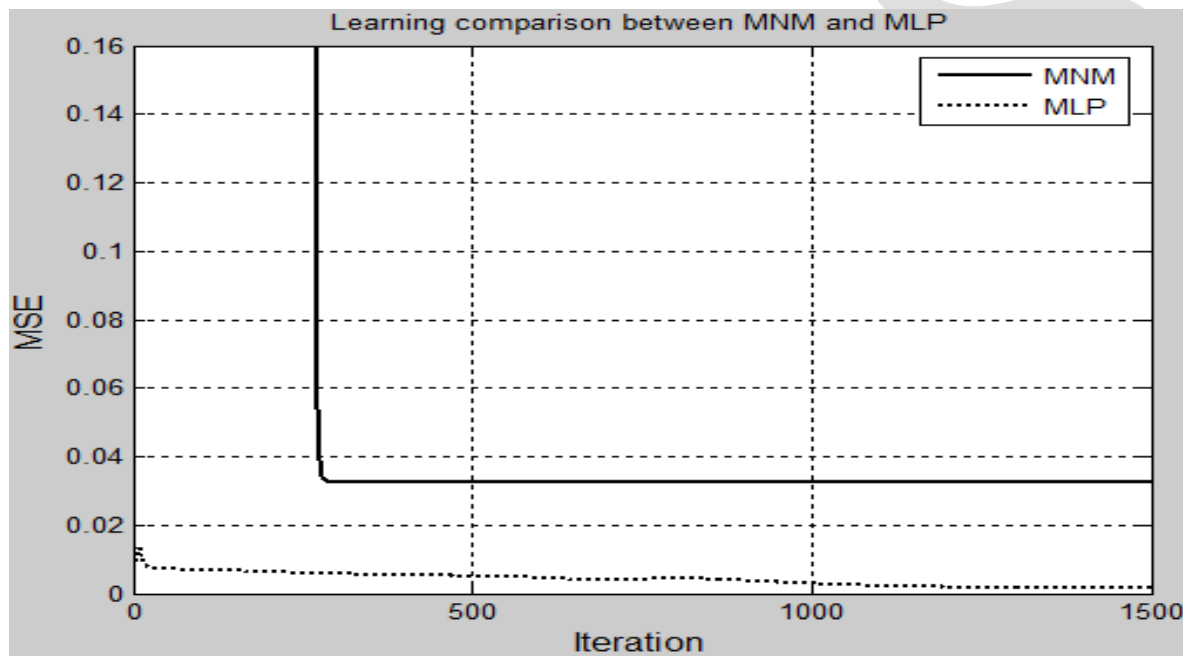
Nine inputs Breast cancer winconsin dataset donate by Dr. William H. Wolberg to UCI. Table 5 shows the comparison of training and testing performance with MLP and MSN while solving the Breast cancer winconsin problem . It is observed from the table that the performance of the MSN model is Significantly better on this data set. It can be compared with the other tables (Table 1&3) and easily found that Breast cancer problems results are far better than Iris and Pima Indian dataset. The classification results depicted in the Fig.11 and Fig. 12, from the figures it can be seen that the proposed model performance in better than that of MLP. The single neuron model capable to classify the pattern in only 400 epochs where the MLP model with total 26 neurons learnt in 1500 iterations. It is become clear from the MSE vs. epoch curve in Fig.10. the proposed model resolve the problem with 93% of success.

Table.5

Comparison of training and testing performance for Breast Cancer winconsin

S.No.	Parameter	MNM	MLP
1	Training goal, in term of MSE (error check)	0.0001	0.00001

2	Iteration needed	400	1500
3	Training time in seconds	77.72	89.23
4	testing time in seconds	0.02	0.01
5	MSE for training data	0.185	0.0012
6	MSE for testing data	0.0128	0.0004
7	RSME for training	0.1363	0.034
8	RMSE for testing	0.1132	0.0202
9	Correlation coefficient	0.8699	0.9924
10	percentage of miss classification	7%	0%
11	number of neurons	1	26
12	learning late ( $\eta$ )	2.1	2.1



**Fig.10 MSE vs. iteration for training of Breast Cancer Winconsin problem.**

Table 6, shows the input values and equivalent outputs values of both models. The table show the deviation of output values from the actual values. For the same input values the corresponding output values of both models. It can be seen from the table that there is a little bit difference between both models despite of huge difference in the participating neurons.

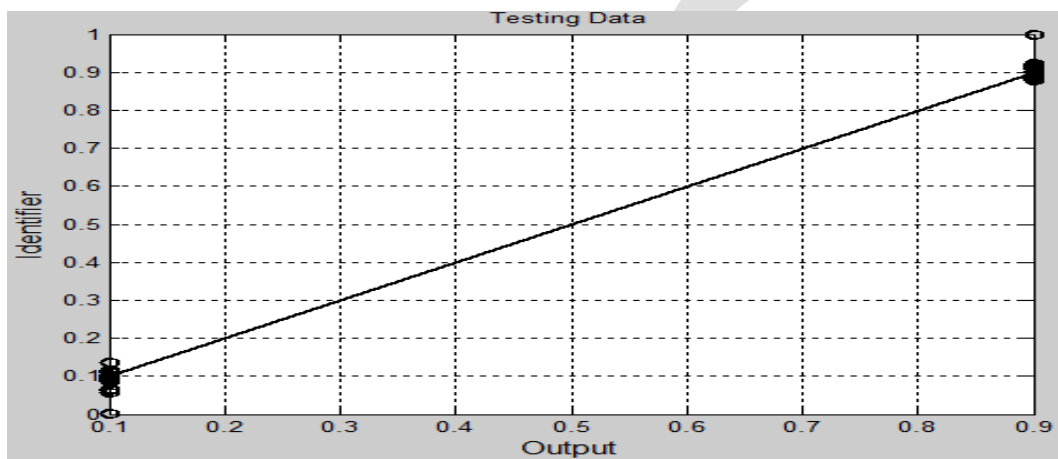
**Table.6**

**Comparison of Output of MNM and MLP for Breast Cancer Winconsin**

Input	Target	Actual Output with MNM	Actual Output with MLP
0.72222,0.9,0.9,0.72222,0.63333,0.9,0.81111,0.63333,0.1	0.9	0.808	0.8703
0.45556,0.27778,0.27778,0.27778,0.18889,0.27778,0.36667,0.1	0.9	0.78438	0.90227
0.36667,0.1,0.1,0.27778,0.18889,0.1,0.27778,0.1,0.1	0.1	0.072989	0.096094
0.1,0.1,0.1,0.1,0.18889,0.9,0.27778,0.1,0.1	0.1	0.09421	0.14736



**Fig.11 Training results (MLP) for Breast Cancer Wisconsin Problem.**



**Fig.12 Testing results for (MLP) Breast Cancer Wisconsin Problem.**

## V. Conclusion

After the finding the training and testing results of MNM and MLP using both popular IRIS, Mammographic Mass and Breast Cancer Wisconsin classification problem, it can be seen in simulation results that that single multiplicative neuron capable of performing classification task as efficiently as a multilayer perceptron with many neurons. By seeing the misclassification rate, Iris and Breast Cancer problem cases, learning of single Multiplicative neuron is good and in case of Mammographic Mass problem, it is considerable than that of multilayer perceptron. Eventually it is observed that training and testing time in case of MNM are significantly less as compared with MLP, in both problems. R. N. Mishra and et. al's finding on time series prediction, supports our study[18]. Therefore it is justified that the proposed model is better than MLP. Future scopes of this work, incorporation of the Multiplicative neuron in different networks and analysis the learning capabilities for classification, regression, function approximation, and time series prediction.

## Acknowledgment

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# Digitized estimation of haemoglobin using image processing

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**Abstract**—Hemoglobin is the protein present in RBCs which carries oxygen to all the parts of the body. It is one of the important parameters to be measured for surgeries, during traumatic conditions, pregnancies etc. The first part of this paper gives an insight of hemoglobin color scale (HCS) which is used by many developing countries where there are no laboratories and the flaws of that device. The second part of the paper introduces a new method for the estimation of hemoglobin that is by image processing in MATLAB. The two approaches taken forward for the estimation and one of them being the appropriate one.

**Keywords**— Hemoglobin (Hb), HCS (Hemoglobin color scale), anemia, invasive, digital image processing, MATLAB, RGB analysis, histogram, intensity level analysis

## INTRODUCTION

Anemia is a worldwide threat. Lack of Hemoglobin causes anemia, which has affected about 1.6 billion people which is about 30 percent of the total population according to WHO <sup>[1]</sup>. Anemia is found to affect most of the pregnant ladies, low hemoglobin count during pregnancy can be a serious issue <sup>[6,11]</sup>. Therefore, quick accurate hemoglobin estimation without any complex lab arrangement will be very resourceful.

Determination of hemoglobin percentage (Hb %) prior to any surgery has become an integral part of pre-anesthetic evaluation; the rationale being a mere belief or a custom inherited from our teachers than a valid scientific evidence <sup>[1,7,9]</sup>. The sole objective of an anesthesiologists is to ensure the adequate supply of oxygen; therefore HB % is one of those parameters which should be augmented easily for preoperative conditions. So, a need for quick estimation of hemoglobin with accurate values was felt by WHO, for critical conditions like pregnant women going into labor especially during trauma and in trauma patients <sup>[3,5]</sup>.

The various methods of estimation of hemoglobin so far used: Hemocue, Blood gas analyzer, Sahli's hemoglobinometer, Colorimeter.

## Estimation of hemoglobin using color scale:

A color scale was devised for estimating hemoglobin by matching the blood sample with ten levels of hemoglobin (3, 4, 5, 6, 7, 8, 9, 10, 12 and 14 g/dl). Its preliminary results showed good correlations with spectrophotometric readings. This device is used for estimating hemoglobin where no laboratory facilities are available. (Fig A)

Methods for assessing hemoglobin levels by matching a drop of blood on a piece of blotting paper against a color scale have been widely used in health centers in developing countries for the detection of anemia. In theory, they are attractive because of their simplicity, portability and low cost <sup>[4,8,11,12]</sup>. In practice, they are so grossly inaccurate, especially at lower hemoglobin levels, that they have little value according to the studies of G.J. Stott & S.M. Lewis. ( G.J.Stott1 & S.M. Lewis2. (1995). simple and reliable A method for estimating haemoglobin. *WHO BulletinOMS.* 3 (1), 1-5 <sup>[1]</sup>

The image taken of the HCS was image processed to get RGB values and inter pixel distance, the red values showed notable differences between the high values of the sample and the blue and green data showed differences in the lower values as shown in the graph (Fig B) below.

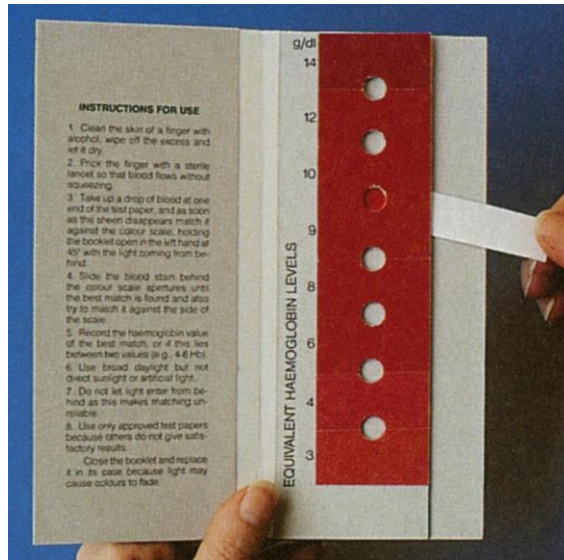


Fig A: HCS scale from<sup>[1]</sup> G.J.Stot1 & S.M. Lewis2. (1995). simple and reliable A method for estimating hemoglobin. *WHO BulletinOMS.* 3 (1), 1-5.

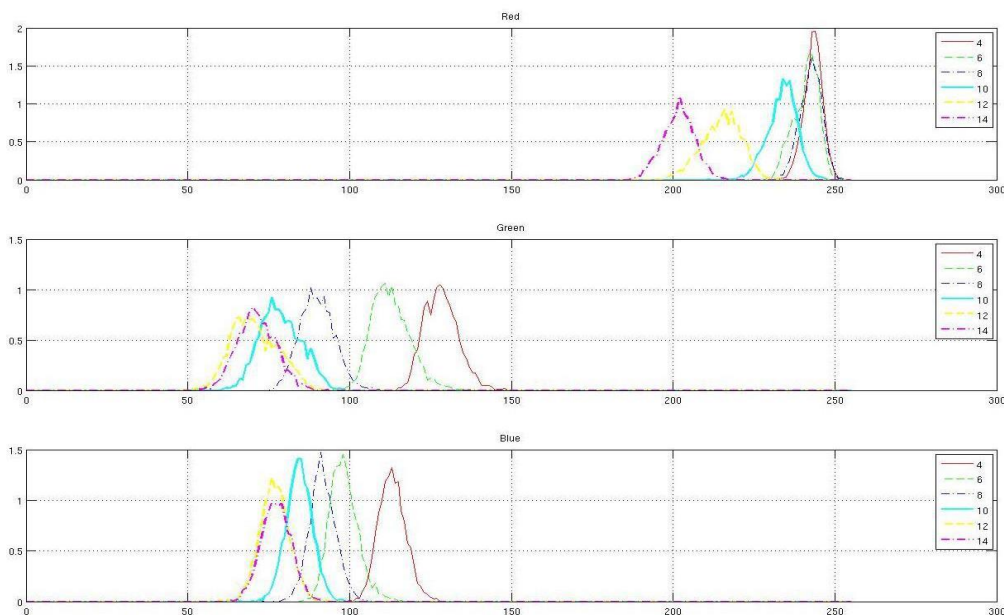


Fig B: RGB graph from<sup>[2]</sup> Rajendra Kumar M. 1,2, Hemant Misra 2, Sujit Hiwale 2, Manjunath Ramachandra 2. (2014). Digital WHO Hemoglobin Color Scale: Analysis and Performance. *eTELEMED 2014 : The Sixth International Conference on eHealth, Telemedicine, and Social Medicine.* 6 (1), 1-6

#### Flaws in these methods:

- Printing errors: the printed colors on the scale can differ depending on different manufacturers
- Absorbent paper: the paper should be of proper thickness a little variation can result in wrong estimation.
- Illumination: the intensity of light can affect the readings

- Effect of time: time taken for the sample to dry. If the sample is dried excessively the readings can be wrong.
- Accuracy & Human errors: hence the accuracy depends on the light source and color standards and also at the angle at which the scale is being held.

### ESTIMATION OF HEMOGLOBIN USING IMAGE PROCESSING METHOD:

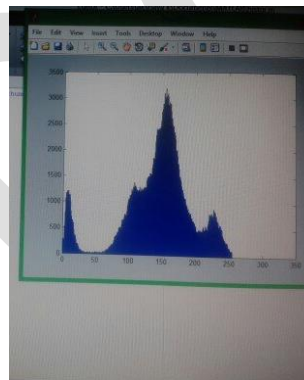
The basic idea behind the digitization of haemoglobin estimation is to use simple MATLAB image processing techniques for quick results. Our first approach to the samples was histogram analysis and when that failed to show appropriate results we switched to analysing the pixel region that is intensity levels according to the RGB Scaling.

#### The following steps were carried out for our first approach i.e. histogram analysis:

1. Normal Whatmann filter paper, lancet, cotton, alcohol swabs, 8MP camera, perfect illumination are the materials required.
2. Apply alcohol on a finger and prick it with the help of lancet.
3. Draw a drop of blood on the filter paper.
4. Let it dry for 30-45 seconds.
5. Capture the image of the dried sample within 30-60 seconds.
6. Histogram analysis was done on MATLAB.



(a)

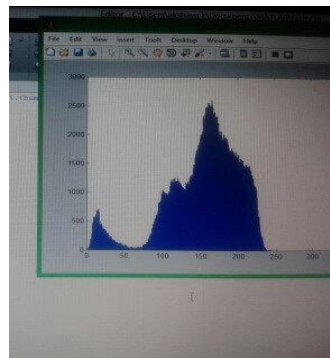


(b)

Fig.1. (a), (b): the first figure is the image of blood sample for which the histogram analysis was done. The second image (b) is the histogram of the sample which shows a particular intensity peak on i-t graph.



(A)



(B)

Fig.1.1. (A), (B): the first image is the blood sample of the same subject but the arrangement of the sample is different. The second image (B) is i-t graph that is the histogram of the sample.

But as we can observe from all the figures the histogram graph for both the samples are different but the peak value remains the same which implies that the intensity level of the samples although of different orientation but of the same subject showed same intensity peak. Although the intensity peaks didn't change by the orientation of the image but we couldn't find any discrete method to differentiate and find the hemoglobin range. Hence this method failed and we proceeded with our next method of intensity level analysis based on RGB scale.

### The following were the steps for our second approach:

Before analyzing original samples we implemented the method on the standard hemoglobin color scale by taking and processing each color individually.

Sr.no.	Haemoglobin levels	Intensity range
1.	14	108-119
2.	12	120-126
3.	10	127-134
4.	8	135-142
5.	6	143-147
6.	4	148-152
7.	3	153-160

Table. 1: intensity range of the HCS (hemoglobin color scale) (rough outline)

The above displayed table (1) is the intensity range of HCS (figure. A) Which showed slight deviation from the original samples.

Hence we analyzed original samples and requested the subjects to check their hemoglobin levels with conventional methods also. So we proceeded by:

- Apply alcohol on a finger and prick it with the help of lancet.
- Draw a minute drop of blood on the filter paper.
- Let it dry for 30-45 seconds.
- Capture the image of the dried sample within 30-60 seconds.
- Pixel region was found on MATLAB.

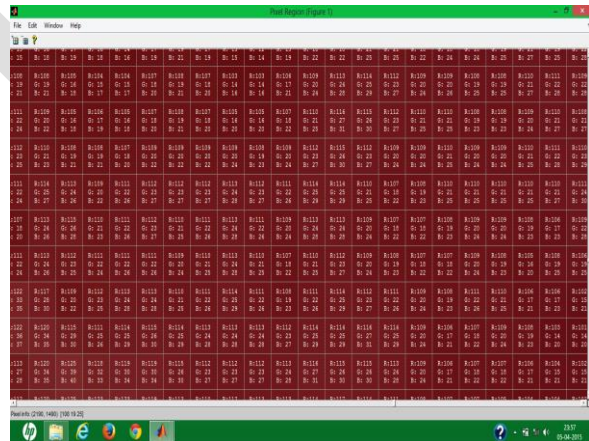


Fig 2: Hemoglobin value= 13

Sr.no.	subjects	Intensity range	Hb value by image processing	Hb value by conventional method
1.	A	106-116	13	12.5
2.	B	117-123	12	12
3.	C	124-134	10	10

4.	D	135-142	8	8.5
5.	E	130- 137	9	9

Table.2: Hemoglobin values obtained by image processing and by conventional methods

## ACKNOWLEDGEMENT

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## CONCLUSION

As a conclusion, this research successfully determine discrete intensity range for a particular hemoglobin value by the approach of finding the pixel region of sample i.e. image processing on MATLAB. We will further put our efforts to device a method into a low cost standalone device that will be able to determine the hemoglobin level of a subject during emergency or any traumatic conditions. We have tried two main methods, out of which the RGB color scale method was appropriate. We have collected samples and found that the range of the hemoglobin values fall at a particular RGB color level.

We have come to the conclusion that hemoglobin ranges have their particular intensity levels. One major issue to be worked on in this method is decimal point precision as this method will give only discrete values of hemoglobin. Also, the hemoglobin estimation is only available till 14g/dl which has to be raised to 20g/dl as it is concerned with the new born hemoglobin estimation.

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IJERGS

# Performance of Convolutional Code Encoder Structure with Code Rate $\frac{1}{3}$ Using Particle Swarm Optimization

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**Abstract:** During the transmission process, the transmitted signals pass through some noisy channel. Due to noise interference, some errors are introduced in the received data. These errors can be detected and correcting using coding technique. The error correcting codes are very useful for transmitting information through noisy channels. Convolutional code is the most reliable method for transmitting or retrieving the error free data. Convolutional code encoder consists of shift registers and mod-2 adders. The performance of convolutional code depends upon the connections between shift registers and mod-2 adders. In this paper a method is proposed for convolutional code encoder structure with code rate  $\frac{1}{3}$  using particle swarm optimization which is an efficient optimization technique.

**Keywords:** Convolutional code, PSO (particle swarm optimization), Mod-2 Adder, Shift register, coderate

## 1. INTRODUCTION

Today the use of digital cell phones, the internet, and CD and DVD players is ubiquitous. In all of these cases, digitally represented data is either transmitted from one place to another or retrieved from a storage device when needed. For the proper functioning of these systems the transmitted or retrieved data must be sufficiently error free. This can be accomplished efficiently by using channel efficiently coding techniques [8]. Coding techniques create code words by adding redundant information to the user information vectors. The convolutional codes takes advantage of the relativity between code blocks, so they have better error correction performance and are used widely. Unlike the block code, convolutional code is not memory-less devices.

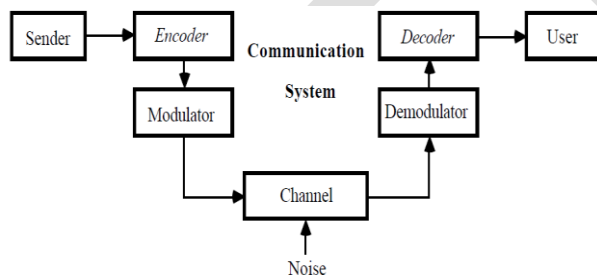


Figure 1: A simplified model of a communication system.

Because of its ability of error control, convolutional codes with longer constraint lengths are widely applied in domains such as satellite communications and digital video. Encoding algorithms generates the code word, which transmitted over the channel (Figure1). Convolutional code accepts a fixed number of message symbols and produces a fixed number of code symbols. Its computation depends not only on the current set of input symbols but also on some of previous input symbols. Convolutional code has many encoder structures (outputs connection with shift registers). The complexity of convolutional code encoder structure increased with the number of states. We have investigated that the PSO algorithm finds to be the best connections for convolutional code encoder. PSO algorithm [3] has some good features such as good diversity, wide searching area and strong global optimize capability. So the best Convolution code encoder structure with code rate  $\frac{1}{3}$  based upon particles swarm optimization algorithm is presented in this paper[7]. In this paper present the best convolutional code encoder structure (connection of output with the shift registers) with code rate  $\frac{1}{3}$ .

## 2. CONVOLUTIONAL CODE

Convolutional code was introduced by Elias. A convolutional code is a type of code in which each m-bit information to be encoded is transformed into an n-bit symbol. A convolutional code introduces redundant bits into the data stream through the use of linear shift registers as shown in (Figure2). The inputs to the shift registers are information bits and the output encoded bits are obtained by modulo-2 addition of the input information bits and the contents of the shift registers. The connections to the modulo-2 adders were developed heuristically with no algebraic or combinatorial foundation.

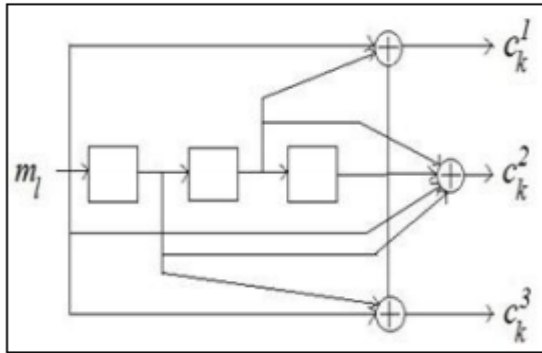


Figure 2: Convolutional encoder (Rate=1/3, K=4)

A convolutional code is described by three integers, n, k, and K. The code rate R for a convolutional code is defined as  $R = k/n$ , where k is the number of parallel input information bits and n is the number of parallel output encoded bits at one time interval. The constraint length K for a convolutional code is defined as  $K = m + 1$ , where m is the maximum number of stages (memory size) in any shift register. The number of encoder structure depends upon constraint length(K). For a particular value of K, the number of structure (N) is defined as:

$$N = (2^K - 1) * (2^K - 1)$$

## 3. PARTICLE SWARM OPTIMIZATION

Particle Swarm Optimization (PSO) is a technique used to explore the search space of a given problem to find the settings or parameters required to maximize a particular objective. This technique, first described by James Kennedy and Russell C. Eberhart in 1995 [6] originates from two separate concepts: the idea of swarm intelligence based off the observation of swarming habits by certain kinds of animals (such as birds and fish); and the field of evolutionary computation. The algorithm maintains a population potential where each particle represents a potential solution to an optimization problem. The PSO algorithm works by simultaneously maintaining several candidate solutions in the search space. During each iteration of the algorithm, each candidate solution is evaluated by the objective function being optimized, determining the fitness of that solution. Each candidate solution can be thought of as a particle “flying” through the fitness landscape finding the maximum or minimum of the objective function.

## 4. PSO ALGORITHM

The PSO algorithm consists of following steps, which are repeated until some stopping condition is met:

1. Initialize the population, location and velocity.
2. Evaluate the fitness of the individual particle (Pbest).
3. Keep track of the individual highest fitness (Gbest).
4. Modify velocity based on Pbest and Gbest location.
5. Update the particle position.
- 6.

The first three steps are fairly trivial. Fitness evaluation is conducted by supplying the candidate solution to the objective function. Individual and global best fitnesses and positions are updated by comparing the newly evaluated fitnesses against the previous individual and global best fitnesses, and replacing the best fitnesses and positions as necessary. The velocity and position update step is responsible for the optimization ability of the PSO algorithm. The velocity of each particle in the swarm is updated using the following equation:

$$v_i(t+1) = w.v_i(t) + c_1 r_1 [l_i(t) - x_i(t)] + c_2 r_2 [g(t) - x_i(t)] \text{-----}(1)$$

$$x_i(t+1) = x_i(t) + v_i(t+1) \text{-----}(2)$$

where  $v_i(t)$  &  $x_i(t)$  is the velocity and position of the particle at time  $t$  and parameter  $w$ ,  $c_1$  &  $c_2$  ( $0 \leq w \leq 1.2$ ,  $0 \leq c_1 \leq 2$  and  $0 \leq c_2 \leq 2$ ) are user supplied co-efficient. The values  $r_1$  and  $r_2$  ( $0 \leq r_1 \leq 1$  and  $0 \leq r_2 \leq 1$ ) are random value regenerated for each velocity update.

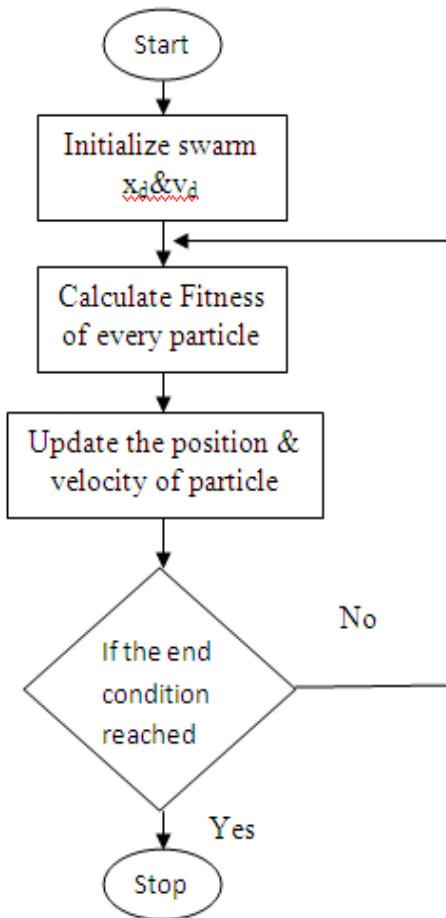


Figure 3: PSO Algorithm

## 5. CONVOLUTIONAL CODE OPTIMIZATION USING PSO

Optimization is the mechanism by which one finds the maximum or minimum value of a function or process. Optimization can refer to either minimization or maximization.

### Step1: Generate polynomial

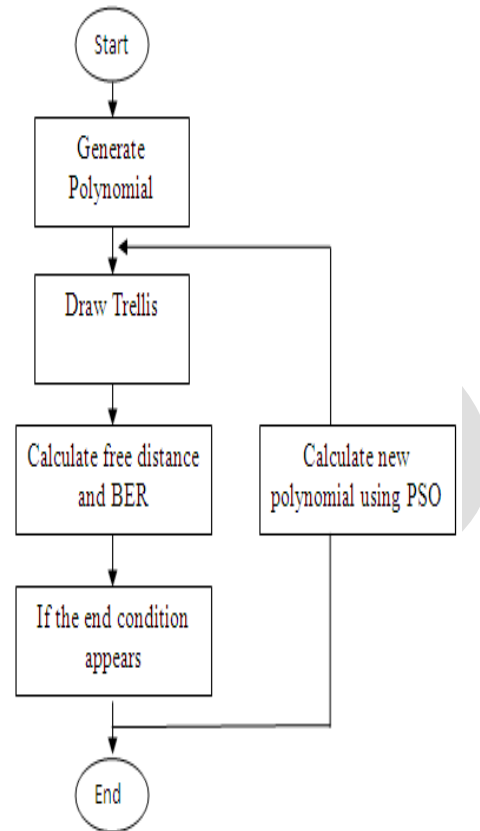
A Polynomial description of convolution encoder describes the connection among shift registers and modulo -2 adders. Build a binary number representation by placing a 1 in each connection line from shift feed into the adder and 0 elsewhere. Convert this binary representation into an octal representation.

### Step2: Draw the trellis

A trellis description of a convolutional encoder shows how each possible input of encoder influences both the output and state transition of encoder. Start with a polynomial description of the encoder and use poly2trellis function to convert it to valid structure.

### Step3: Calculate BER

Calculate bit error rate using octal code and trellis structure. To decode convolutional code use the vitdec function with the flag hard and with binary input data. Because the output of convenc is binary, hard decision decoding can use the output of convenc directly.



After convenc adds white Gaussian noise to the code with AWGN.

Figure 4: Convolutional Encoder using PSO

### Step4 : Update particle's position and velocity

At each time, all particles have an update. At iteration  $t$ , the  $t^{\text{th}}$  element in the vector is updated. Particle's position is decided by velocity as equation (2). At the decoding process, the update of  $v_i(t+1)$  and  $x_i(t)$  update must act up to transfer rule of encoder state. Select lowest value of bit error rate as fitness function.

Figure 4: Convolutional Encoder using PSO

### Step 5 : Update personal best position and the global best position.

Update personal best position and the global best position after all particles position have been updated.

### Step 6 : Ending condition

When iteration  $t=L$ , all particle's position have been updated for  $L$  times and reached the grids ending

## 6. RESULT:

The performance of particle swarm optimization with convolutional code of code-rate 1/3 is verified using MATLAB software. The free distance  $d_{\text{free}}$  of a convolutional code is a good indicator of the error correcting performance of the code. Figure 5 represent the best connection of output with shift registers for convolutional code with code rate 1/3.

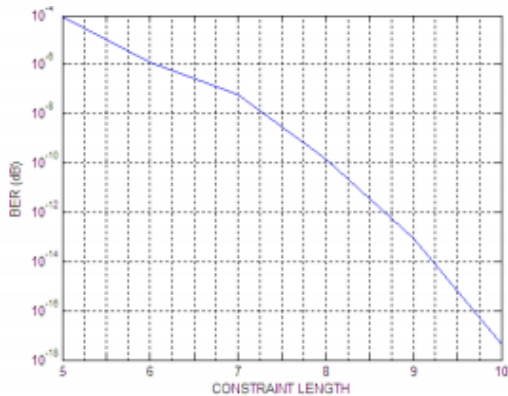


Figure 5: Graph between BER and constraint length for code rate 1/3

This is obtained with less decoding delay and also good bit error rates are achieved within less number of trials. Without optimization, to obtain such results 1000 trials or more are required.

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## 2D Image segmentation by Hybridization of PSO and BBO

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**Abstract**— Image segmentation is an important research issue in image processing. In this paper, hybridizing of the PSO and BBO algorithm for 2-D image segmentation is implemented. The common features from PSO and BBO algorithm are used and then hybridized for the segmentation. The results are evaluated on the basis of parameters; PSNR and SSIM. The results depicts that the proposed hybrid algorithm performed well and produce better segmented 2D images .

**Keywords**— Segmentation, PSO, BBO, 2D, Hybrid, PSO-BBO, Fitness function, habitat, crossover.

### INTRODUCTION

It is widely used in analyzing the exactness and dimensions of an image. The slices of 2D images have like shapes which gives clue for segmentation of 2D image [1]. Image segmentation is used to recognize the each segment of the image more clearly. In this paper we are representing the 2D image segmentation by combined approach of PSO and BBO [2]. Also comparing the results of 2D segmentation from PSO, BBO and Hybrid algorithm.

PSO and BBO algorithms come under the category of swarm optimization. The concept of swarm optimization has arrived from the activities of social insects and birds. Social birds are characterized from their self organizing behavior and by finding the optimum paths through minimum communication. They can get information about surroundings and can interact with other birds indirectly through stigmergy. These all features characterise swarm intelligence. The two widely used swarm intelligence techniques are Particle Swarm Optimization and Biogeography Based Optimization.

### I. METHODOLOGY

For this work, simulation based work has been performed on 2-D images. The 2-D images were collected from the online database.



Fig.1: Slices of face obtained from MRI image

### PARTICLE SWARM OPTIMIZATION

PSO is a computational optimization technique developed by Kennedy and Eberhart in 1995[3]. The impression of Particle Swarm Optimization has been originated from the behaviour of particles of swarm and the social interaction between particles [4]. While finding for the food, the birds get scattered here and there for searching of food or they move together to find for the food [5]. When the birds hunt for food from one place to another, there is a bird which can smell the food. The basic algorithm of particle swarm optimization consists of “n” swarm particles, and the position of each of the particle stands for the possible solution. The swarm particles may change its position according to the three principles: (1) keep its inertia (2) to update the condition with respect to its

optimal position (3) to update the condition with respect to the most optimal position of swarm. The position of each of the particle presented in the swarm is affected by the optimal position during the movement of individual and the most optimist particle position in the surrounding near to it [6]. Thus it is called PSO when the complete swarm is surrounding the particle then the optimum position of the individual is equal to the whole optimum particle.

## BIOGEOGRAPHY BASED OPTIMIZATION

BBO is a new and advance biological – inspired and optimizes the population based technique developed by the Dan Simon in year 2008. and it is inspired by the mathematical models of the biogeography developed by Robert and Edward [7]. The Biogeography-based optimization is one of the main and evolutionary technique which mainly optimizes a function by the stochastically and repeatedly improving the candidate solutions with the regard to a given quality measurement. BBO is the study which relates to the concept of distribution of species in the nature. Island is referring to as each possible solution and its features that add up to a habitat is known as Suitability Index variables. Also the habitat suitability index which contain all the goodness of every solution. BBO basically works on migration and mutation. Migration means moving of species into some different habitat that is better to survive than already existing [8]. The place where these species is moving is referred to as immigrating. Mutation is used to upgrade diversity. In BBO, habitat H is initialized randomly vector of SIV. While the migration the information is passed between different habitats that depend upon the emigration rates and immigration rates of every solution. A problem is given and a way to find the possible solution to that exists in the firm of HIS value.

## PROPOSED ALGORITHM

As per the earlier discussion in above sections, the concept of BBO and PSO was learnt. In the hybrid algorithm, it will take over the common properties of BBO and PSO algorithm [9]. Like in BBO algorithm, it involves: fitness function, migration of species, and immigration of species [10]. In PSO algorithm, it involves: fitness function, particles tend to acquire best position i.e., cross of position takes place, the optimum path is obtained. So, mixture algorithm of both these will contain common properties of both these algorithms: the fitness function, crossover of particles and get optimum path[11][12]. The particles tend to migrate or move to the best possible solution such as in PSO, the particles moves to the secure position that means they are changing their positions and in BBO, the individuals transfer to best environment [13][14]. In both the cases, the positions of individuals tend to change. So all these common properties are inherited in hybrid algorithm which increases its performance and efficiency.

In the hybrid algorithm, firstly the fitness function of the pixels is evaluated since in PSO and BBO the fitness value is evaluated. The pixels are selected on the fitness function.

$$\text{Fitness function} = \sum_{i=0}^n [A_i(B_i - C_i) / A_i]^{1/2} \dots\dots\dots(i)$$

Where  $A_i$  =habitat

$B_i$  = Migrate or immigrate rates of  $i_{th}$  species

$C_i$  = Crossover of  $i_{th}$  species.

Now describe a certain threshold value for the pixels and on the basis of the respective threshold value the new image is generated. The threshold value is assumed 0.1. Since in BBO and PSO, the solution which is best is achieved. So in hybrid algorithm, two habitats are generated randomly according to fitness function. Now crossover the pixels or check the pixels from the image earlier generated on basis of threshold value with these two habitats. The pixels which suits best between these are included in Region of Interest and are thus extracted. Now with this algorithm the segmentation gets improved to a large extent.

Input: Dicom images are given as input for working of algorithm.

Step 1: Initialize the particles to the population.

Step 2: For all particles, a fitness function for finding the best position of particles is defined.

Step 3: A certain threshold value for the segmentation of region of interest is defined

say threshold value in present work =0.01

Step 4: Generate an image on the basis of threshold value and generate two habitats randomly from the original image for the crossover.

Step 5: Crossover the position which suits best from the habitats and set it as area of interest that is to be segmented

Step 6: Iterate this process until best solution is obtained. Output: Segmented image is obtained as final output

## II. IMPLEMENTATION AND RESULTS:

The implementation of the proposed algorithm is done using MATLAB Version. R2012a (7.14.0.739). For 3D, the execution time for PSO algorithm is 00.00.04 sec, for BBO 00.00.03 sec and for hybrid algorithm 00.00.02 sec

### PARAMETERS FOR COMPARISON

The proposed algorithm had been tested successfully on different types of medical images. We are presenting the result and conclusions obtained from Particle swarm optimization and biogeography based optimization algorithms. Comparing the different segmentation algorithms to each other was difficult task because they totally differ in their properties. In our work, we had compared our results of hybrid algorithm of 2D and 3D image segmentation with results of PSO algorithm and BBO algorithm. Parameters are evaluated for checking the performance PSNR and SSIM has been taken in this work.

$$\text{PSNR} = 10 \log_{10} [R^2 / \text{MSE}] \quad (i)$$

where, R is error or fluctuation in the image given as input. SSIM is calculated by the inbuilt MATLAB function ssimval.

Table 1. Comparison of 2D Image Segmentation Results

Imag	PSO		BBO		PSO-BBO	
	PSNR	SSIM	PSNR	SSIM	PSNR	SSIM
1	27.554	0.120	28.196	0.074	53.525	0.207
2	30.983	0.084	31.633	0.017	50.406	0.269
3	27.553	0.001	28.350	0.030	59.081	0.669
4	26.683	0.062	27.468	0.034	57.795	0.171
5	27.639	0.067	28.436	0.003	61.529	0.276

The comparison of SSIM and PSNR of 2D images between PSO, BBO and Hybrid algorithm PSO-BBO The results shows that Hybrid algorithm is better algorithm than PSO and BBO.

## III. CONCLUSION

As Particle swarm optimization and biogeography based optimization algorithms are optimization algorithms, we are using it for segmentation. In our work, we had used it for 3D medical images for segmentation by using Particle swarm optimization and biogeography based optimization This algorithm is flexible, and reliable where the many objective can be used as functions, due to this reason, it can be used for oriented segmentation and has shown better results in 3D segmentation than 2D also the execution time for hybrid algorithm is less than PSO and BBO algorithm. The results of the hybrid algorithm are better than that of PSO and BBO algorithms. For future, we can use better artificial intelligence schemes for higher equality of sufficiency and emphasize on reduction of computational complexity and time. The future work can be also done as increasing the EPI and SSIM parameters to more extent for better segmented image.

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# Experimental Study on the Shear Behaviour of Basalt Fiber Reinforced Concrete Beam with Steel and BFRP Stirrups

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**Abstract**— This paper deals with the shear behaviour of self compacting concrete (SCC) beams reinforced with basalt fiber-reinforced polymer (BFRP) bars. Fifteen concrete beams were, respectively, made with steel and BFRP shear reinforcements. The beams were tested in a static two point bending load setup by kept the shear span-to-depth (a/d) ratio as 1.952. The test results are presented in terms of crack patterns, failure modes, load-deflection, load-strain behaviour, and shear capacity. It was observed that the shear capacity and ductility of SCC beams increased by using BFRP reinforcements. The test results were compared with predictions of different available codes and design guidelines. Standard provisions predictions were conservative.

**Keywords**— Basalt rebar, BFRP, Crack pattern, deflection, Self Compacting Concrete (SCC), Shear failure, Stirrups

## INTRODUCTION

Concrete is the most common and widely used structural material in the construction world. It is more versatile but modern day engineering structures require more demanding concrete owing to the huge applied load on smaller area and increasing adverse environmental conditions [13]. In recent years a lot of studies were carried out to improve the performance of concrete in terms of strength and durability. This lead to the development of self compacting concrete (SCC), it maintains durability and characteristics of concrete and also lower the time needed for construction.

Many reinforced concrete structures are exposed to serious deterioration problems due to the corrosion of the steel rebar inside the concrete. Therefore, the need for non-corroding materials has become important. In the past three decades fiber-reinforced polymer (FRP) materials have emerged as an alternative material to steel as reinforcing bars for concrete structures. Fiber-reinforced polymer composites have several advantages over steel such as high strength, high stiffness to weight ratios, resistance to corrosion and chemical attacks, controllable thermal expansion, good damping characteristics, and electromagnetic neutrality [11; 12]. The most commonly used FRP types in infrastructure are glass FRP, carbon FRP, and aramid FRP. Basalt fiber-reinforced polymer (BFRP) is not common compared with other FRPs due to the lack of research, design specifications, and construction guidelines.

In this paper, the study on shear capacity of concrete beams reinforced with BFRP longitudinal bars made with steel and BFRP stirrups are discussed. Experimental results are compared with the available design codes and given formulas.

## SIGNIFICANCE OF THE WORK

### A. Scope of the Work

The main problem with the steel reinforcement is the corrosion that finally affects the life and durability of the concrete structures. Many techniques such as epoxy coating and high performance concrete are used to avoid the corrosion. However, it was found that such remedies might not eliminate the problem of corrosion of steel reinforcement in the concrete structures. New materials such as FRP reinforcement is identified as an alternative to steel reinforcement in aggressive environments. Although BFRP has many advantages over other FRP materials limited studies have been done. In addition, these studies didn't include larger BFRP reinforcement bar diameters that are mostly used in practice. Therefore, the shear behaviour of larger beam sizes with larger BFRP reinforcement bar diameters are needed to investigated. And the application of BFRP stirrups in BFRP bar reinforced concrete beams is need to be scrutinized.

## B. Objective of the Work

The objective is the introduction of new material for reinforcing the concrete structures other than steel and to check the shear capacity of such beams compared with conventional steel beams.

## C. Methodology

The methodology of the work consists of:

- (1) Selection of self compacting concrete grade; S25
- (2) Mix design for S25 grade SCC
- (3) Casting beam specimens of normal RC beams, Normal SCC beams, BFRP reinforced beams with steel stirrups, BFRP reinforced beams with steel and BFRP stirrups, BFRP reinforced beams with BFRP stirrups
- (4) Conducting two point loading test using 50t loading frame.
- (5) Study on the obtained the results
- (6) Comparing the experimental result with available results in the design codes

## MATERIAL TESTS

The materials selected for S25 mix were OPC (Ordinary Portland Cement) 53 grade BHARATHI CEMENTS, fly ash collected from Coimbatore, M sand as fine aggregate, 20 mm size coarse aggregates, water and Master Glenium SKY 8233 as admixture. Each material except the admixture was tested as per the specifications in the relevant IS codes. The results are provided in Table I. The beam is reinforced with BFRP bars using steel and BFRP stirrups. Basalt fiber reinforced polymer bars were collected from Nickunj Eximp Entp P Ltd, Mumbai. The properties of BFRP bars provided in Table II.

TABLE I  
MATERIAL TEST RESULTS

Test	Material	Equipment Used	Values Obtained
Specific Gravity	Ordinary Portland Cement	Le-Chatelier Flask	3.15
Specific Gravity	Fine Aggregates	Pycnometer	2.7
Specific Gravity	Coarse Aggregates	Vessel	2.94
Specific Gravity	Fly ash	Le-Chatelier Flask	2.13

TABLE II  
PROPERTIES OF BFRP BARS

Properties	Obtained Values
Tensile strength	1273.25 MPa
Modulus of elasticity	0.94 GPa
% Elongation	12.5%



Fig.1 BFRP longitudinal bar and shear reinforcement

## MIX DESIGN

Many different test methods have been developed in attempts to characterize the properties of SCC. So far no single method or combination of methods has achieved universal approval and most of them have their adherents. Many trial mixes were prepared and comparing the test results with the standard values. Mix proportioning values are given in Table III.

TABLE III  
S25 MIX PROPORTIONING

Cement (Kg/m <sup>3</sup> )	561
Fly ash	99
Fine aggregate (kg/m <sup>3</sup> )	1055.275
Coarse aggregate (Kg/m <sup>3</sup> )	623.158
Water (l/m <sup>3</sup> )	167.45
Water cement ratio	0.2537
Mix ratio	1:1.6:0.9

## EXPERIMENTAL INVESTIGATION

### A. Experimental Procedure

Fifteen, 1250 mm long, concrete beams with a 150 × 200 mm was included in this experimental investigation.. Six beams were casted as control specimens with steel reinforcement and steel stirrups using M25 mix and S25 mix. Details of specimens cast are shown in Table IV. Three beams were made up of using BFRP reinforcement with steel stirrups. Three were made up using BFRP reinforcement with BFRP stirrups and remaining three beams were made with BFRP reinforcement and stirrups were a combination of steel and BFRP. The steel RC beams were designed as per IS 456:2000 specifications and the BFRP RC beams were designed as per ACI 440.1R (ACI 2006) specifications. The main lower reinforcement was 2-12 mm in diameter and 8mm diameter stirrups for both steel RC beams and BFRP RC beams. And the spacing adopted for steel RC beams were 130 mm and for BFRP RC beams were 125 mm.

All BFRP beams were casted using Self Compacting Concrete. The beams were cured using jute bags with room temperature for 28 days. The compressive strength of the concrete mix was measured after 28 days using standard cubes. The mean compressive strength for the mix was 27.6 MPa.

TABLE IV  
DETAILS OF SPECIMENS CAST

Sl. No:	Number Of Beams	Designation Used	Flexure bar type	Shear reinforcement type	Spacing Adopted
1	3	NS130	Steel	Steel	130
2	3	SS130	Steel	Steel	130
3	3	SBS125	BFRP	Steel	125
4	3	SBSB125	BFRP	Steel & BFRP	125
5	3	SBB125	BFRP	BFRP	125

NS - Normal Steel beams  
SS - SCC Steel beams  
SBS - SCC BFRP beams with Steel stirrups  
SBSB - SCC BFRP beams with Steel and BFRP stirrups  
SBB - SCC BFRP beams with BFRP stirrups

## B. Test Procedure

The shear strength of the specimens was tested using a 50 ton loading frame. A dial gauge was attached at the bottom of the beam to determine the deflection at the centre of the beam. The effective span of the beam is taken as 990mm in the case of 1250mm beam. A proving ring of 500kN is connected at the top of the beam to determine the load applied.

The shear strength of the beam is tested as a two point loading system using a hydraulic jack attached to the loading frame. The behaviour of beam was observed from beginning to the failure. The loading was stopped when the beam was just on the verge of collapse. The first crack propagation and its development and propagation were observed. The values of load applied and deflection were noted. The load in kN is applied with uniformly increasing the value of the load and the deflection under the different applied loads is noted. The applied load increased up to the breaking point or till the failure of the material.

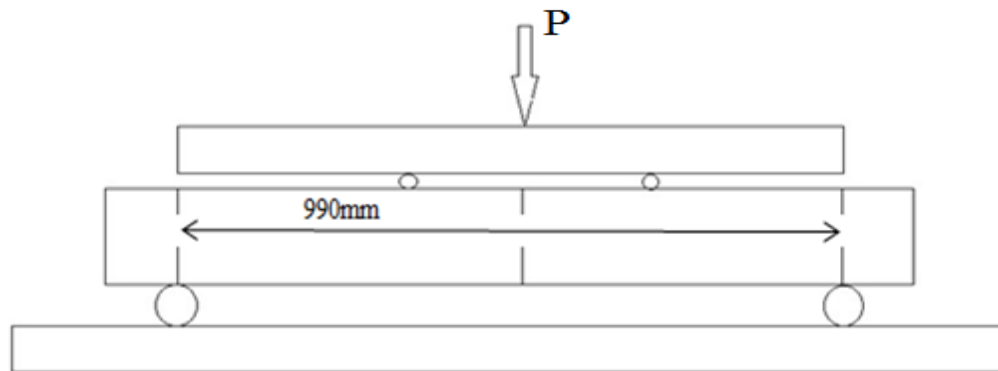


Fig. 2 Schematic Set Up of Testing

## EXPERIMENTAL RESULTS

### A. Load Deflection Behavior

As the load increases the deflection of the beams increases and all beams exhibited a linear load deflection relationship for same a/d ratio. The stiffness of the BFRP reinforced beams increases with the increase of load and deflection compared to the conventional beams. Compared to conventional beams the BFRP reinforced beam deflect more without failure and sustain more loads. Among the BFRP reinforced beams SBB125 deflect more and taken more loads.

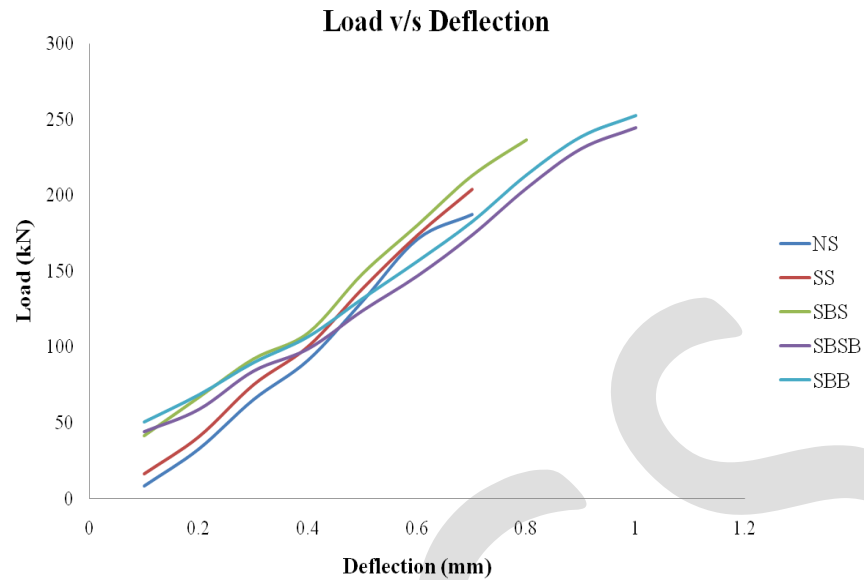


Fig.3 Load - deflection curve

### B. Load Carrying Capacity

Ultimate strength of beams under two point loading was the maximum load indicated by the proving ring at the time of loading. Table V shows the ultimate load carrying capacity of all tested beams. From the results it was found that the BFRP reinforced beams exhibit more load carrying capacity than conventional beams. SBB125, the beam fully replaced by BFRP reinforcement has the maximum load carrying capacity compared to the beams partially replaced by BFRP.

TABLE V  
ULTIMATE LOAD OF BEAMS

Beam Specimen	Ultimate Load (kN)
NS130	187.45
SS130	203.75
SBS125	236.35
SBSB125	244.5
SBB125	252.65

### C. Ultimate Shear Capacity

The shear capacity ( $V_{ult}$ ) of the RC beams was quantified by summing the contribution of shear in the concrete ( $V_c$ ) and shear in transverse reinforcement ( $V_s$ ). The shear capacity of BFRP reinforced beam provided in Table VI. SBB125 beams exhibits more shear capacity than other beams. BFRP reinforced beams in this study failed in shear, the ultimate shear strength presented in terms of

the normalized shear as given by Eq. (1) where  $b$  and  $d$  are the width and depth to flexural reinforcement of the section and  $V_n$  is the Ultimate shear load of the beam.

$$V_{norm} = \frac{V_n}{\sqrt{f_{tc}}} \frac{1}{bd} \quad (1)$$

TABLE VI  
SHEAR CAPACITY OF BEAMS

Beam Specimen	Shear Load (kN)	Peak Normalized Shear (N/mm <sup>2</sup> )
SBS125	118.175	0.89
SBSB125	122.25	0.92
SBB125	126.325	0.95

#### D. Crack Pattern

The crack pattern beams are presented in Figs. 4(a) and 4(e). For conventional beams the first flexural crack initiated in the middle of the beam. As the load increased, more flexural cracks initiated and propagate. There were no shear cracks in NS130 and SS130 beams. In the case of BFRP RC beams mainly shear cracks were developed from the supporting points and widened up as the load increased. Like conventional beams, flexural cracks were first developed in the BFRP RC beams but it was very minute cracks. The shear cracks continued to widen as the load increased. After the release of load, the flexural cracks suddenly disappeared and the shear cracks were diminished.

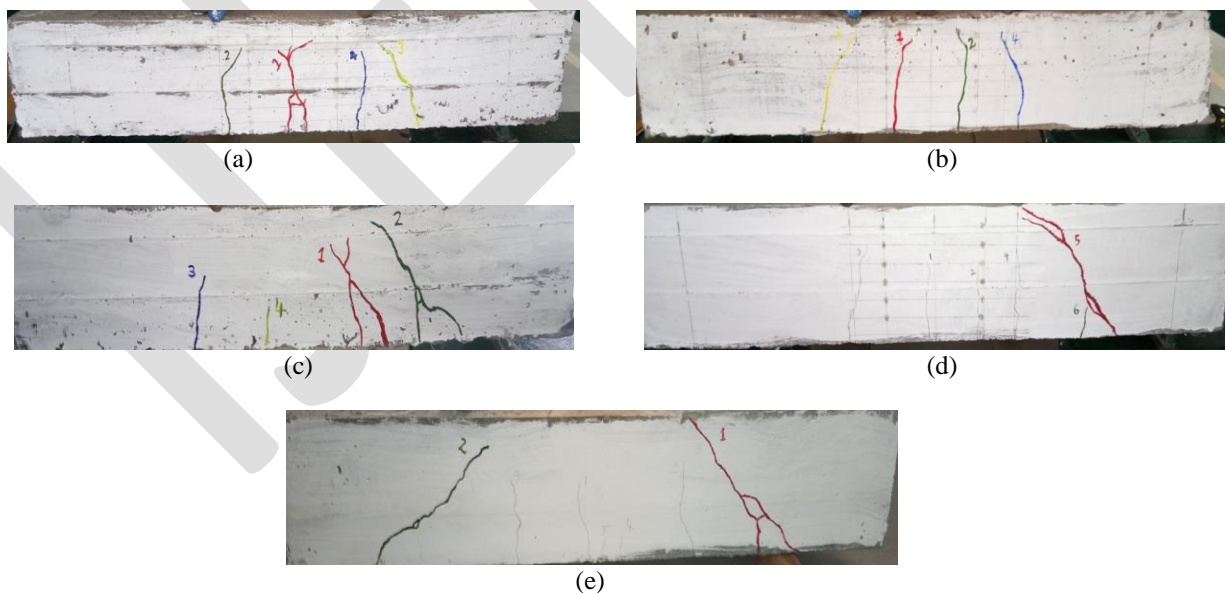


Fig.4 Crack patterns of beams: (a) NS130; (b) SS130; (c) SBS125; (d) SBSB125; (e) SBB125

## E. Comparison between Experimental and Predicted Shear Strength

The shear strength of the BFRP RC-beams were predicted using the shear design provisions of the ACI 440.1R (ACI 2006), CSA S806 (CSA 2012), ISIS 2007 and the shear strength equation based on the modified compression field theory (MCFT) developed by Hoult et al. (2008). Table VII shows a summary of the shear strength prediction equations for the shear capacity in concrete and the shear capacity in FRP stirrups. The ratio of experimental to predicted shear strength values was calculated for each specimen in the database. The results are shown in Table VIII. It can be seen that all of the design methods provide conservative predictions of the shear strengths of the tested beams ( $V_{exp} / V_{pred} > 1$ ). The experimentally obtained shear strength is more than all predicted values.

TABLE VII  
SHEAR CAPACITY PREDICTION METHODS FOR CONCRETE REINFORCED WITH FRP [7]

Prediction methods	Shear capacity in concrete. $V_c$ (N)	Shear capacity in FRP stirrups, $V_s$ (N)
ACI 440.1R (2006)	$V_s = \frac{2}{5} \sqrt{f'c} b c$ <p>Where <math>c = k d</math></p> $k = \sqrt{2 \rho_f n_f (\rho_f n_f)^2 - \rho_f n_f}$	$V_s = \frac{A_{fv} f_{fv} d}{s}$ <p>Where <math>f_{fv} = 0.004 E_f \leq f_{fb}</math></p>
CSA S806 (2012)	$V_c = 0.05 \lambda k_m k_r k_a \sqrt{f'c} b d \text{ for } d \leq 300 \text{ mm}$ $0.11 \phi \sqrt{f'c} b d \leq V_c \leq 0.2 \phi \sqrt{f'c} b d$ $f'c \leq 60 \text{ MPa}; k_m = \sqrt{V_f d / M_f}$ $k_r = 1 + \sqrt[3]{E_f \rho_f}$ $k_a = (2.5 V_f d) / M_f \text{ for } a/d < 2.5$	$V_s = \frac{A_{fv} f_{fv} d_v}{s} \cot \theta$ $\theta = 30 + 7000 \epsilon_x$ $\epsilon_x = \frac{M_f / d_v + V_f + 0.5 N_f}{2 E_f A_f}$ $d_v = 0.9 d \text{ or } 0.72 h$
ISIS (2007)	$V_c = 0.2 \lambda \sqrt{f'c} b d \sqrt{\frac{E_f}{E_s}}$	$V_s = \frac{A_{fv} f_{fv} d_v}{s} \cot \theta$ $f_{fv} = E_{fv}; d_v = 0.9 d$ $\epsilon_{fv} = 0.001 \sqrt{\frac{f'c \rho_{ft} E_{ft}}{\rho_{fv} E_{fv}}} \left[ 1 + 2 \left( \frac{\sigma_v}{f'c} \right) \right] \leq 0.0025$
MCFT (Hoult et al. 2008)	$V_c = \frac{0.30}{0.5 + (1000 \epsilon_x + 0.15)^{0.7}} \frac{1300}{(1000 + s_{xe})} \sqrt{f'c} b d_v$ $\epsilon_x = \frac{(M_f / d_v) + V_f}{2 E_f A_f}$ $s_{xe} = \frac{31.5 d}{16 + a_g} \geq 0.77 d$	$V_s = \frac{A_{fv} f_{fv} d_v}{s} \cot \theta$

**TABLE VIII**  
**EXPERIMENTAL AND PREDICTED RESULTS**

Beam	Test Result (MPa)	FRP design codes and theory							
		ACI 440.1-06		CSA S806-12		ISIS-07		MCFT (Hoult et al. 2008)	
		Predicted (MPa)	Test/Predicted	Predicted (MPa)	Test/Predicted	Predicted (MPa)	Test/Predicted	Predicted (MPa)	Test/Predicted
SBS125	0.89	0.47	1.89	0.7	1.27	0.64	1.39	0.58	1.53
SBSB125	0.92	0.46	2	0.68	1.35	0.62	1.48	0.57	1.61
SBB 125	0.95	0.45	2.04	0.67	1.42	0.61	1.56	0.56	1.7

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## CONCLUSIONS

The shear behaviour of concrete beams reinforced with BFRP longitudinal bars and with steel and BFRP shear reinforcement has been presented in this study. Fifteen beams were tested for shear strength. The beams were reinforced with same BFRP reinforcement ratios and same shear span to depth ratios. The following conclusions can be made from this study:

1. The load carrying capacity of BFRP reinforced beams is more than the conventional beams.
2. Shear capacity of SBB125 is more than the other BFRP reinforced beams.
3. Crack pattern is different in all beams and for BFRP RC beams shear cracks are detected mainly, they are seen at the supports. After the release of load the flexural cracks formed are suddenly disappeared and the shear cracks are diminishing proving the elastic property of basalt rebars. This property is useful for the construction of structures in the earthquake prone areas
4. Deflection of the beam increases with the replacement of steel with BFRP. It can take more loads without much deflection.
5. The experimentally obtained values are more than the predicted values by design codes and theory. All of the design methods provide conservative predictions of the shear strengths of the tested beams ( $V_{exp} / V_{pred} > 1$ ).

The shear failure can be eliminated by using more shear reinforcements at the supports. Shear capacity can be increased by using shear reinforcements having smaller diameter and also by using more longitudinal reinforcements.

## NOTATIONS

$A$  = area of longitudinal reinforcement ( $\text{mm}^2$ );  
 $a_g$  = aggregate size (mm);  
 $b$  = width of cross section (mm);  
 $d$  = distance from extreme fiber in compression to centre of reinforcement (mm);  
 $d_v$  = effective shear depth (taken as the greater of  $0.9d$  or  $0.72h$ );  
 $E$  = modulus of elasticity of longitudinal FRP reinforcement (MPa);  
 $E_s$  = modulus of elasticity of longitudinal steel reinforcement (MPa);  
 $f'_c$  = concrete compressive strength (MPa);  
 $f_u$  = ultimate tensile stress in longitudinal reinforcement (MPa);  
 $M_f$  = factored moment applied (kNm);  
 $N_f$  = factored axial load applied (kN);  
 $s_{ze}$  = crack spacing (mm);  
 $V_c$  = shear strength of concrete (kN);  
 $V_{exp}$  = experimental shear force (kN);  
 $V_f$  = factored shear force (kN);  
 $V_s$  = shear strength of transverse reinforcement (kN);  
 $\lambda$  = factor for concrete density (taken  $\frac{1}{4}$  1 in this study);

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# Experimental Study on the Behaviour of Spirally Reinforced SCC beams

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**Abstract**— Normally, shear reinforcement of concrete beams consists of traditional stirrups. Replacing the individual stirrups by a continuous spiral can reduce the labour cost for production of the reinforcement cage and improves the shear capacity and ductility in beams. In this paper the use of spiral shear reinforcement in Self Compacting Concrete (SCC) is investigated by testing of 12 reinforced concrete beams in a static two-point bending test. Further, 12 additional beams with an advanced rectangular spiral reinforcement that has shear-favourably inclined vertical links is also presented and tested as shear reinforcement.

In this paper the shear span to depth ratio is kept constant as 1.952 and four spacing (80, 100, 120, 150 mm) are adopted. During the tests, crack evolution is monitored, and the fracture mechanisms of the beams are analysed and compared. The behavior of the shear-critical beams is studied through the load–deflection curves, ultimate load values, vertical deflections measurements and crack propagation during static tests.

Test results clearly indicate that using rectangular spiral shear reinforcement improved the shear capacity and ductility of beams compared with traditional individual closed stirrup beams. Furthermore, the results showed that SCC yields a more favourable critical crack evolution compared to CVC (Conventional Vibrated Concrete).

**Keywords**— Self Compacting Concrete (SCC), Spiral reinforcement, Shear failure, Beam, Crack pattern, Shear-critical beams.

## INTRODUCTION

The use of self-compacting concrete (SCC) is steadily increasing, mainly in the precast industry, and a large amount of research has been conducted on the fresh and hardened properties of SCC. However, relatively little research has been carried out on the structural behaviour of SCC.

In comparison with a vibrated concrete (VC) of the same strength class, self-compacting concrete (SCC) typically has a lower coarse aggregate content and, possibly, a smaller maximum aggregate size. This may result in reduced aggregate interlock between the fracture surfaces of a SCC. Since aggregate interlock plays an important role in the shear strength of slender beams, SCC beams may have shear strength lower than that of similar VC beams, but studies on that subject are still limited. By the use of small percentage of transverse reinforcement the shear capacity of beams can be increased.

All reinforced concrete beams require shear reinforcement, calculated or minimum ratio. Theoretically, calculated shear reinforcement is only required when the externally applied shear force  $V$  exceeds the design shear resistance of the member without shear reinforcement. However, for various reasons, including avoiding brittle fracture, minimum shear reinforcement should be provided. Both minimum and calculated shear reinforcement is in the shape of vertical or inclined individual stirrups.

The use of continuous spiral reinforcement can be considered more effective in construction compared to individual vertical stirrups due to the fact that the spiral reinforcement is made of spirally shaped cage that can be quickly installed into place which reduces the time and labour costs significantly. The spiral reinforcement enhances the strength and ductility capacity due to the confining of concrete core.

Reinforced concrete column-beam joints, columns and in filled frames with rectangular members and rectangular spirals as shear reinforcement have already been tested under cyclic loading. The experimental results of these tests showed that the spiral reinforcement improved the overall seismic performance and increase maximum loading energy absorption and ductility capabilities of beam column joints [19,20].

Recently the use of rectangular continuous spiral reinforcement in reinforced concrete beams with rectangular cross sections has been studied. De Corte and Boel [12] tested 24 beams to assess the effectiveness of using spiral reinforcement in beams. The results showed that spiral reinforcement performs equally well compared to individual stirrups, and the self-compacted concrete yields a better critical crack evolution compared to conventional concrete. They recommend that more tests are required to establish boundaries for the inclination angle and the type of concrete used.

Considering the behaviour of shear critical members, it is stressed that the shear failure of RC beam is characterized by the inclination of the diagonal cracking. It has been proved that the amount of the steel stirrups along with the amount of the steel stirrups along with the amount the main tension reinforcement and the span-to-depth ratio control the inclined shear cracking [21]. It is stressed that common continuous spiral reinforcement comprises of two vertical links with opposite inclination and therefore, only one of these links has the right inclination to resist against the applied shear.

## **SIGNIFICANCE OF THE WORK**

### **A. Scope of the Work**

The earlier studies reveals that using rectangular continuous spiral reinforcement in reinforced concrete beams is a new promising technology that could enhance the shear strength of beams as well as the ductility.

Beams with advanced spiral which have shear favourable inclined vertical links are proposed in the present study to check the shear capacity as well as improved ductility performance.

### **B. Objective of the Work**

The objective is the introduction of continuous rectangular reinforcement and advanced spiral reinforcement for reinforcing the concrete structures other than normal vertical steel stirrup and to check the shear capacity of such beams compared with conventional steel beams.

### **C. Methodology**

The methodology of the work consists of:

- (1) Selection of self compacting concrete grade; S25
- (2) Mix design for S25 grade SCC
- (3) Casting beam specimens of normal RC beams, Normal SCC beams, Continuous spiral reinforcement and advanced spiral reinforcement.
- (4) Conducting three point loading test using 50t loading frame.
- (5) Study on the obtained results

## **MATERIAL TESTS**

The materials selected for S25 mix were OPC (Ordinary Portland Cement) 53 grade BHARATHI CEMENTS, fly ash collected from Coimbatore, M sand as fine aggregate, 20 mm size coarse aggregates, water and Master Glenium SKY 8233 as admixture. Each material except the admixture was tested as per the specifications in the relevant IS codes. The results are provided in Table I. The beam is reinforced with continuous rectangular spiral reinforcement. There were 4 groups of reinforcement pattern according to the

spacing provided (SP80, SPA80, SP100, SPA100, SP120, SPA120, SP150, SPA150). The first part indicates the type of reinforcement pattern, SP indicating continuous spiral, SPA indicating the advanced spiral and the numerical part indicating the pitch spacing.

TABLE I  
MATERIAL TEST RESULTS

Test	Material	Equipment Used	Values Obtained
Specific Gravity	Ordinary Portland Cement	Le-Chatelier Flask	3.15
Specific Gravity	Fine Aggregates	Pycnometer	2.7
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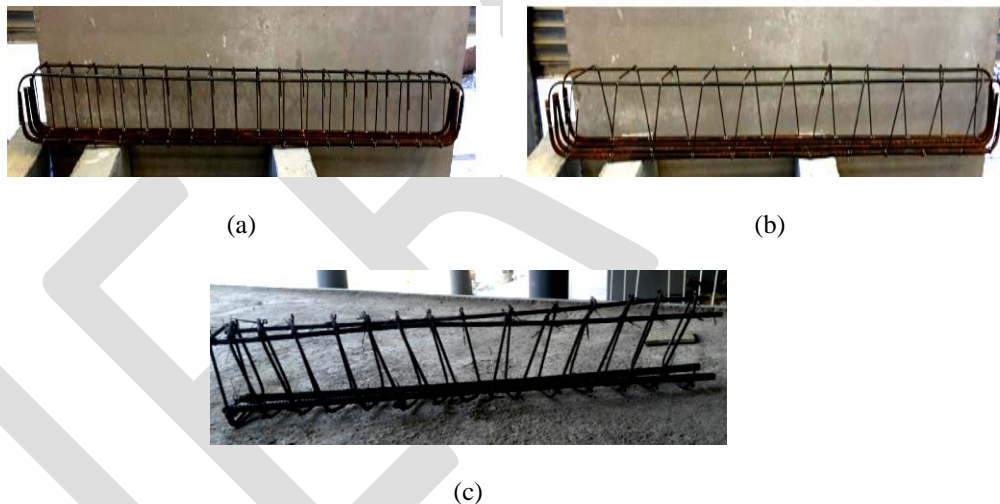


Fig. 1 (a) traditional vertical stirrup, (b) continuous spiral reinforcement, (c) advanced spiral reinforcement

## MIX DESIGN

Many different test methods have been developed in attempts to characterize the properties of SCC. So far no single method or combination of methods has achieved universal approval and most of them have their adherents. Many trial mixes were prepared and comparing the test results with the standard values. Mix proportioning values are given in Table II.

TABLE II  
S25 MIX PROPORTIONING

Cement (Kg/m <sup>3</sup> )	561
-----------------------------	-----

Fly ash	99
Fine aggregate (kg/m <sup>3</sup> )	1055.275
Coarse aggregate (Kg/m <sup>3</sup> )	623.158
Water (l/m <sup>3</sup> )	167.45
Water cement ratio	0.2537
Mix ratio	1:1.6:0.9

## EXPERIMENTAL INVESTIGATION

### A. Experimental Procedure

Thirty, 1250 mm long, concrete beams with a 150 × 200 mm was included in this experimental investigation. Six beams were casted as control specimens with vertical steel stirrups using M25 mix and S25 mix. Details of specimens cast are shown in Table IV. Four sets of beams were made up of using Continuous spiral reinforcement and each set with spacing 80 mm, 100 mm, 120 mm, 150 mm. Further, another Four sets of beams with Advanced spiral reinforcement with the same spacing as discussed above were cast. The steel RC beams were designed as per IS 456:2000 specifications. The main lower reinforcement was 2-12 mm in diameter and 6 mm diameter stirrups for all beams.

All beams were casted using Self Compacting Concrete. The beams were cured using jute bags with room temperature for 28 days. The compressive strength of the concrete mix was measured after 28 days using standard cubes. The mean compressive strength for the mix was 27.6 MPa.

TABLE III  
DETAILS OF SPECIMENS CAST

Sl. No:	Number Of Beams	Designation Used	Flexure bar type	Shear reinforcement type	Spacing Adopted
1	3	SP80	HYSD Steel	Mild Steel	80
2	3	SPA80	HYSD Steel	Mild Steel	80
3	3	SP100	HYSD Steel	Mild Steel	100
4	3	SPA100	HYSD Steel	Mild Steel	100
5	3	SP120	HYSD Steel	Mild Steel	120
6	3	SPA120	HYSD Steel	Mild Steel	120

7	3	SP150	HYSD Steel	Mild Steel	150
8	3	SPA150	HYSD Steel	Mild Steel	150

SP- Continuous spiral

SPA-Advanced spirals

## B. Test Procedure

The shear strength of the specimens was tested using a 50 ton loading frame. A dial gauge was attached at the bottom of the beam to determine the deflection at the centre of the beam. The effective span of the beam is taken as 990mm in the case of 1250mm beam. A proving ring of 500kN is connected at the top of the beam to determine the load applied.

The shear strength of the beam is tested as a three point loading system using a hydraulic jack attached to the loading frame. The behaviour of beam was observed from beginning to the failure. The loading was stopped when the beam was just on the verge of collapse. The first crack propagation and its development and propagation were observed. The values of load applied and deflection were noted. The load in kN is applied with uniformly increasing the value of the load and the deflection under the different applied loads is noted. The applied load increased up to the breaking point or till the failure of the material.

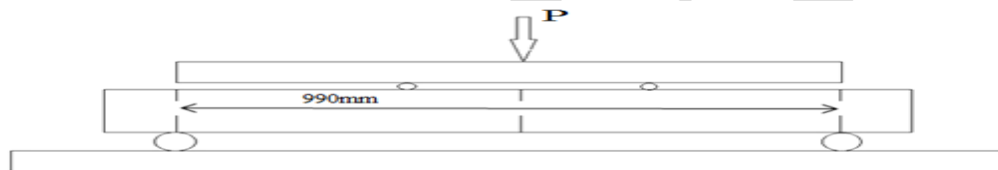


Fig.2 Schematic Set Up of Testing

## EXPERIMENTAL RESULTS

### A. Load Deflection Behavior

Due to increase in the load, deflection of the beams starts, up to certain level the load v/s. deflection graph will be linear that is load will be directly proportional to deflection. Due to further increase in the load, the load value will not be proportional to deflection, since the deflection values increases as the strength of the materials goes on increasing material loses elasticity and undergoes plastic deformation.

The deflection and the corresponding load, of SCC beam with spiral and advanced spiral reinforcement is compared with normal RCC and SCC beams with vertical stirrups

The load values and corresponding deflection of normal RCC beam (CS), SCC beams with vertical stirrups, beams with spiral and advanced spiral reinforcement is given in Table IV.

Flexural cracks and shear-flexural cracks were formed in the mid-span and quarter span respectively of all the tested beams. No shear failure of the beam was observed since the loading was limited. The maximum load values ( $P_{max}$ ) and maximum vertical deflection ( $\delta_{max}$ ) at midspan is given in table 6.1 and observed that the maximum load is carried by the beams with advanced spirals with spacing 120 mm.

TABLE IV  
DEFLECTION AND CORRESPONDING LOAD

Deflection	Load									
Mix	M25	S25	SP 80	SPA 80	SP 100	SPA100	SP 120	SPA120	SP 150	SPA150
0.1	8.15	16.3	33.415	49.715	50.54	53.56	54.667	56.668	51.98	52.612
0.2	32.6	40.75	73.35	97.8	164.63	174.7	185.89	225.73	158.34	179.58
0.3	65.2	74.98	107.58	163	185.67	213.6	211.9	230.85	173.76	217.85
0.4	91.28	100.25	133.66	228.2	197.23	220.16	261.62	246.75	220.93	237.6
0.5	130.4	138.55	172.78	250.8	236.35	255.77	279.55	269.95	250.36	265.5
0.6	171.15	173.6	197.23	268.95	255.5	275.25	270.58	287.92	257.89	275.7

Fig.3 and 4 indicates the load-deflection curve of spirals and advanced spirals respectively. The test results clearly indicates that using rectangular spiral reinforcement increases the maximum load that the beams can sustain compared with the control beams. In figure 6.1 and 6.2 performance is best followed by SP 120 and SPA 120 regarding maximum load and ductility. Beams with spiral reinforcement nominal spacing 120mm exhibited around 55% increase in load carrying capacity with respect to control beams with closed stirrups. Beams with spiral reinforcement at nominal spacing 150 mm exhibited an increase in load bearing capacity of 48% when compared with control beams with closed stirrups.

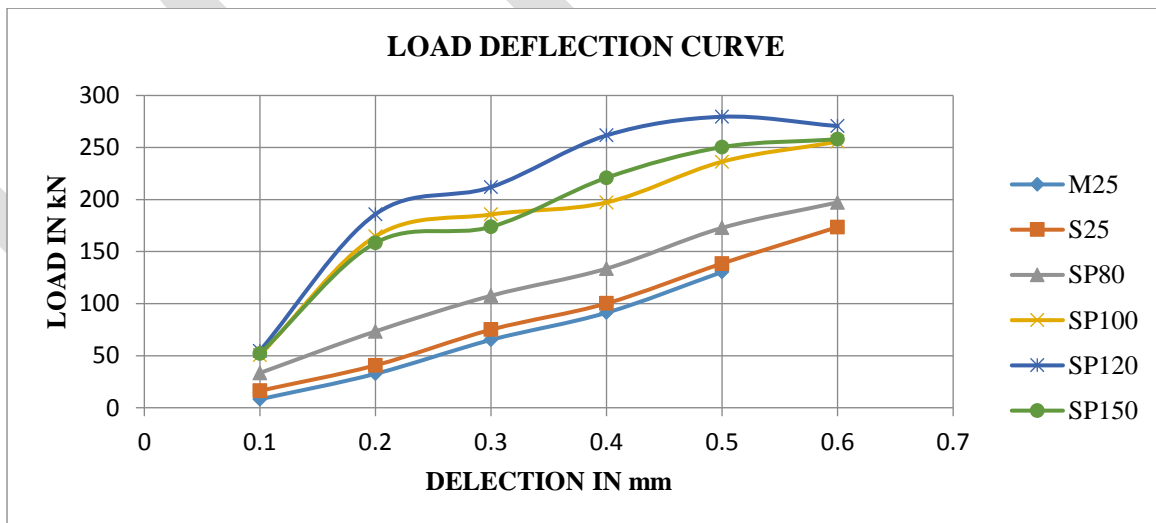


Fig.3 Load - deflection curve of Continuous Spiral reinforcement

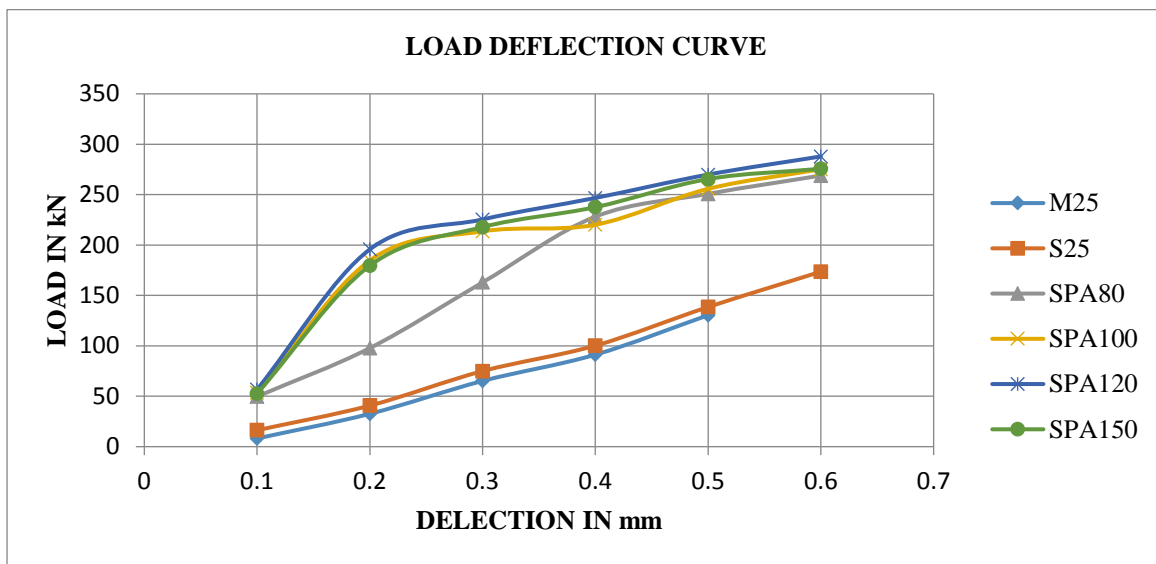


Fig.4 Load - deflection curve of Advanced Spiral reinforcement

## B. Load Carrying Capacity

TABLE V  
ULTIMATE LOAD OF BEAMS

Beam Specimen	Ultimate Load (kN)
SP80	197.23
SPA80	268.95
SP100	255.5
SPA100	275.25
SP120	270.58
SPA120	287.92
SP150	257.89
SPA150	275.7

It's concluded that there is also an improvement in shear for beams with rectangular continuous spiral reinforcement. The improvement in shear capacity and ductility are mainly attributed to the fact that the continuous spiral have favourable inclination to applied shear and meet the potential shear cracks.

Incase of traditional stirrups, the developed axial force in the stirrups is a function of the observed shear angle. whereas, the developed axial force in the spiral stirrups is a function of the observed shear angle and the inclination angle of the spirals. It's also concluded that the spiral reinforcement increases the compressive strength of concrete through enhancing the confinement of the concrete.

The most favourable inclination angle was found to be  $80^\circ$ . This inclination angle provides the optimistic inclination of the front legs and the back legs to the imposed shear and thus expected to meet the potential shear crack normally. On the other hand, if the inclination angle of spiral reinforcement is under  $80^\circ$ , only one set of rectangular spiral legs would have favourable inclination to the applied shear.

### C. Ductility

Evaluation of the experimental results in terms of middle span deflection ductility in order to check the efficiency of applied rectangular spiral reinforcement in the post-peak behaviour of the beams is done. Although shear critical beams exhibit brittle behaviour in this study, the deformation ductility factor  $\mu_{u80}$ , has been employed in order to examine the post-peak behaviour of the spirally reinforced beams. This factor is defined by the following relationship:

$$\mu_{u80} = \frac{\delta_{peak}}{\delta_{u80}}$$

$\delta_{u80}$  = post-peak deformation at the point where the remaining strength is equal 80% of the observed peak strength and

$\delta_{peak}$  = the deformation at the observed ultimate shear strength

The values of the deformation ductility factor,  $\mu_{u80}$ , of the tested beams are presented in table 6.2. The purpose of the use of this index is just to examine quantitatively if the spiral reinforcement could provide some flexural characteristics to the shear critical beam. From these values its observed that, the increase in amount of the shear reinforcement causes an improvement in the behaviour after the peak load. This enhancement seems to be more apparent in the beams with transverse reinforcement spacing at 80 mm. although all the tested beams are shear-critical beams and no ductility would be expected, the spirally reinforced beams with advanced spirals and shear favourably inclined links exhibited some flexural characteristics, demonstrating this way an improved post peak behaviour. The values of displacement ductility factor should be within the range of 3-5.

TABLE IV  
DUCTILITY FACTOR

MIX	M25	SCC25	SP80	SPA80	SP100	SPA100	SP120	SPA120	SP150	SPA150
$\delta_{peak}$	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
$\delta_{u,80}$	0.26	0.18	0.24	0.2	0.26	0.22	0.28	0.26	0.26	0.24
$\mu_{80}$	2.31	3.33	2.50	3.00	2.3	2.73	2.14	2.31	2.31	2.50

### D. Crack Pattern

Regarding the overall performance of the tested beams with spiral reinforcement, the first flexural cracks were formed at bottom surface in the maximum moment region at the midspan of the beams when the applied load was approximately 100 kN that is approximately 50 kN. As the applied load increased, the cracks began to spread out through the length of the beams and became gradually inclined towards the neutral axis of the beams. These values vary among different beams depending on transverse reinforcement ratios ( $\rho_t$ ) and spacing of the stirrups for each group. Due to the limitation of the capacity of loading frame, the loading was stopped before 300 kN and the shear failure which was anticipated didn't occur.

Monitoring of the crack pattern for traditional stirrups and spirals reveals that the crack pattern during static tests could be considered identical and failure mechanism is identical. These findings support the effectiveness of using rectangular continuous spiral.

## ACKNOWLEDGMENT

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## CONCLUSIONS

Thirty RCC beams were tested using a static four-point bending set-up to study the effect of using continuous rectangular spiral reinforcement as transverse reinforcement. The behaviour of shear critical beams was studied through monitoring the load-deflection curve, ultimate load values and crack propagation during static tests. The results showed that using rectangular spiral shear reinforcement improved the shear capacity and the ductility of beams compared with traditional individual closed stirrups beams regardless of pitch spacing and inclination angle of stirrups. Beams with spiral reinforcement spacing at 120 mm exhibited 55% increased capacity with respect to the beams with stirrup. Furthermore beams with advanced spiral spacing 120 mm exhibited 65% increased load carrying capacity. The crack pattern for traditional stirrups and spiral beams were identical and the failure mechanism was practically equal.

Moreover, a middle span deflection ductility index has been adopted in order to evaluate the efficiency of the spiral reinforcement in the post-peak part of the tested shear-critical beams. The beams with advanced spirals with spacing 80 mm exhibited higher deformation ductility value of 3, demonstrating this way improved post-peak deformation capacity compared to the beams with equal quantity of commonly used stirrup.

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# An Ultra-Wide-Band 2.66 - 3.75 GHz LNA in 0.18- $\mu$ m CMOS Radio Frequency

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**Abstract**— An Ultra-Wide-Band Low Noise Amplifier is designed in this work. The designed LNA is of two stages that may be used in various applications in communication systems. The designed LNA is simulated by HSPICE in 0.18- $\mu$ m CMOS Radio Frequency technology. This LNA has a gain of 20 dB which stays there from 3.06 GHz to 3.21 GHz and noise figure of 3.78 dB. HSPICE simulation shows the bandwidth as 1.09 GHz with a center frequency at 3.13 GHz. It consumes 13.4150 mW from a 1.8 V supply and has a 1 dB compression point of -16.2 dBm. Characterization of the designed LNA exhibits a high gain and considerably low noise figure with good impedance matching.

**Keywords**— LNA, CMOS\_RF, Circuit and Systems, HSPICE, High Gain, S Parameters, Noise Figure & 1-dB compression point.

## INTRODUCTION

Wireless communication system has been a very important and convenient way of communication for quite a long time. In recent years, in order to add some improvements in the system, the demand for high speed and high data rate wireless communication is increasing day by day. For IEEE 802.11b [1] and 802.11g standards [2] the operation frequency is 2.4 GHz with data rate 11 and 54 Mbps respectively [3]. At present, ultra-wide band (UWB) systems are emerging wireless technology capable of transmitting data over a wide frequency band for short ranges, which have the advantages of low power but at a superior data rate. The allocated band of UWB (IEEE 802.15.3a) is between 3.1 to 10.6 GHz [4]. For a wireless front-end, a wide-band low-noise amplifier (LNA) is critical in spite of the receiver architecture. The amplifier must meet quite a number of inflexible requirements such as - broadband input matching in order to minimize the return-loss, sufficient gain to suppress the noise of a mixer, low noise-figure (NF) to improve receiver sensitivity, low power consumption to increase battery-life and small die area to reduce the expense. There are several techniques available to UWB LNAs in literature [3]-[12]. However, there are certain limitations of these topologies. For example, the conventional distributed amplifier suffers from high power consumption [5]. Resistive feedback is a well-known wide-band technique used in wide-band amplifiers, but it is hard to satisfy the gain and noise requirements simultaneously. [6] Another solution is to embed the input network in a multi-section reactive network so that the overall input reactance is resonated over a wider bandwidth [4]. Although this filter type topology achieves wide-band matching, low power consumption and can suppress the high frequency variation depending on the technology; the insertion of filter adds noise at low frequency. On the contrary, NF grows hastily at higher frequency for CMOS technology. So to get desirable matching condition, inductor modeling in the filter must be accurate enough, or else, the bandwidth and flatness will be degraded.

So to overcome all these drawbacks, an UWB LNA is presented with the common gate in first stage and common source-common gate in second stage cascaded together. It needs only two inductors and a few resistances and the wide-band matching condition is achieved with low power consumption.

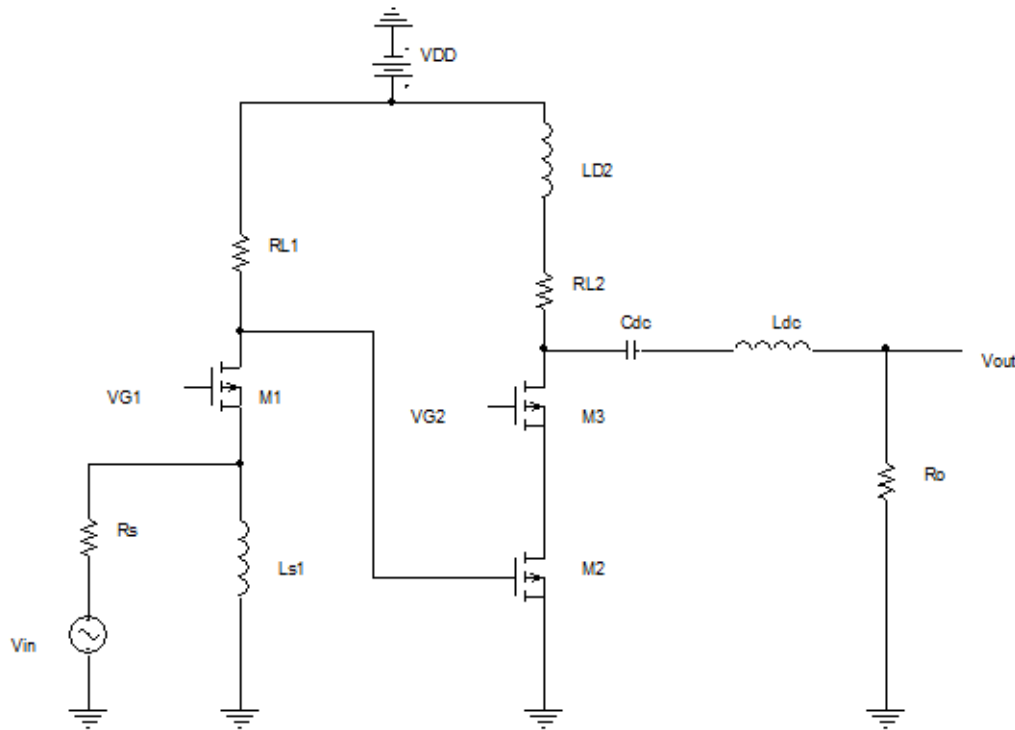


Figure 1 : Proposed UWB

## CIRCUIT DESIGN

The designed circuit is two-staged consisting of a common-gate model and a common source-common gate configuration. It has been designed with three NMOS:  $M_1$ ,  $M_2$  and  $M_3$ . The input common-gate is there for providing wide-band input matching. It is the first stage of the model. It also provides power matching for the circuit. It offers a good input matching with the source. If we neglect the loading effect of the second stage and the parasitic resistance of input inductor ( $L_{S1}$ ), the input impedance can be represented as follows:

$$Z_{in} = \frac{sL_{S1}}{1 + (g_{m1} + sC_{gs1})sL_{S1}} \dots\dots\dots(1)$$

Here,  $g_{m1}$  is the transconductance and  $C_{gs1}$  is the gate to source capacitance of the transistor  $M_1$ . From the equation, it is clear that, there is a zero near DC which determines the low 3-dB frequency. The input inductor  $L_{S1}$ , at low frequency, gives very little impedance to ground. As a result,  $Z_{in}$  is dominated by  $L_{S1}$  and the value is negligible (almost zero). The chosen value of  $L_{S1}$  for this model is 8.3 nH. Even though the common-gate stage gives a wide-band input matching, it compensates with a narrow-band frequency response. The transfer function represented by the first stage is given as:

$$\frac{V_{D1}}{V_{in}} = \frac{(1 + g_{m1}r_{o1})R_{L1}}{(1 + \frac{R_S}{sL_{S1}} + sR_S C_{gs1})(r_{o1} + R_{L1}) + (1 + g_{m1}r_{o1})R_S} \dots\dots\dots(2)$$

While designing, size of  $M_1$  is a special concern for proper input matching. Even the value of  $R_{L1}$  is critical here, since it determines the gain and gate bias for the first and second stages respectively. The best match was 280  $\Omega$  for fulfilling these entire requirements and it was accepted for the model.

A simple cascaded common source-common-gate is the second stage of the model. It offers high frequency gain and determines higher 3-dB bandwidth for the LNA.  $M_3$ , the cascode transistor, is used for better isolation, higher frequency response and higher gain. A series of peaking inductor  $L_{D2}$  of 10 nH is resonant with the total parasitic capacitance  $C_{D3}$  at the drain of  $M_3$ , which is around 10 GHz [9]. The transfer function for this stage is expressed as:

$$\frac{V_{D2}}{V_{D1}} = g_{m2} \times \left[ (g_{m3} \bullet r_{o3} \bullet r_{o2}) // \left( \frac{R_{L2} \left[ s \left( \frac{L_{D2}}{R_{L2}} \right) + 1 \right]}{s^2 L_{D2} C_{D3} + s R_{L2} C_{D3} + 1} \right) \right] \dots\dots\dots(3)$$

In order to keep the parasitic capacitance lower, the cascode device  $M_3$  is chosen to be smaller. The Q factor (quality factor) of the inductors for the LNA should be kept as high as possible in order to ensure high gain, narrow-band characteristics. However, in this design, the Q factor of  $L_{D2}$  is used for the flat gain of whole LNA. As a result an extra resistor  $R_{L2}$  of  $50 \Omega$  is added to reduce the Q factor.

For blocking any unwanted dc current, a series connection of a dc blocking capacitor of  $180 \text{ fF}$  ( $C_{dc}$ ) and an inductor of  $0.05 \text{ nH}$  ( $L_{dc}$ ) is used. A  $100 \text{ k}\Omega$  resistor ( $R_o$ ) is used in parallel for making the output open.

## RESULT

The simulated result of the designed LNA is shown in the below section.

S-parameters are shown in fig. 4.  $S_{11}$  curve of our LNA remains always negative. From  $1.39 \text{ GHz}$  onward it remains under  $-10 \text{ dB}$  point. Lowest value is  $-23.1 \text{ dB}$  at  $3.1 \text{ GHz}$  and  $4.15 \text{ GHz}$ . At  $3.13 \text{ GHz}$ , which is the center frequency, value of  $S_{11}$  curve is  $-23 \text{ dB}$  means perfect input matching.  $S_{11}$  should be below  $-10 \text{ dB}$  for perfect input matching.

$S_{12}$  curve is also negative and below  $-47 \text{ dB}$  at all times.  $S_{12}$  means input-output isolation. It becomes stable after  $3 \text{ GHz}$  and the value under stable condition is  $-51 \text{ dB}$ . At center frequency ( $3.13 \text{ GHz}$ ) this value is  $-52.2 \text{ dB}$  means high input-output isolation.

$S_{21}$  means the gain of the amplifier.  $S_{21}$  curve becomes positive after  $1.2 \text{ GHz}$  and stays above  $10 \text{ dB}$  point from  $2.04 \text{ GHz}$  to  $5.41 \text{ GHz}$ . The curve reaches its highest peak,  $20 \text{ dB}$  and stays there from  $3.06 \text{ GHz}$  to  $3.21 \text{ GHz}$ . We succeeded to achieve considerably high gain, but we had to compromise the bandwidth which is  $1.09 \text{ GHz}$  starting from  $2.66 \text{ GHz}$  to  $3.75 \text{ GHz}$ .

Output matching parameter ( $S_{22}$ ) curve is always negative. It is under  $-5 \text{ dB}$  from  $2.81 \text{ GHz}$  to  $3.4 \text{ GHz}$ . Lowest values of the curve is  $-10 \text{ dB}$  at  $3.1 \text{ GHz}$ . At center frequency it has a value of  $-9.85 \text{ dB}$ .

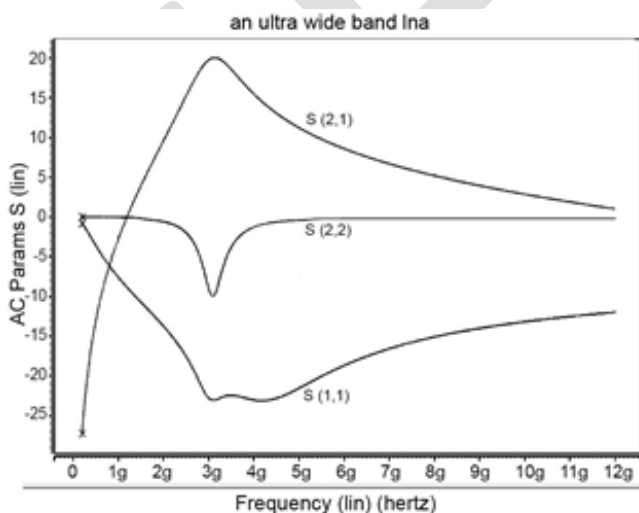


Figure 2: Simulation results for  $S_{11}$ ,  $S_{12}$ ,  $S_{22}$

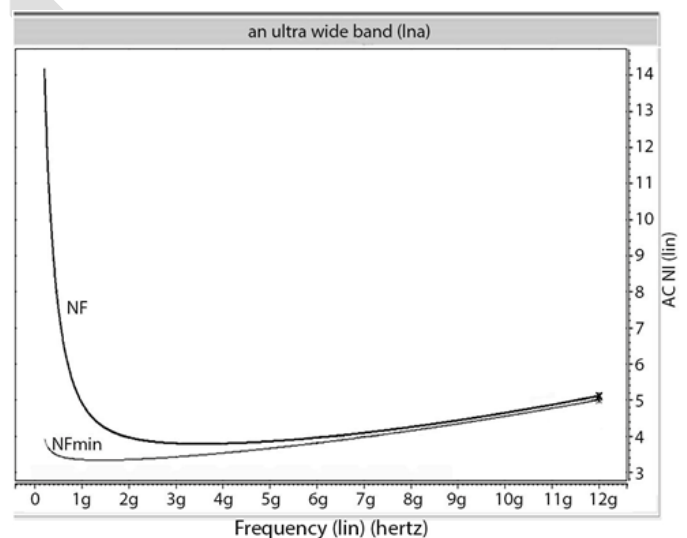


Figure 3:  $NF$  and  $NF_{min}$

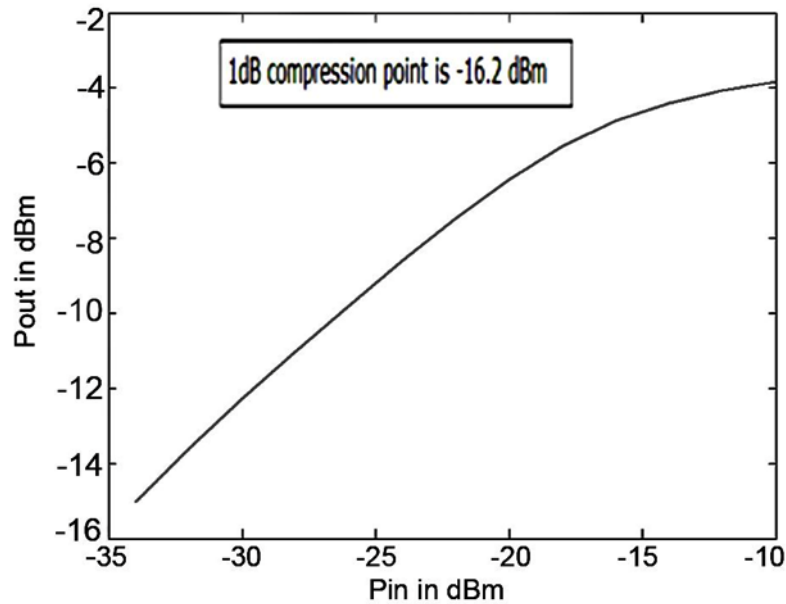


Figure 4: 1 dB compression point

Due to common-gate characteristics the NF does not rise in higher frequencies. The noise figure remains below 4 dB from 1.88 GHz to 6.43 GHz. Lowest value is 3.78 dB which starts from the center frequency (3.13 GHz) and stays constant till 3.97 GHz. Minimum noise figure is below 3.5 dB starting from 428 MHz to 3.7 GHz. Its lowest value is 3.13 dB at 1.4 GHz. At center frequency the value is 3.44dB.

Linearity of an amplifier is measured using 1-dB compression point. 1 dB compression point of the LNA is calculated to measure linearity of the circuit. The measured 1 dB compression point is -16.2 dBm. The power consumption can be considered reasonable which has a value of 13.4150 mW.

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#### CONCLUSION

An ultra-wide band (UWB) CMOS low noise amplifier (LNA) has been implemented in a 0.18  $\mu\text{m}$  CMOS<sub>RF</sub> process. The measured peak power gain is 20 dB and NF is 3.85 - 3.78 dB with 3 dB bandwidth of 2.66 - 3.75 GHz. Here input matching is below -17 dB between the bandwidth region and -23.1 dB at center frequency while the output matching is -10 dB at center frequency. The 1 dB compression point is -16.2 dBm. The designed LNA has the following advantages compared to other broad-band techniques: less design complexity, low noise, low power dissipation and high gain.

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# The Lean thinking approach: Implementation in Moroccan engineering education

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**Abstract:** In the context of the global economic crisis, Moroccan engineering education is expected to meet increased performance requirements using limited resources (budget, materials, staff, and buildings). Considerable efforts have been devoted recently to develop high education performance in Morocco. The purpose of this study is firstly to identify some of these efforts. Thereafter, we have presented a brief overview of lean thinking principles and their implementation approach on Moroccan engineering education improvement.

**Keywords:** Moroccan engineering education, performance, limited resources, lean thinking, implementation, approach, improvement

## 1. INTRODUCTION

Engineering education success is becoming a major driver of competitiveness in a knowledge-driven economy. Engineering graduates learn to apply scientific principles to develop product and process that contribute to promote sustainable development, national security, resource management, innovation technologies and economic growth. In this way Morocco has devoted special efforts to perform high education quality.

Engineering education system contains a set of processes that can be optimized in order to improve schools performance while saving costs and eliminating wastes.

Lean thinking is a manufacturing philosophy to reduce costs by eliminating non-value added activities. It is not only applied in manufacturing, but also can be applied in any kind of organization to achieve high performance levels. This paper presents lean principles, goals and benefits. It also describes the implementation approach of lean thinking in Moroccan engineering education.

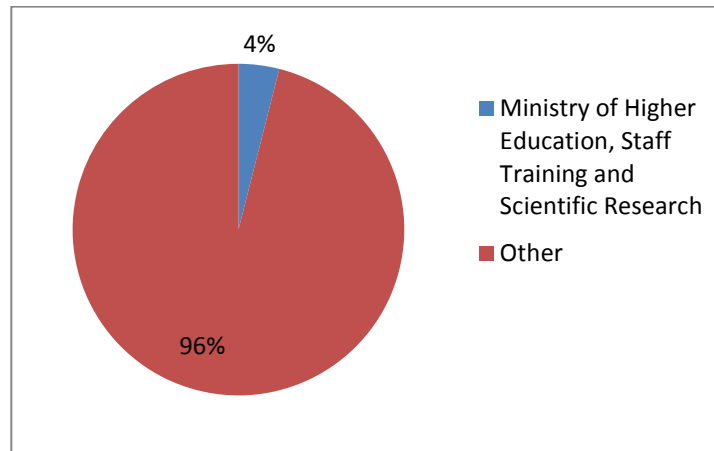
## 2. MOROCCAN EFFORTS TO IMPROVE ENGINEERING EDUCATION QUALITY

Higher education is a key lever for development, particularly in a knowledge economy relying on research and innovation. In the light of the new expanded vision of the Moroccan educational reform (2015-2030), the efforts go towards enabling all higher education institutions to follow the strategic objectives of the National Education and Training Charter. Strategic actions in terms of higher education and scientific research contain a number of key aspects that we summarized as below [1]:

- Training and recruitment of 15.000 teachers-researchers in the horizon 2030
- Gradual increase in the GDP (Gross National Product) allocated to scientific research funding to achieve 1% in the short term, 1,5% in 2025 et 2% in 2030
- Development of orientation and guidance systems in Moroccan higher education institutions
- Diversification of the language choices provided by higher education programs

In order to achieve these objectives, Moroccan government dedicates a budget especially to fund higher education improvement projects.

In the 2015-2016 academic year, 4% of the state budget was allocated for high education financing as we have illustrated in Figure 1. It includes operating budget (staff pay, scholarships, subsidies to university residence, subsidies to university institutions, promotion of scientific research, administration) and investments. Institutions of engineering education represent 13% of the total number of university establishments of higher education [2].



**Figure 1.** Distribution of Moroccan budget in 2015-2016

### 3. CONSTRAINTS OF MOROCCAN ENGINEERING EDUCATION DEVELOPMENT

In Morocco, the improvement of quality of engineering education is being hindered by some factors, such as:

**-Massification:** Moroccan engineering institutions produce a growing number of engineers looking for professional insertion. For example, the number of students studying engineering at academic institutions has increased by 7,80 percent between 2014-2015 and 2015-2016 (17 284 in 2014-2015 and 18 633 in 2015-2016) [2]. In order to deal with the situation of massification, institutions of engineering education have to develop the adequate strategies and resources (human, financial, material) to ensure equity and improving quality across education systems [3].

**-Market demand:** The accelerating pace of socio-economic disruption is changing the skills required by employers. Education systems are concerned with identifying skills that are needed today and anticipating those that will become so in the future to enable engineers to seize emerging opportunities [4].

**-Limited resources:** financial, human and physical resources are limited, these resources should best be distributed, managed and exploited to promote continuous improvement in education [4].

**-Competitiveness:** there are almost 35 institutions of engineering education with almost 135 engineering field in Morocco, in addition to private engineering schools that provide a competitive engineering training [5]. When it comes to employment, engineers of both government and private institutions with the right skills needed in the labour market can easily seize opportunities. In a context of heightened competition, innovative engineering schools must offer the widest choice of engineering degree programs that can enable engineers to be adaptable and operational on their job.

### 4. CHALLENGE OF DOING MORE WITH LESS IN THE LEAN THINKING

Moroccan country is in a situation of economic difficulties which strongly affects the resources allocated to different development sectors and at the same time performance is necessary to stimulate economic growth. As a result, engineering education institutions are expected to promote high quality (doing more) while using the minimum amount of resources (human effort, time, space, equipment, and budget). To be more efficient, engineering institutions need to be able to identify, reduce and eliminate waste in the learning process [6]. The challenge of doing more with less has been called “Lean” by scientists at Massachusetts Institute of Technology (MIT).

#### 4.1 LEAN THINKING GOALS

Lean originated in the mass production setting in the automotive sector, specifically the Toyota Production System. The lean approach has then been adopted in every process different from that of high volume repetitive manufacturing such as healthcare, administration and higher education. Lean, simply defined, is an approach of eliminating waste from the process and maintaining continuous improvement [7]. The important goals of lean systems can be described as follows [8]:

- **Quality improvement:** to gain a competitive advantage, a company must focus on the customer satisfaction and be always confident that the product delivered meets the customer’s need
- **Waste elimination:** waste is described in the lean context as any step within the process that doesn’t participate directly in achieving the desired process output
- **Time reduction:** the most important way to reduce time in the process consists on waste elimination
- **Costs reduction:** in order to reduce costs, a company must produce without non-value added activities and only to customer order

## 4.2 LEAN THINKING PRINCIPLES

James P. Womack and Daniel T. Jones defined lean in their book Lean thinking as “Lean Thinking can be summarized in five principles: precisely specify value by specific product, identify the value stream for each product, make value flow without interruptions, let the customer pull value from the producer, and pursue perfection”. Lean is based on five fundamentals value, value stream, flow, pull and perfection [9]. We can define the latter as follows:

**Value:** value is defined from the customer’s standpoint. It determines what the customer specially wants and will pay for. Value is about meeting the customer’s demand at a given price at a given point in time. Any characteristics in the product that do not provide value to the customer are undesired.

**Value stream:** a value stream consists of all the processes, steps, and materials required to produce and deliver the end product or service

**Flow:** once the value stream is defined, the elimination of waste is an important component of achieving flow, which is reached when the process progresses through a series of value-added steps. The elimination of wasted activities will result in the fact of saving time and delivering the product or service to the consumer more quickly.

**Pull:** it means that the process responds to customer pull and doesn’t produce anything until the customer orders it

**Perfection:** it refers to the process of producing without waste, using a continuous flow and according to the customer demand. Lean is not about a static effort and vigilance to perfect, it requires continuous improvement of each and every aspect of the process.

## 4.3 LEAN THINKING IN HIGHER EDUCATION

Lean Higher Education (LHE) refers to the implementation of lean thinking in higher education. It has been successfully adopted by many universities to respond to higher education's heightened expectations, emphasize respect for people and continuous improvement. Some of these universities that have applied lean thinking to improve their administrative processes and academic processes include [10], [11]:

- University of Central Oklahoma (USA)
- University of Aberdeen (Scotland)
- University of Waterloo (Canada)
- University of St Andrews (United Kingdom)

## 4.4 LEAN HIGHER EDUCATION BENEFITS

Lean has been named as a successful approach to improve customer satisfaction by eliminating wastes and improving flow in many higher education institutions [11]. We have described in table 1 some of the positive and promising benefits of implementing lean at three universities in the United States.

**Table 1.** Lean higher education benefits

<b>Rensselaer Polytechnic Institute</b>	<b>University of Central Oklahoma</b>	<b>University of Iowa</b>
Formulate clear learning outcomes and objectives (define specific skills and knowledge to be achieved)	Decreased number of pieces of paper generated per work order by 88%	Decreased time of the employee hiring process by 33% (from initiation to job posting)
Use updated course materials (use emerging technology in learning, eliminate duplicate case studies across courses, show how course concepts will be applied in real business practice)	Decreased annual paper cost by 92%	Decreased number of the employee hiring process steps by 17%
Determine class level to establish course progress to improve flow and save time	Decreased average number of days to assign a work order by 90%	Decreased reworking submissions in the employee hiring process by 50%
Use different learning style to stimulate student participation and motivation	Increased percent of work orders submitted by e-mail from 26.8% to 91.1%	Reduced number of steps in the contract administration by 62%

Design Transparent Assignment to Enhance Student Success		Reduced waits for contracts administration by 65%
Make best use of students feedback and suggestions to improve current and future course design and delivery		Reduced review time for complex contracts by 16%
		Eliminated 20 days between the time from bid opening to contract execution

Process optimization and cost saving remains a key issue for universities of all sizes. By implementing a lean approach university can optimize its processes such as hiring process, contract management, planning, course design, and course delivery. Cost savings can be invested in financing strategic project. For example, purchase and install new equipment and technology to improve the quality of education.

## 5. LEAN THINKING AND MOROCCAN ENGINEERING EDUCATION

### 5.1 MOROCCAN EXPERIENCE IN LEAN MANUFACTURING

The Ministry of Industry, Commerce and New Technologies (MICNT) and the National Agency for the Promotion of Small and Medium Enterprises, have launched the INMAA initiative (the Moroccan improvement initiative) in 2011, in partnership with the McKinsey & Company consulting firm. The purpose of this initiative is to encourage operational transformation of 100 enterprises per year, this transformation falls within the context of industrial emergency plan. INMAA help companies to implement lean principles and achieve sustainable performance improvement by recording an increase in productivity of 25%, a decrease in unit costs of 20% and a reduction in production deadlines of 50%. Many companies have adopted the lean approach to build their own production system, such as Renault Production System (RPS-Renault), Valeo Production System (VPs-Valeo), Delphi Manufacturing System (DMS-Delphi) and Danone Manufacturing Way (DaMaWay) [12], [13], [14].

### 5.2 MOROCCAN ENGINEERING EDUCATION PROCESS

Engineering education refers to the set of processes engaged in providing students with the necessary skills and knowledge to achieve employability in knowledge-based societies. In a context of limited resources and increased requirements, Moroccan engineering schools must seek strategies to promote performance improvement and operational excellence [15]. In table 2, we have identified some of engineering education processes.

**Table 2.** Engineering education processes

Phase	Processes
Planning	Identifying learner needs (employability skills and abilities)
	Setting achievable objectives to meet the learner needs
	Identifying the teaching content and strategies
	Resources planning (teachers, employers, available materials, time, budget)
Implementation	Reserving a classroom
	Offering courses
	Advising students
	Establishing a partnership with an external institution
	Performing education using specific tools and strategies
	Providing medical or mental health services
Evaluation	Verifying the achievement of the objectives
	Evaluating student's knowledge

Engineering education is a system that creates value for its customers. We can identify two sets of customers external and internal.

Some of external customers are the services industries, manufacturing industries and government agencies that create job opportunities for engineers. The engineering education's internal customers include students, teachers, administration staff, and directors. All these beneficiaries should work together to achieve continuous improvement. Moroccan engineering schools should work hard to attract the best students that are the most important internal customers. If the engineering school doesn't increase stakeholder satisfaction, the customers will seek their needs in the other competitive schools:

- Best student can enroll in another school
- school members can be recruited by other schools
- Companies can recruit engineers trained elsewhere
- Donors can support any other competitive school

### 5.3 IMPLEMENTATION OF LEAN THINKING IN MOROCCAN ENGINEERING EDUCATION

Lean will enable engineering education staff perform its work and increase its feeling of fulfillment and motivation. It offers the methodologies and the tools to achieve strategic objectives, engaging all stakeholders in higher education. Lean offers a set of transformations that affects many aspects of an engineering school simultaneously, helping engineering schools to become more competitive and use their limited resources (staff, budget, materials, building) more effectively. Lean approach can help Moroccan engineering schools to reduce or eliminate process steps that don't add value to the customers (students, manufacturing companies, staff, and so on) in order to improve the flow of the process and relieve staff of unnecessary tasks. In this way, all stakeholders are engaged in achieving successful lean transformation. In table 3, we have identified some examples of engineering education wastes [11], [16].

**Table 3.** Engineering education wastes

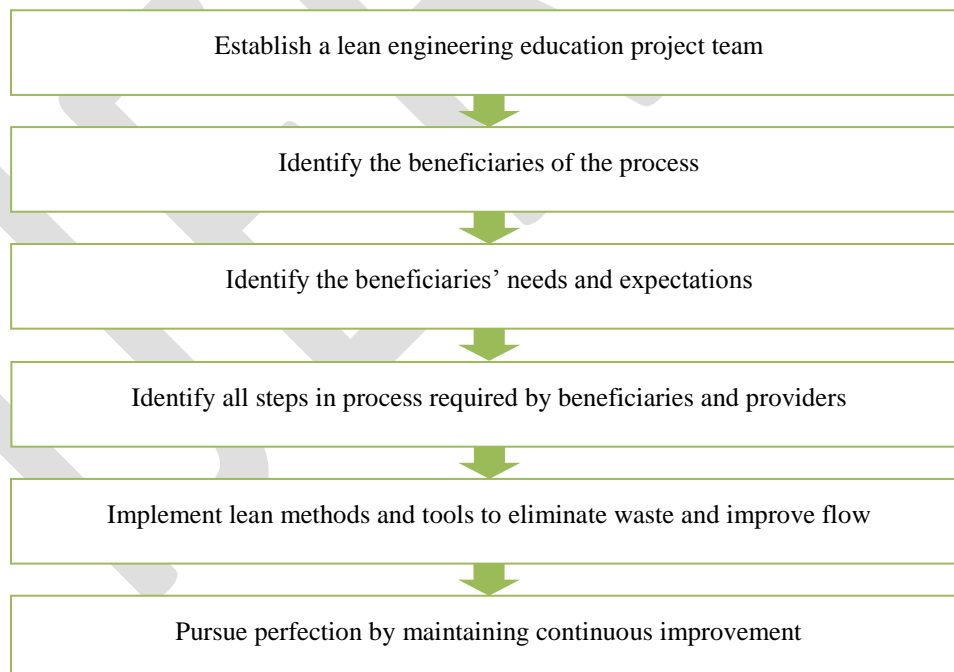
Factors inherent to the process	Examples of wastes
Human resources	Goal misalignment (when stakeholders don't share the same goals)
	Waste of incorrect assignment (when staff members are assigned inappropriate tasks)
	Waste of waiting (when the process is stopped or slowed while waiting for ressources)
	Waste of non optimal processing (when task is performed in an ineffective way)
Process	Waste of ineffective control (when performance measurement doesn't have a long-term effect on the process performance)
	Waste of variability (when data is not updated)
	Waste of non-strategic effort (when effort is invested in tasks that don't satisfy long-term objectives)
	Waste of unreliable processes (when effort is invested in correcting the impact of ineffective tasks)
	Waste of non standardization (when work is not standardized)
	Waste of sub optimization (when process contains duplicative steps)
	Waste of poor scheduling(when process comprises uncoordinated activities)
	Waste of uneven flow (when additional resources are required to deal with unexpected demand)
	Waste of checking (when effort is invested in reviewing suspected steps)
Information	Waste of correcting errors
	Waste of information translation (when data can be modified by staff at different steps in the process)

	Waste of missing information (when process presents missing data)
	Waste of irrelevant information (when the process is overloaded with unnecessary information)
	Waste of inaccurate information (when effort is invested in correcting the results of using incorrect data)
Asset	Waste of overproduction and inventory (when process surpasses what is needed)
	Waste of unnecessary transport
	Waste of overburdening people (when tasks exceed individual capacity)

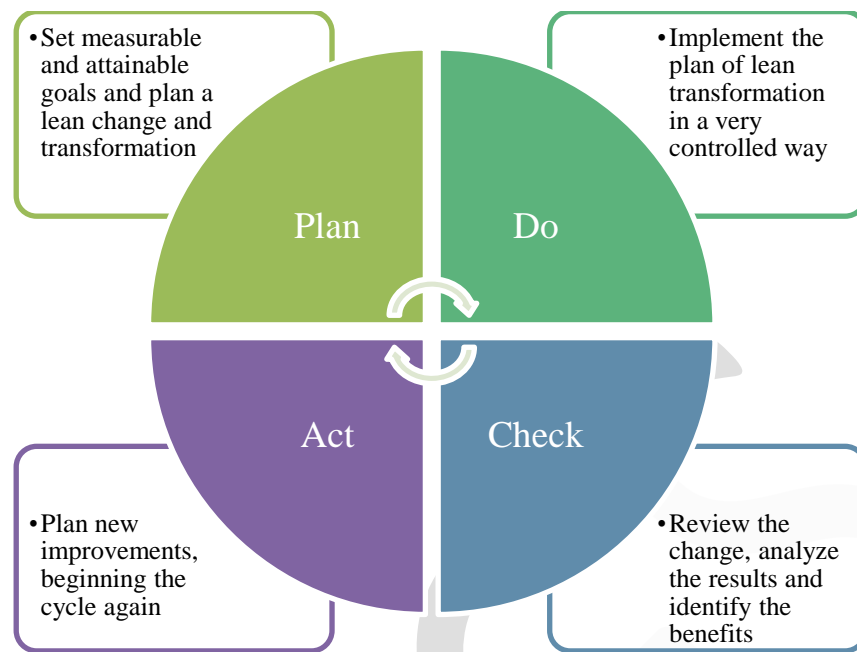
#### 5.4 STEPS OF IMPLEMENTING LEAN ENGINEERING EDUCATION APPROACH

Lean approach is about engaging all stakeholders who are part of engineering education process to apply lean strategies and tools to achieve continuous improvement. Our study will be based on the different steps that we summarized in figure 2 [11]. Teamwork organization is the key constraints to conduct a successful lean engineering education transformation. Creating an interdisciplinary team with highly skilled members who are collaboratively involved in achieving shared objectives is a vital tool for process improvement. The primary focus of a Lean transformation is the identification of customers and the development of a clear vision of what they want and expect from the process. If the university has a clear vision about its beneficiaries, it can easily meet their needs and expectations. Lean team members should work together in order to develop a deep understanding of the current process and identify all its steps and activities. These steps should be carefully reviewed to detect no value added activities and implement lean tools to eliminate wastes and improve flow. Lean steps and tools rely on the continuous improvement of processes.

The PDCA cycle is the most used methodology to implement a continuous improvement strategy in an organization. PDCA refers to the acronym “Plan, Do, Check, Act” known as the cycle of continuous improvement or Deming Cycle. It is an iterative four-step problem solving model to promote continuous improvement. This cycle is shown in figure 3.



**Figure . Steps to implement lean approach**



**Figure 3.** PDCA cycle

## 6. CONCLUSION

Through applying lean thinking in engineering education, Morocco can meet the challenge of doing more with less. This means, that engineering institutions will promote high performance using the available resources (human resources, financial resources, building, materials) to improve the quality of education. Lean thinking is a strategy built on continuous improvement and respect for people. Moroccan engineering institutions must take full advantage of the successful implementation of lean in many universities in the world. Engineering schools can benefit from applying lean thinking principles in terms of quality improvement, waste elimination, time reduction and costs reduction. In this paper we have deeply identified lean thinking principles, goals and several steps to be successfully implemented in Moroccan engineering education.

Through the case of the Higher National School of Electricity and Mechanics (ENSEM), we will determine how “lean” can be successfully introduced into Moroccan engineering schools while respecting the following steps:

- Establish a lean engineering education project team
- Specify the value desired by the beneficiaries
- Identify the value stream of the engineering education process
- Implement lean tools to eliminate wastes
- Stimulate continuous improvement strategies

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# Combined Effect of Fibre Loading and Silane Treatment on the Flexural Properties of Oil Palm Empty Fruit Bunch Reinforced Composites

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**Abstract:** Overtime, protection of fishing nets was sought by dipping in hot pine tar. The tars were effective because their constituents were toxic to microbial growth including the protection of fibre from moisture penetration, thereby retarding microbial growth. Probably, these stimulated the quest for surface treatment of natural fibres for composite utilization. In the current work, the use of age-long hand lay-up method was adopted in the production of oil palm empty fruit bunch reinforced polyester composites for the study of effect of fibre loading and silane treatment on the flexural properties for loss prevention and reliability in process selection for sustainable development. The result showed that flexural strength values of both green and treated fibre composites increased with increased fibre content, but started to drop after 40% loading. The effect of silane treatment as overcoming the inherent limitations of the fibres was significant. The issues of wettability preceding 40% fibre content as influencing the flexural properties was established, especially for the use of intended applications in automobile, building and packaging industries.

**Keywords:** oil palm, empty fruit bunch, composites, loading, treatment, flexure, strength, modulus.

## 1. INTRODUCTION

The increasing deterioration of world environments caused by the extensive exploration of petroleum resources, the quest for decreasing dependence on petroleum products, increasing interest in maximizing the use of renewable materials and natural resources, and the continuous expansion of synthetic product market including the encouragement in the use of cheaper and abundantly available indigenous materials has given rise to the exploration of viable alternatives in material application in engineering design.

Various kinds of materials have emerged and are being developed for use in engineering and in various aspects of the economy. The development of fibre reinforced composite-based products to substitute traditional engineering materials is becoming a trend in engineering application. Particularly attractive are the new materials in which a good part is based on natural renewable resources like those in the Palmaceae family. These renewable and biodegradable materials are in abundance in the tropics, including Nigeria and have been in use for hundreds of years for many applications such as in making ropes, beds and bags. The use of these materials as alternative fibres in composite production is becoming increasingly important because of their chemical, mechanical and environmental characteristics (Rozman et al., 2006).

Oil palm trees are found in abundance in most parts of the tropics where the extracted fruits are processed for the pharmaceutical and allied industries. The empty fruit bunch (EFB), from where the fruits are extracted is often discarded as wastes without proper utilization. However, this biodegradable material from the oil palm empty is of low-density, and a source for production of fibres for industrial cost-efficient utilization, especially for the production of low-to-medium flexural strength applications.

However, the efficiency of the natural fibre-based composites depends on the fibre-matrix interface and the ability to transfer stress from the matrix to the fibre. The main obstacles in the use of natural fibres have been the poor compatibility between the fibres and the matrix that may lead to micro-cracking of the composite and degradation of mechanical properties. Various treatments have been used to improve the matrix-fibre adhesion in natural fibre reinforced composites (Rowell et al., 1997).

Related studies on composite materials included the works of Azman et al., 2010, which inferred that oil palm fibers and commercially available polymers offer some specific properties which could be compared to conventional synthetic fiber composite materials.

Rozman et al., 2005, reported that oil palm EFB consists of a bunch of fibres in which palm fruits are embedded. The work stated that materials have been used in the production of potassium fertilizers as well as mulching even as they are of high fibre content, and that a great deal of potential is derived from using oil palm EFB as fillers in thermoplastic composites, which finds useful applications in

engineering as well as alleviating environmental problems related to the disposal of oil palm wastes and produce materials, including the offer as a favorable balance of quality, performance and cost.

Some recent studies on the effect of surface treatment and fibre loading on the mechanical properties of oil palm fibres as composites included the work of Ahmad et al, 2010, on the compressive, tensile and flexural strength properties of the concrete. The addition of 1% oil palm trunk fibre as crack arrester at low dosage improved the resistance against NaOH and NaCl attack of the composites.

Rozman et al. (2006), in their work on incorporation of oil palm EFB into the polymer matrix reported that the poor filler-matrix interaction resulted in the low flexural strength, reduced tensile strength and elongation at break of composites. Additionally the results showed that both flexural and tensile modulus of PE and PP composites improved upon the addition of fillers.

Anyakora and Abubakre (2011) reported that the composites of oil palm EFB exhibited improved impact strength properties from 10% fiber content to 60% fiber content after which problems of poor wetting set-in.

Other researchers who worked on oil palm EFB HDPE composites included Rozman et al. (2005), which reported that tensile modulus increased with filler increment, while the tensile strength decreased with filler increment. Their result indicated that the treatment of fibre did not show any significant influence on the strength of the composites, while the oil palm EFB fillers imparted greater stiffness to HDPE composites, in agreement with the other lignocellulose-filled thermoplastics.

Brydson (2001) reported that oil palm EFB fibre exhibited low elasticity and high degree of plasticity when compared to coconut empty fruit fibres.

Ramli and Suffain (2004) reported in their work that fibres of oil-palm empty-fruit bunch were highly lignified with less cellulose.

Nor et al. (2009) reported that modifying the fiber surface by using chemical treatment could enhance bond strength between fiber and matrix and thus recommended the adoption of chemical treatment as an effective way to modify the fibre surface by increasing the surface roughness. Also reported in the same work was the incorporation of oil palm EFB fibre as increasing the flexural strength and modulus of composites at smaller fibre size, including the decrease in both flexural strength and flexural modulus at higher oil palm EFB fibre size, believed to be due to poor interfacial bonding between oil palm EFB and matrix.

Razak and Kalam (2012) reported that the fractured surfaces of composites oil palm EFB using scanning electron microscope indicated that the treatment improved the interfacial bonding between fibre and matrix.

The hand lay-up process of composite fabrication is a low volume, labor intensive method suited especially for high volume and large components as needed in the automobile, building and packaging industries. Although the process is age-long for the production of low-to-medium quality products, the method of removal of entrapped air by manually squeezing the rollers to complete the laminates structure, improves the product quality, at least for the intended applications where high quality is not desirable.

The current efforts therefore, are geared towards utilizing the combined effects of fibre loading and silane treatment on the flexural properties of oil palm EFB reinforced polyester composites. Essentially, the flexure composites will be applied as valid and viable alternative to the production of various low-to-medium structural and medium quality products in the automobile, building and packaging industries. The conversion wastes as potential raw material for other industries achieved in this work, will in no small measures actualize the Goals 9 and parts of Goal 12 and 15 of Sustainable Development Goals of engaging people meaningfully to offer employment, create wealth, achieve the Circular Economy Quest, and solve environmental problems associated with improper disposal of agricultural wastes, and most importantly, ensure that these fast depleting these non-renewable resources that are gradually becoming depleted is preserved.

## **2. MATERIALS AND METHODS**

### **2.1 Materials**

Oil palm EFB with varying diameters of 0.45mm - 0.81mm and lengths of 12.00mm - 36.90mm were extracted from mature plants of three to five years, collected from Nigerian Institute for Oil Palm Research (NIFOR) and Umuahia Forestry Departments. These plants, with known age, were collected, with emphasis on trees that have fruited, but felled and used within two weeks. These extracts were processed at the Pulp and Paper section of Federal Institute for Industrial Research, (FIIRO) Oshodi, Lagos, Nigeria into tangled mass of varying diameters of 0.45mm - 0.81mm and lengths of 12.00mm - 36.90mm.

The Polymer used was Siropol 7440 un-saturated polyester resin purchased from Dickson Chemicals Ltd, Lagos, Nigeria with specific gravity of 1.04, viscosity of 0.24 Pa.s at 25°C. Other chemicals used were; cobalt in styrene, diglycidylethers and phenylsilane procured from Zayo - Sigma Chemicals Limited, Jos, Nigeria.

A two-part mould facility (mild steel flat 4mm thick sheet) - of 150mm x 150mm with active surfaces ground, pre-designed cavity of 5mm depth, with clamping bolts in place, fabricated at the Dantata & Sawoe Mechanical Workshop, Abuja, was adopted in the production of test specimen plates. Other equipment used were Universal Testing Machine, Instron, Model 3369, Compact Scale/Balance (Model – FEJ, Capacity – 1500g, 1500A).

## **2.2 Methods**

### **2.2.1 Fibre extraction**

The collected EFB of oil palm fibres were extracted by chemico-mechanical process. The process involved the impregnation of sample with “white liquor” and conversion of the softened sample into fibre by mechanical action, followed by thorough washing, screening and drying. The extracted fibres were separated, re-washed and dried in the forced-air circulation type oven. The fibres were subsequently weighed and percentage yield determined.

### **2.2.2 Surface treatment of the extracted fibre**

The process adopted in this work was the silane treatment preceded by the sodium hydroxide treatment. 10%, 20%, 30%, 40%, 50% 60% and 70% weights of extracted oil palm EFB fibres were soaked in prepared known volume of 0.5 mol/litre of NaOH for 2 hours. The products were removed and washed with distilled water before air-drying. Subsequent processes included soaking the surface-treated fibres in 2% phenylsilane solution for 24 hours. Subsequently, the product was removed, dried at 60°C and stored in specimen bag ready for use.

### **2.2.3 Production of test specimen**

The test specimen composite panels of fibre content % by weight were produced by hand lay-up process. Curing was assisted by placing the composite in an oven operated at 110°C. The laminates were removed from the oven after 30 minutes and conditioned following the BS ISO 1268-3:2000 Instructions and Guidelines.

### **2.2.4 Composite characterization**

Five (5) test samples each of green and surface-treated laminates were cut into the standard test dimensions by using a hacksaw. The 3-Point loading technique in compliance with BS2782 - 10, Method 1005 of 1997 for the determination of flexural properties of fibre reinforced composites was employed. The Instron Universal Testing machine of 10KN capacity was subsequently operated at a crosshead speed of 5 mm/min, until the loading blocks are brought in contact with upper surface of the beam, and load applied until the piece fractured. The span to depth ratio was maintained at 9 when determining the flexural strength of each of the specimens of green and treated-fibre composites. The load at fracture and other measurements were recorded and used for the evaluation of flexural strength.

## **3. RESULTS & DISCUSSION**

### **3.1 The flexural strength of oil palm EFB fibre reinforced polyester composite**

Figure 1 shows the effect of fibre content and silane treatment on the flexural strength oil palm EFB fibre reinforced polyester composite. It was evident from figure 1 that the flexural strength of oil palm empty fruit bunch fibre polyester composite increased with increased fibre loadings, even as the fibre treatment showed significant influence on the flexural strength properties of the composites. These results were corroborated in some other findings (Razak and Kalam, 2012), that the increase of oil palm EFB fibre size resulted in increased flexural strength, and modulus at smaller oil palm EFB fibre size.

A decrease of both flexural strength and flexural modulus was observed at higher fibre loading, which was believed to be due to the poor interfacial bonding between oil palm EFB and matrix. The result in this study does not corroborate the second part of finding above, because the no decrease in flexural strength was observed at increased fibre loading. This suggests that the composite production method adopted may have considerable influence on the results, thus use of appropriate production method is necessary for the production of standardized products for a particular application.

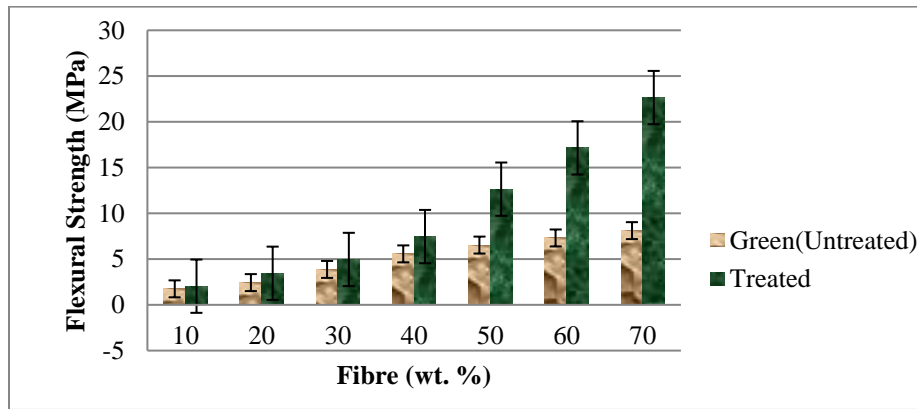


Figure 1: Effect of fibre content and silane treatment on the flexural strength of oil palm EFB fibre reinforced polyester composite.

### 3.2 The flexural modulus of oil palm EFB fibre reinforced polyester composite

Figure 2 shows the effect of fibre content and silane treatment on the flexural modulus of oil palm EFB fibre reinforced polyester composite. As observed in figure 2, fibre content and surface treatment had significant influence on the flexural modulus of oil palm EFB composites from 10% to 40% fibre loading. The values started dropping beyond 40% fibre loading. These results corroborated part of other findings (Razak and Kalam, 2012), who noted that a decrease of both flexural strength and flexural modulus was observed at higher oil palm EFB fibre size, which was believed to be due to the poor interfacial bonding between oil palm EFB and matrix.

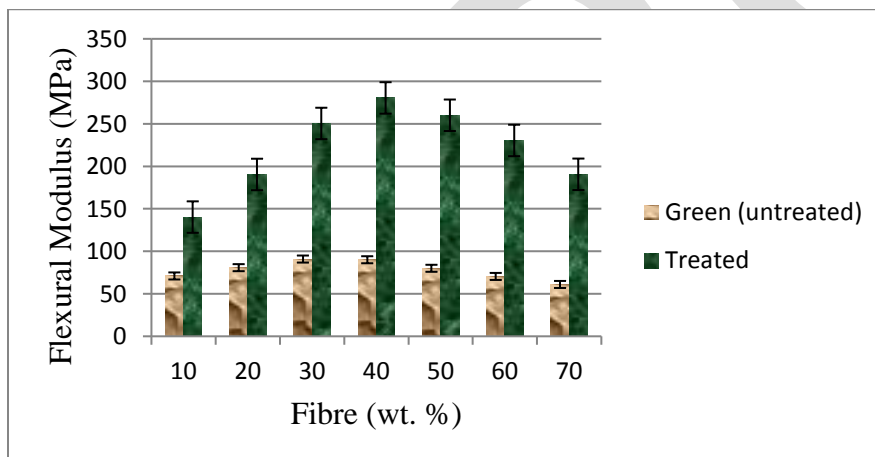


Figure 2: Effect of fibre content and silane treatment on the flexural modulus of oil palm EFB fibre reinforced polyester composite.

## 4. CONCLUSION

Based on the results from this work, the following deductions were made; (a) the flexural strength of oil palm EFB fibre reinforced with polyester matrix increased with increased fibre loadings. The silane treatment of fibres showed significant influence on the flexural strength of the composites at higher fibre loadings, (b) the flexural modulus of oil palm EFB reinforced with polyester matrix was significantly influenced upon on fibre loading and silane treatment at loadings of 40% and below. (c) Surprisingly, there was a sudden drop in flexural modulus values beyond 40% fibre loading, which may be due to a combination of unstable morphology of the fibre, that is common to most natural plant materials, and the composite production method adopted in the work. Thus, the use of silane treated oil palm EFB fibre reinforced polyester composites can offer suitable and viable alternative for applications in the automobile, building and packaging industries, which is in line with the “closing the loop” quest of the Circular Economy of utilizing ones waste as raw material for another.

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# Study Relationship between Strategic forecasting, Performance and Operation for Keshavarzi Bank in Iran-Tehran

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**ABSTRACT-**The purpose of this paper is to assess the effect of strategic planning on the performance of banks in Iran with reference to the operations of the Keshavarzi Development Bank (KDB). Secondary and Primary data was utilized in this study. Secondary data was obtained from reviewing text books, publications, financial records and internal records of KDB. Primary data was gathered with the aid of questionnaires. One hundred and sixty (160) questionnaires were sent to employees of the Iran-Tehran region of KDB and one hundred and forty (140) responses were obtained representing a response rate of 87.5%. The results of the administered questionnaires showed a fairly high level of agreement for the features of the various dimensions of an effectively managed bank. However, this study showed that structures put in place for bottom-up information flow were not known to all employees. This study also showed that employees were either ignorant about program evaluation or there was a clear disregard for program evaluation at KDB. The researcher recommends that all factors of the various dimensions should be put into the right perspective so as to help the general workforce of the bank to understand the main objectives and strategic plans in place to achieve the objectives of KDB. Lastly, it is recommended that, the bank develops quarterly meetings at the zonal level to provide employees the opportunity to be heard on matters relative to strategic planning practices at KDB.

**Keyword-** Strategic Planning, Strategic Management, Strategy Implementation, Long- Range Planning, Operational Planning, Performance Measurement, Quality and Consistency, Primary and Secondary Data Source.

## INTRODUCTION

In order to assess the level of success or otherwise of a corporate body, its established strategic plans relative to the performance of the organization in all fronts of operations have to be ascertained. Formulating, implementing and the evaluation of a Strategic Plan indisputably become a major activity in both profit and not-for-profit organizations, especially, the banking sector.

Strategic Plan provides the basic direction and rationale for determining the focus of an organization; and also provides the specification against which any organization may best decide what to do and how to do it. Simply put, it is a process for creating and describing a better future in measurable terms and the selection of the best means to achieve the results desired. It is important to note that not all planning is actually strategic even though they may be termed so. It is said that failure to plan leads to planning to fail.

Strategic planning standardizes the processes of goal/objective setting, situation analysis, alternative consideration, implementation and evaluation that enable an organization to attain its goals and objectives [32]. [28] Asserted to the positive correlation between strategic planning and performance achievements as very beneficial for organizations. In their studies [6]; [17] further emphasized the need for organizations to align their strategies with their performance measurement systems.

Performance measurement has significant influence in supporting the achievement of an organization's goals and the effectiveness and efficiency of its strategic planning process. Thus, in order to assess the level of success or otherwise of a corporate body, its established strategic plans in connection with the performance of the company in all fronts of operations had to be established.

Strategic management expert [34] writes that a company without a strategy is like an airplane weaving through the skies, hurled up and down, slammed by winds and lost in the thunder heads. If lightning or crushing winds do not destroy it, it will simply run out of gas. In a similar line of thought, [27] note that, without a strategy an organization is like a ship without a rudder. It goes round in circles and like a tramp, has no specific place to go.

Clearly, these statements emphasize the importance and the need for a comprehensive, systematic and dynamic strategic planning for every company which seeks to survive competition in the ever changing global competitive business environment. [1] Argues that planning generally produces better alignment and financial results in companies which are strategically managed than those which are not. This suggests an apparent correlation between strategic planning and the ultimate performance of a company in terms of its growth, profits, attainment of objectives and sustained competitiveness [30].

Though these assertions are largely true, [24] affirm that exceptional situations also arise when some companies gain not because they had in place any strategy but because they just benefited from some sudden conditions in the external environment. Nonetheless, and still consistent with the need for evolving and constantly reviewing strategy, it is important to note that having a sound strategy in itself does not necessarily translate into desired performance goals if it is not properly implemented. Both strategy and implementation must be good and timely to achieve positive results. As for a company driven by wrong strategic planning, [16] likens it to a train on a wrong track saying, every station it comes to is the wrong station.

These fundamental principles essentially hold true for all industries globally and as should be expected, management is subject no less to the dynamics of these tendencies. It is assumed that strategic planning, like other management initiatives developed basically for business, can be adapted in spite of the differences between profit and not-for-profit organizations.

The need for organizations to plan and monitor their activities in order to focus resources and efforts to ensure their future survival has spawned an industry of practitioners, consultants and educational programs. Strategic planning is now a routine part of business or organizations with an accompanying set of beliefs and protocols that underpin the day-to-day practice. As indicated in the works of [26], [3] as well as [20], the conceptualization that best recognizes and appropriates all the possibilities of strategy may be termed strategic. Each of the three aspects is essential to the others: Strategic Thinking, Strategic Planning, and Strategic Action.

### Statement of the Problem

Managements' lead role requiring strategic thinking, planning, decision-making and ultimate implementation could also have much to contribute to the fortunes or otherwise of the various organizations in their respective industries. Much as the differences in the performance levels of various organizations are to be expected, it is still strongly believed that the strategies pursued by each organization are largely accountable for the outcome of their performances.

Strategic planning increases the efficiency and effectiveness of organizations by improving both current and future operations. Strategic planning provides a framework for management's vision of the future. The process determines how the organization will change to take advantage of new opportunities that help meet the needs of customers and clients. Strategic planning is a difficult process which requires that people think and act creatively. The strategic planning process is used by management to establish objectives, set goals, and schedule activities for achieving those goals and includes a method for measuring progress. These goals can be accomplished through the steps of the strategic plan, beginning with an external and internal analysis, a clearly defined mission statement, goals and objectives, formulation of specific strategies, concluding with the implementation of the strategy and managed control process.

This paper explores the extent to which a new organizational structure, policy direction and business models affect the performance and operations of KDB. KDB's business models and policies appear to have created new relationships and roles which demand employees to stay focused, know exactly what part they play in the plan and ultimately what is expected of them as a result. These demands have created some interest and apprehension among employees and these seem to have significant implications in the new strategic plan of KDB. It is against this background that the researcher is exploring into the effect of strategic planning on the performance of the Keshavarzi Development bank.

The sources of materials for the study were both primary and secondary. Primary data was collected by the use of a structured questionnaire which was designed and administered to the management and staff of KDB, for information on the general perception of corporate performance on the subject of strategic planning. Secondary material was extracted from relevant textbooks, newspapers, reports/articles, journals, bulletins and documents presented by corporate strategists and policy planners. Due to time and resources constraints, a fraction of KDB staff was sampled for this work.

The difficulty in getting information from the management of KDB placed a restriction on the researcher's work. Secondly, the lack of database on Strategic planning in the KDB Iran-Tehran branches hindered the dependability on this work. Even though KDB nationwide study would have been more appropriate, there were constraints of financial resources and unavailability of data as well as materials which made it impossible to undertake such a nationwide study. The researcher had to combine academic work with his regular profession. Costs in terms of printing, photocopying, binding as well as opportunity cost were incurred.

### DATA ANALYSES AND DISCUSSION OF RESULTS

This part of study presents the data analyses of the administered questionnaires, the presentation of the analyses and the fall out of the results as well as discussions for the study. Descriptive statistics such as frequency and mean were used in the analyses.

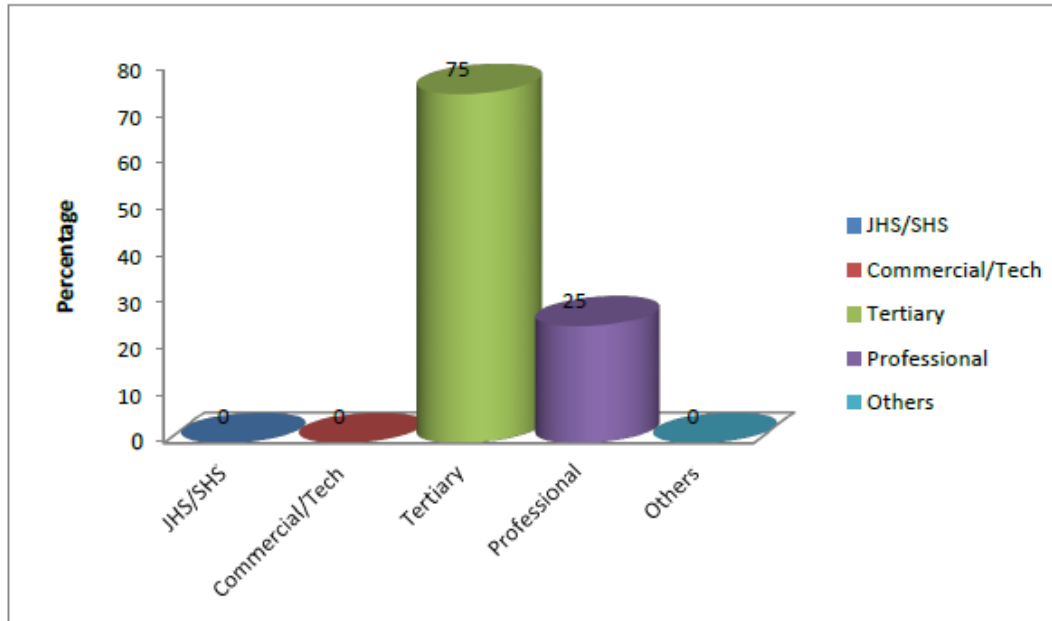
Table 4.1: Sex and Age Group of Respondents

Detail	Male	Female	Total	Percentage
20-29 years	33	35	68	42.5%
30-39 years	28	21	49	30.63%
40-49 years	16	9	25	15.63%
50-59 years	10	8	18	11.26%
60 and above	0	0	0	0.00%
<b>Total</b>	<b>87(54.38%)</b>	<b>73(45.62%)</b>	<b>160(100.00%)</b>	

The composition of respondents' gender was found to be mainly males which constituted 54.38% while females also represented 45.62%, this structure is due to the fact that, the males were more willing to respond to the questionnaires than the females, hence the females have a fair representation in the analysis. This is essential in order to have a combine view of both male and female in the analysis.

Moreover, the age categories show that, the study is composed of mainly youth within the ages of 20-29 which constitutes 42.5%, followed by those within 30-39 representing 30.63%, 40-49 years, 50-59 years and 60 and above also constitute 15.63%, 11.26% and 0.00% respectively.

Figure 4.1: Educational Levels of Respondents



Source: Researcher's field Survey, June, 2012

Figure 4.1 shows the educational level of the respondents, evidently none of the respondents holds a JHS/SHS or commercial/Technical certificate. This finding is consistent with the quality of staff of the bank, since the industry requires high caliber of working force to operate the activities of the bank. However, majority of the respondents have tertiary level education which comprises, HND diplomas, First degree certificate and masters, a significant number of 25% also holds professional certificates in CIMA, ACCA and CA Iran. This indicates the professionalism of staff and management of the bank, as all the respondents possess the necessary certificates to hold the various positions within the bank and can confidently attest to the strategic planning on the performance and operations of the bank.

### Measurement for the Study

A five point Likert scale was used for measurements, which assigns a weighted value to the extent of agreement or disagreement for a factor as shown below 1--- Strongly Disagree, 2 – Disagree, 3 --- Uncertain/Neutral, 4 --- Agree, 5 --- Strongly Agree Mean measures the average response in a collective manner to each factor given by

$$\mu = \frac{1}{N} \sum_{i=1}^j \tau \rho_i$$

Where  $\tau$  is the number of respondents agreeing to the factor  $j$  is the total number of extent of agreement or disagreement  $N$  is the total number of respondents involved in the response and  $\rho_i$  is the assigned weight to the level of agreement or disagreement.

### Strategic Planning Dimensions

A mission is a statement of the purpose of a company or organization. The mission statement guides the actions of the organization, spells out its overall goal, provides a path, and guides decision-making. It provides "the framework or context within which the company's strategies are formulated. The mission of the Keshavarzi Development Bank is the general and long term value the bank wants to achieve, it comprises the primary business and services it wants to offer to its cherished customers and to the general public and the role it wants to play in the industry.

Table 4.2: Descriptive Statistics on Mission of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
The bank has a clearly articulated and agreed upon purpose(statement that describes the ultimate result the organization is working to achieve)	54	85	18	5	0	4.19
There is a consensus on the primary business(es), primary services that the bank should provide	48	78	27	7	0	4.03
There are shared values and beliefs that guide the bank and its staff	34	95	32	0	0	4.00
There is clear and agreed upon vision of what the bank is trying to accomplish and what it will take to make the vision happen	42	78	40	0	0	4.02
Mission over all assessment	45	94	22	0	0	4.13

Source: Researcher's field Survey, June, 2012

The mission of the bank had a higher mean for all factors assessed; the study reveals a definite agreement on all details of the bank's mission. Four factors had the mean to be 4.0 and above indicating a high acceptance of the mission by the staff and management which shows the mission of KDB is part of the strategic plan to help achieve the needed performance and operations of the company. Moreover, these outcomes indicate that, KDB has a clear articulated mission which thrives on consensus primary business including shared values and beliefs of the bank which is mandated for all employees to fulfill.

Planning (also called forethought) is the process of thinking about and organizing the activities required to achieve a desired goal. It involves the creation and maintenance of a plan. As such, it is a fundamental property of intelligent behavior for KDB. This thought process is essential to the creation and refinement of a plan, or integration of it with other plans within the company; that is, it combines forecasting of developments with the preparation of scenarios of how to react to them.

Table 4.3: Descriptive Statistics on Planning of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
There are shared and explicit values and beliefs which serve as the foundation on which the organization and its members do their work	53	92	18	0	0	4.23
A three to five year strategic plan is in Place. The plan is reviewed yearly and modified as needed to reflect trends in the environment, current and future client needs, and the bank's capacity to meet those needs	41	82	32	3	0	4.03
There is an annual process to set program goals and budget	24	48	84	2	0	3.59
There is a written annual operational plan that includes timelines and identification of who is responsible for which outcomes or activities	38	84	36	2	0	4.01
There is an agreement on overall major Strategies that the bank uses for the allocation of resources. (Strategies are priority responses that an organization will use to best accomplish its purpose)	35	99	23	7	0	4.00
Planning: Overall assessment	47	85	29	0	0	4.12

Source: Researcher's field Survey, June, 2012

Four (4) out of five (5) factors used were found to be heavily scored for a general agreement among the staff and management of KDB which include „shared and explicit values and beliefs which serve as the foundation on which the organization and its members do their work“, „written annual operational plan that includes timelines and identification of who is responsible for which outcomes or activities“, „three to five year strategic plan is in place“ and „an agreement on overall major strategies that the bank uses for the allocation of resources“. All had a mean of more than 4.0 with the exception of the factor „There is an annual process to set program goals and budget“ which had a mean of 3.59 and shows much of neutrality among the respondents. The general overall assessment indicates a strong agreement for the planning dimension of KDB and hence makes it forms part of the strategic planning tool for performance of the bank.

Structure is a fundamental, tangible or intangible notion referring to the recognition, observation, nature, and permanence of patterns and relationships of entities. This notion may itself be an object, such as a built structure, or an attribute, such as the structure of society. From a child's verbal description of a snowflake, to the detailed scientific analysis of the properties of magnetic fields, the concept of structure is now often an essential foundation of nearly every mode of inquiry and discovery in science, philosophy, and art and business. The description of structure implicitly offers an account of what a system is made of: a configuration of items, a collection of inter-related components or services. A structure is a hierarchy (a cascade of one-to-many relationships), a network featuring many-to-many links, or a lattice featuring connections between components that are neighbors in space.

With reference to table 4.4, two factors which were highly agreed upon consisted of „There is a well-defined organizational structure, an up to date organizational chart accurately reflects the reporting relationships“ and „Meetings are well organized with the right people in attendance“, all had mean above 4.0 showing a strong agreement for the factors. On the other hand, „lines of communication encourage and support the flow of information and feedback between managerial and non-managerial staff“ scored a mean of below 4.00 and had about 43% of the respondents being uncertain on it. This indicated that structures put in place for bottom-up information flow were not known to all employees. However, the general assessment of KDB's structure was high which gives it a thumb up as part of the strategic planning dimension for the company as a whole.

Table 4.4: Descriptive Statistics on Structure of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
<b>There is a well-defined organizational structure, an up to date organizational chart accurately reflects the reporting relationships</b>	48	84	21	9	0	4.08
<b>There is a decision-making process and structure that supports decisions being implemented</b>	37	76	36	11	0	3.87
<b>Lines of communication encourage and support the flow of information and feedback between managerial and non- managerial Staff. There are communication structures in place to support this information flow</b>	33	57	71	0	0	3.77
<b>Meetings are well organized with the right people in attendance</b>	46	95	16	3	0	4.15
<b>Structure: Overall assessment</b>	35	91	28	4	0	3.98

Source: Researcher's field Survey, June, 2012

## People

People contribute labor and expertise to an endeavor of an employer and are usually hired to perform specific duties which are packaged into a job. In most modern economies, the term (people, staff, and employees) refers to a specific defined relationship between an individual and a corporation, which differs from those of customer or client.

Table 4.5: Descriptive Statistics on People of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
<b>The bank is sufficiently and appropriately staffed with well-paid personnel who are able to meet the needs of the organization. The organization is able to attract and retain qualified, competent, and committed employees</b>	54	84	22	3	0	4.18
<b>Roles and responsibilities for members of staff are clearly established; there are accurate and up-to-date written job descriptions for all staff</b>	48	84	27	4	0	4.09
<b>There is a staff evaluation process that includes established performance expectations, periodic work review sessions, and an annual evaluation</b>	43	78	32	5	0	4.02
<b>There are written job descriptions for management and specific expectations of members are clearly articulated; Management annually evaluates its performance</b>	41	89	25	4	0	4.05
<b>There are training opportunities to enhance current skills, learn new skills in order to build the capacity of employees</b>	45	81	37	0	0	4.07
<b>There are appropriate rewards and recognition for all personnel. Staff and management feel valued and appreciated</b>	58	95	8	0	0	4.34
<b>People: Overall assessment</b>	42	78	42	0	0	4.00

Source: Researcher's field Survey, June, 2012

The inclusion of people for the achievement of performance forms a critical part of every organization's strategic planning. All factors were found to be playing a significant role in achieving the general performance of the bank. As indicated in Table 4.5, respondents tend to agree more on each factor of the dimension as to its contribution to performance within the bank. The general assessment confirms the confidence of the human relationship of the people within the organization which also had a high score for its assessment; hence these findings make the inclusion of people a critical part of performance achievement within KDB.

## System

System of communication involves the use of electrical devices such as the telegraph, telephone, and tele printer, as well as the use of radio and microwave communications, fiber optics and their associated electronics, plus the use of the orbiting satellites and the Internet to transfer information to colleagues and to external stakeholders of an organization.

From table 4.6, all factors for the system of communication and the use of internal policy were agreed upon with the exception of the item „A budgeting process is in place that ensures the effective allocation of resources“ which was much more general due to lack of information on such matters to the staff of the bank. However, the use of a well-structured system to follow within the organization was found to be firm and strong as it was agreed by almost all respondents of the KDB. The general grading of the system in the bank indicates an acceptance of the systems of KDB which shows that, it is part of the strategic plan for achieving a higher performance.

Table 4.6: Descriptive Statistics on System of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
Systems are networked, all staff members have email access and an intranet/web presence exists	62	73	25	0	0	4.23
Sufficient training and support exist to facilitate staff use of information technology	41	78	41	0	0	4.00
The organization uses computers, email and electronic media to streamline communication	35	86	39	0	0	3.98
There is uniformity in operating standards for products and services	48	95	13	4	0	4.17
There are internal control systems in place to shield the bank from losses due to negligence or fraud	76	68	16	0	0	4.38
A budgeting process is in place that ensures the effective allocation of resources	24	37	99	0	0	3.53
<b>System: Overall assessment</b>	57	80	23	0	0	4.21

Source: Researcher's field Survey, June, 2012

## Result and Quality

Quality of Results is a term used in evaluating processes. It is generally represented as an assessment of performance indicator component.

Table 4.7 which addresses the quality of services and products showed that, all the respondents indicate a higher acceptance or agreement for factors within the dimensions for quality. Several factors recorded means of more than 3.5; this result indicates the familiarity of services of KDB to its customers, which include programs that support the bank's mission and feedback mechanism for assessing satisfaction of respondents, there is a high adherence to issues affecting quality. However, about 69% of respondents were either uncertain or disagreed with the factor „In-depth program evaluation is conducted as part of the planning process. This includes assessment based on identified benchmarks for quality and specific outcomes and process objectives“. This showed that employees were either ignorant about this or there was a disregard for program evaluation at KDB.

Table 4.7: Descriptive Statistics on Result and Quality of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
In-depth program evaluation is conducted as part of the planning process. This includes assessment based on identified benchmarks for quality and specific outcomes and process objectives	12	37	32	56	21	2.77
The bank has feedback mechanisms in place to assess customer's satisfaction and their needs	45	73	38	6	0	3.98
Customers are satisfied with the services offered by the bank	41	79	41	0	0	4.02
Programs are effective and efficient. The organization provides quality programs that support the bank's mission	33	55	72	2	0	3.72
<b>Result and Quality: Overall assessment</b>	31	75	53	0	0	3.89

Source: Researcher's field Survey, June, 2012

## Leadership

Leadership has been described as “a process of social influence in which one person can enlist the aid and support of others in the accomplishment of a common task”, it represents the bank’s general management style and the team’s responsibilities of taking actions with regards to the operations of the company.

From table 4.8, Leadership, supervisors and management play a decisive role in ensuring a better management and planning of resources for usage within the organization. It reveals that, none of the factors enjoys a comprehensive agreement from the respondents; however, factors enjoy a supportive mood as they all scored more than 3.0 with more concentration on those who agreed, since in cumulative form disagreement frequency was less than that of agreement frequency as shown in the table.

Table 4.8: Descriptive Statistics on Leadership of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
<b>The bank’s management is a model for effective leadership</b>	14	24	84	38	0	3.05
<b>The management team takes responsibility for creating an environment in which all personnel feel supported and motivated to produce quality results</b>	43	21	33	65	0	3.27
<b>Leadership is not just personified in one person, but it is a shared function among many people</b>	14	61	74	13	0	3.45
<b>The CEO models effective leadership by taking responsibility for ensuring that the board is performing its governance and support roles</b>	32	25	85	21	0	3.4
<b>Leadership inspires employees to provide commitment to achieve organizational goals</b>	27	58	43	32	0	3.48
<b>Leadership: Overall assessment</b>	42	35	77	8	0	3.75

Source: Researcher’s field Survey, June, 2012

This shows a staff support of management leadership style as a cooperative leadership approach which makes sure that, resources are available for them to use to achieve the purposes and the mission of the company. Again, the responds reveal that the CEO shows a personal responsibility of making sure that, certain vital equipment is provided effectively and periodically for the comfort of the staff as well as to help the various departments to function well. In addition, leadership of the company is not personified in one person but a collective approach to help the management to deliver the essential materials for the workers. Even though, the support for leadership as a dimension was not all embracing, the overall assessment shows a support for the leadership style of KDB.

## Relationship

An interpersonal relationship is an association between two or more people that may range from fleeting to enduring. This association may be based on inference, love, solidarity, regular business interactions, or some other type of social commitment. Relationships are formed in the context of social, cultural and other influences. The context can vary from family or kinship relations, friendship, and marriage, relations with associates, work, clubs, neighborhoods, and places of worship. They may be regulated by law, custom, or mutual agreement, and are the basis of social groups and society as a whole. This talks about the general relationship in the business environment which creates an atmosphere of responsibility within the organization.

Table 4.9 shows a relationship relating to strategic planning which was found to be strong among the staff and management of the bank irrespective of not showing a strong agreement for all factors. Although, not overwhelming, the study shows there is a constructive climate within the organization for freeness of voicing out with regards to usage of materials which include the development of innovative and creative ways by groups within the company to solve problems in the face of constrained resources. Besides, people within the company are willing to work through conflict and discussions of difficult issues are done within an atmosphere of supportiveness. The overall assessment shows a supportive agreement for the existence of a strong relationship within the bank.

Table 4.9: Descriptive Statistics on Relationship of the Bank

Detail	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Mean
There is a constructive climate in which people are able to feel free to express unusual or unpopular views without fear of personal attack or reprisal	34	73	31	22	0	3.72
Individuals and groups have developed effective ways to be creative, innovative, and solve problems together	32	71	56	0	0	3.84
There is a strong commitment among all employees to working effectively as a team. Team spirit within and among departments is encourage and supported, and there are effective coordinated services among departments	36	87	27	8	0	3.98
People are willing to work through conflicts. Difficult issues are discussed within an atmosphere of supportiveness and constructive criticism	45	84	32	0	0	4.08
There are effective formal and informal communication systems which encourage support, trust, and cooperation among groups and individuals	27	25	76	34	0	3.28
<b>Relationship: Overall assessment</b>	46	87	26	0	0	4.13

Source: Researcher's field Survey, June, 2012

Table 4.10: Validity and Reliability of the Strategic Planning Dimension

Dimension	Cronbach's alpha	Correlation Coefficient
Mission	0.747	0.737
Planning	0.883	0.636
Structure	0.742	0.662
People	0.855	0.731
System	0.682	0.773
Result and Quality	0.734	0.672
Leadership	0.553	0.558
Relationship	0.804	0.802
<b>Performance</b>	<b>0.782</b>	

Source: Researcher's field Survey, June, 2012

The reliability and correlation of the dimensions with the performance show a strong correlation of the various dimensions towards performance of KDB. As indicated, the rating of performance with the various dimensions of strategic planning exhibits a strong Cronbach's alpha which shows that, the dimensions are valid for the assessment of effects of strategic planning on performance, evidently all values for both Cronbach's alpha and the correlation coefficient are more than 5.0 showing a more validity and reliability for assessment of strategic planning effect on performance.

## Conclusion

The results revealed that, there was a fairly high level of agreement for the features of the various dimensions in relation to the strategic planning practices at KDB.

The study reveals that, there is an existence of strategic planning in KDB, the various dimensions used for the assessment of strategic planning show a consistency of the factors in use throughout the bank, respondents were highly in agreement with most of the factors of the various dimensions indicating an efficient and effective operations of the strategic planning in KDB. Again various factors individual scores show a more agreement or neutrality but with less insignificant disagreement by the respondents who are staff and management of the bank. This shows that, KDB has an efficient strategic planning in operations in all of its various departments within the bank. Strategic planning of corporate bodies is an essential instrument for planning and forecasting which positions the organization to meet demands and changes which might come up in the course of discharging its services. This study reveals that, KDB as a corporate body has a clear strategic plan which is articulated to all of its employees at various levels and departments within the bank. It reveals that, the strong agreement of factors of various dimensions of strategic planning indicate the effectiveness and efficiency of such planning adopted by employees of the bank and hence affects the bank's performance positively.

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# WOOD DEFECT IDENTIFICATION USING GENERALIZED FEED FORWARD NEURAL NETWORK

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**Abstract-** In this paper a new classification algorithm is proposed for the Wood Defect Identification Using Generalized Feed Forward Neural Network. In order to develop algorithm 50 captured wood defect images of plywood have been considered, With a view to extract features from the plywood captured images after image processing, an algorithm proposes (DCT) discrete cosine transformed 128 coefficients. The Efficient classifiers based on Generalized feed forward (GFF) Neural Network. A separate Cross-Validation dataset is used for proper evaluation of the proposed classification algorithm with respect to important performance measures, such as MSE and classification accuracy. The Average Classification Accuracy of GFF Neural Network comprising of one hidden layers with 8 PE's organized in a typical topology is found to be superior (100 %) for Training. Finally, optimal algorithm has been developed on the basis of the best classifier performance. The algorithm will provide an effective alternative to traditional method of plywood captured images analysis for Classify the six type plywood defect.

**Keywords**—Signal & Image processing, neural network, Transformed domain techniques, MATLAB, Microsoft Office Excel etc.

## 1. INTRODUCTION:

Wood is made up of many cells that were produced by the living tissues in the tree. The manner in which the cells develop and are organized has profound effects on the properties of wood. The anatomy of wood is also the basis for separating wood into categories or species.

Natural resources such as wood have become scarce and very expensive. Maximize the usage and reduce the rejection (losses) is a great challenge for the wood industry. The process to maximize the value of wood can be divided into three parts. Initially, the wood is taken to a sawmill and then one needs to decide whether the wood is more valuable as lumber, veneer, or chips. If it is for lumber, then the boards cut from it must be edged and trimmed. This is a process that requires someone to decide how to trim off effective parts and make the board as valuable as possible. Thereafter, someone must examine the board and give it a grade, based on the quality of the wood and presence of defects. Finally, someone cuts the lumber again to produce defect free dimension parts.

Defect develop in growing tree and timber. Some defect are characteristic of both living and felled trees (cracks, rot, wormholes). wood working defects are produced during the procurement, transport, and mechanical working of the wood. The seriousness of defect is determine by its type, size, and location, as well as by the purpose for which the wood is to be used. Thus defects undesirable in some type of timber may be disregarded or even valued in other. For example, Cross grain is unacceptable in resonant wood, acceptable in commercial lumber, and highly valued in plywood.

The main defects of wood include knots, cracks, fungal damage ,warping, slanting, and worm holes. A knot is a part of a branch embedded in wood. Knots appearance of wood and disturb its uniform structure. They twist the grain and the annual rings and weaken the wood when it is pulled with the grain and when bent. On the other hand, knots increase the strength of wood that is compressed transversely or sheared longitudinally.

Therefore, the effective detection of wood defect information is particularly important. A new wood defect detection method an Efficient algorithm for Wood defect identification using neural classifier used in this Research for the detection of wood defect.

We have collected the 50 images of six type of defect plywood captured images. By using this plywood captured images an algorithm is developed which proposes two-dimensional (DCT) Discrete cosine transformed domain coefficients in addition to Average, Standard Deviation, Entropy, Contrast, Correlation, Energy, Homogeneity total coefficient i get in excel sheet by using matlab.

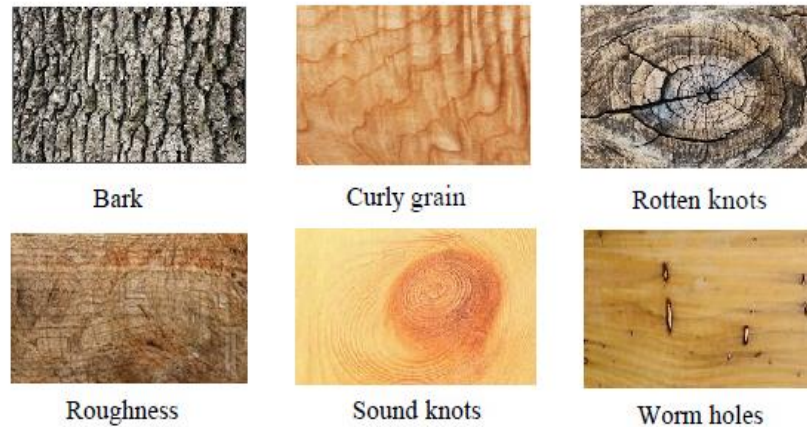


Figure 1: Plywood defect type, there are 6 distinct type defect that need to be identified by the neural network

## 2. Research Methodology:

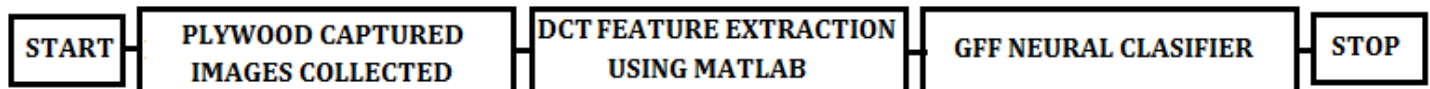


Figure 2 Methodology of work

In this paper to study Wood Defect Identification Using Generalized Feed Forward Neural Network. Data acquisition for the proposed classifier designed for the Recognition of wood defect shall be in the form of plywood captured images. Image data will be Collected from the different- different sawmills .The most important un correlated features as well as coefficient from the images will be extracted .In order to extract features, statistical techniques, image processing techniques, DCT transformed domain will be used.

## 3. NEURAL NETWORKS

Following Neural Networks are tested: Feed-Forward Neural Networks

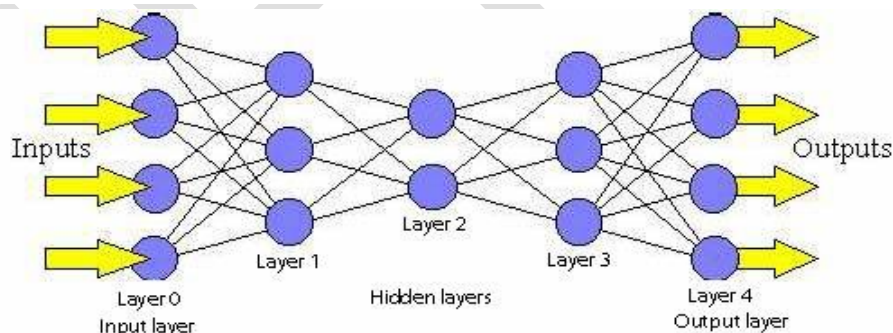


Figure 3 feed-forward network.

Feed-forward networks have the following characteristics:

1. Perceptrons are arranged in layers, with the first layer taking in inputs and the last layer producing outputs. The middle layers have no connection with the external world, and hence are called hidden layers.

2. Each perceptron in one layer is connected to every perceptron on the next layer. Hence information is constantly "fed forward" from one layer to the next., and this explains why these networks are called feed-forward networks.
3. There is no connection among perceptrons in the same layer.

A single perceptron can classify points into two regions that are linearly separable. Now let us extend the discussion into the separation of points into two regions that are not linearly separable. Consider the following network:

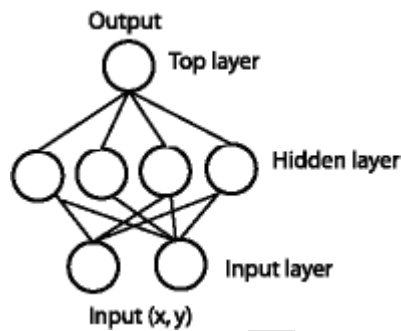


Figure. 3.2 A feed-forward network with one hidden layer.

The same  $(x, y)$  is fed into the network through the perceptrons in the input layer. With four perceptrons that are independent of each other in the hidden layer, the point is classified into 4 pairs of linearly separable regions, each of which has a unique line separating the region.

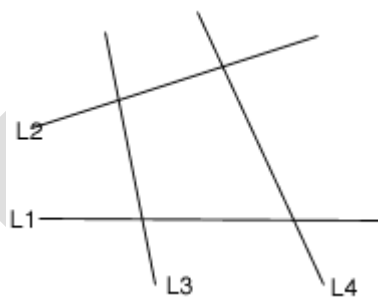


Figure 3.3 lines each dividing the plane into 2 linearly separable regions.

The top perceptron performs logical operations on the outputs of the hidden layers so that the whole network classifies input points in 2 regions that might not be linearly separable. For instance, using the AND operator on these four outputs, one gets the intersection of the 4 regions that forms the center region.

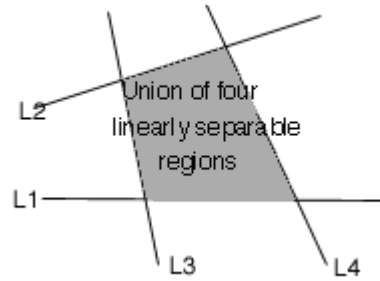


Figure 3.4 Intersection of 4 linearly separable regions forms the center region.

By varying the number of nodes in the hidden layer, the number of layers, and the number of input and output nodes, one can classification of points in arbitrary dimension into an arbitrary number of groups. Hence feed-forward networks are commonly used for classification.

#### 4. Learning Rules used:

##### ➤ Momentum

Momentum simply adds a fraction  $m$  of the previous weight update to the current one. The momentum parameter is used to prevent the system from converging to a local minimum or saddle point. A high momentum parameter can also help to increase the speed of convergence of the system. However, setting the momentum parameter too high can create a risk of overshooting the minimum, which can cause the system to become unstable. A momentum coefficient that is too low cannot reliably avoid local minima, and can also slow down the training of the system.

##### ➤ Conjugate Gradient

CG is the most popular iterative method for solving large systems of linear equations. CG is effective for systems of the form  $Ax=b$  (1) where  $x$  is an unknown vector,  $b$  is a known vector, and  $A$  is a known, square, symmetric, positive-definite (or positive-indefinite) matrix. (Don't worry if you've forgotten what "positive-definite" means; we shall review it.) These systems arise in many important settings, such as finite difference and finite element methods for solving partial differential equations, structural analysis, circuit analysis, and math homework.

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from  $u_i$  to  $u_j$  is given by:  $\Delta w_{ij} = r * a_i * e_j$ , where  $r$  is the learning rate,  $a_i$  represents the activation of  $u_i$  and  $e_j$  is the difference between the expected output and the actual output of  $u_j$ . If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

It has been shown that for networks with linear activation functions and with no hidden units (hidden units are found in networks with more than two layers), the error squared vs. the weight graph is a paraboloid in  $n$ -space. Since the proportionality constant is negative, the graph of such a function is concave upward and has a minimum value. The vertex of this paraboloid represents the point where the error is minimized. The weight vector corresponding to this point is then the ideal weight vector.

##### ➤ Quick propagation

Quick propagation (Quickprop) [1] is one of the most effective and widely used adaptive learning rules. There is only one global parameter making a significant contribution to the result, the  $\epsilon$ -parameter. Quick-propagation uses a set of heuristics to optimise Back-propagation, the condition where  $\epsilon$  is used is when the sign for the current slope and previous slope for the weight is the same.

### ➤ Delta by Delta

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from  $u_i$  to  $u_j$  is given by:  $\Delta w_{ij} = r * a_i * e_j$ , where  $r$  is the learning rate,  $a_i$  represents the activation of  $u_i$  and  $e_j$  is the difference between the expected output and the actual output of  $u_j$ . If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

It has been shown that for networks with linear activation functions and with no hidden units (hidden units are found in networks with more than two layers), the error squared vs. the weight graph is a paraboloid in  $n$ -space. Since the proportionality constant is negative, the graph of such a function is concave upward and has a minimum value. The vertex of this paraboloid represents the point where the error is minimized. The weight vector corresponding to this point is then the ideal weight vector. [10]

## 5. RESULT

The GFF neural network has been simulated for 50 different images of plywood out of which 12 were used for training purpose and 12 were used for cross validation.

The simulation of best classifier along with the confusion matrix is shown below :

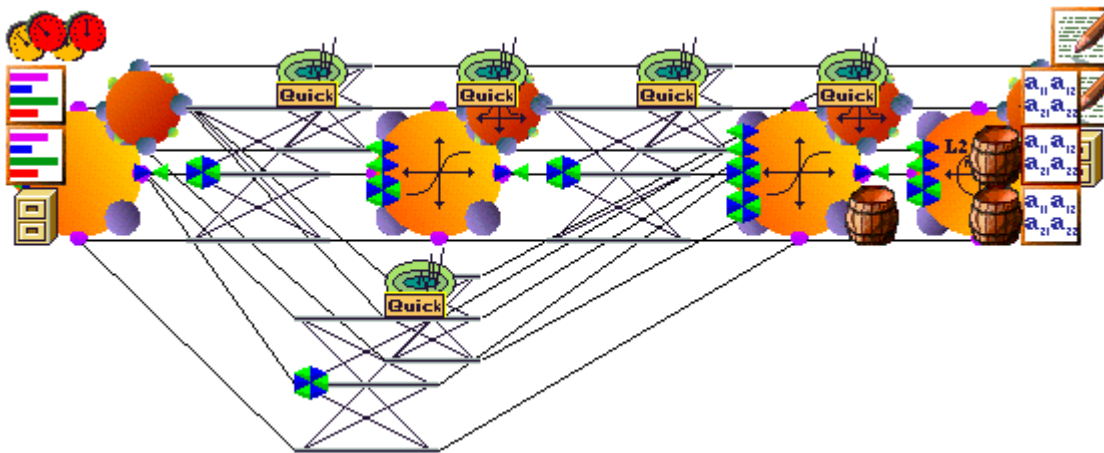


Fig.3.1 GFF neural network trained with QP learning rule

<b>Output / Desired</b>	<i>NAME(WORM HOLES)</i>	<i>NAME(SOUND KNOTS)</i>	<i>NAME(ROUGHNESS)</i>	<i>NAME(ROTTEN KNOTS)</i>	<i>NAME(CURLY GRAIN)</i>	<i>NAME(BARK)</i>
<i>NAME(WORM HOLES)</i>	1	0	0	0	0	0
<i>NAME(SOUND KNOTS)</i>	0	1	0	0	0	0
<i>NAME(ROUGHNESS)</i>	0	0	3	0	0	1
<i>NAME(ROTTEN KNOTS)</i>	0	0	0	1	0	1
<i>NAME(CURLY GRAIN)</i>	0	0	0	0	2	0
<i>NAME(BARK)</i>	0	0	0	1	0	1

Table I. Confusion matrix on CV data set

<b>Output / Desired</b>	<i>NAME(WORM HOLES)</i>	<i>NAME(SOUND KNOTS)</i>	<i>NAME(ROUGHNESS)</i>	<i>NAME(ROTTEN KNOTS)</i>	<i>NAME(CURLY GRAIN)</i>	<i>NAME(BARK)</i>
<i>NAME(WORM HOLES)</i>	4	0	0	0	0	0
<i>NAME(SOUND KNOTS)</i>	0	2	0	0	0	0
<i>NAME(ROUGHNESS)</i>	0	0	8	0	0	0
<i>NAME(ROTTEN KNOTS)</i>	0	0	0	7	0	0
<i>NAME(CURLY GRAIN)</i>	0	0	0	0	7	0
<i>NAME(BARK)</i>	0	0	0	0	0	10

TABLE II. Confusion matrix on Training data set

Here Table I and Table II Contend the C.V as well as Training data set.

<b>Performance</b>	<i>NAME(WORM HOLES)</i>	<i>NAME(SOUND KNOTS)</i>	<i>NAME(ROUGHNESS)</i>	<i>NAME(ROTTEN KNOTS)</i>	<i>NAME(CURLY GRAIN)</i>	<i>NAME(BARK)</i>
MSE	0.07398213	0.006524388	0.239449026	0.154823869	0.05864414	0.158172086
NMSE	0.968493341	0.085410166	1.277061471	1.11473186	0.422237806	0.843584459
MAE	0.111414417	0.064973981	0.32941733	0.234875177	0.133033782	0.195991144
Min Abs Error	0.010544895	0.007503917	0.010263846	0.004744665	0.004879127	0.00489623
Max Abs Error	0.933000404	0.17389578	1.043488912	0.930368191	0.752958851	1.037152624
r	0.645112821	0.957759162	0.195902108	0.029740522	0.788597963	0.540613778
Percent Correct	100	100	100	50	100	33.33333333

TABLE III. Accuracy of the network on CV data set

<b>Performance</b>	<b>NAME(WORM HOLES)</b>	<b>NAME(SOUND KNOTS)</b>	<b>NAME(ROUGHNESS)</b>	<b>NAME(ROTTEN KNOTS)</b>	<b>NAME(CURLY GRAIN)</b>	<b>NAME(BARK)</b>
MSE	0.001431667	0.002349799	0.003854274	0.003374651	0.001789275	0.005900982
NMSE	0.015200937	0.047126525	0.023189881	0.022456203	0.011906514	0.030432208
MAE	0.031659477	0.042040336	0.041625525	0.0430089	0.038909737	0.047642133
Min Abs Error	0.001247344	0.007220327	0.000675769	0.004910652	0.008827058	0.003969832
Max Abs Error	0.055467508	0.15581342	0.240600975	0.226140374	0.081814073	0.387065849
r	0.995494137	0.980247978	0.988911016	0.988714387	0.995812127	0.984999253
Percent Correct	100	100	100	100	100	100

TABLE IV. Accuracy of the network on training data set

Here Table III and Table IV Contain the C.V and Training result.

## 6.CONCLUSION

This paper demonstrated how artificial neural networks(ANN)could be used to build accurate wood defect classifier. In order to train the neural network we extract shape features from real plywood images that we captured at earlier time. We use Generalized Feed-Forward Network as classification. The result show that in training 100% accuracy but in cross-validation result rotten knots is 50% and bark is 33.33% is rest of 100% is not good.

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IJERGS

# CLASSIFICATION OF WATERSHED AND RAINFALL-RUNOFF MODELLING USING SOM, LINEAR REGRESSION ANALYSIS AND ANN

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**ABSTRACT:** - This study presents the homogeneity between various watersheds having similar geomorphological parameters that are significantly responsible for transferring rainfall into runoff. Geomorphological information of watersheds under consideration has been extracted from USGS website. Based on geomorphological parameters, self organizing map (SOM) is used to classify the watersheds. Rainfall and runoff model is then developed using ANN and Regression model for the catchment of each group. The performance of the developed ANN and regression model is evaluated for the other catchments of their group. In this study MAHARASTRA five rivers GHARNI, LIMBGANESH, NITUR, NALEGAON and YELLAMGHAT and the AMERICAN river MISSISSIPPI's tributaries considered.

**(1) KEYWORDS:** - watershed, Artificial neural network, Regression analysis

**(2) INTRODUCTION:-** Runoff data is most important for the effective management of water resources and also for solving many engineering problems such as forecasting stream flow for the purpose of water supply, flood control, irrigation, drainage, water quality, power generation, recreation, etc. again the rainfall to runoff transformation process is one of the most complex hydrologic phenomena to analyze due to the tremendous spatial and temporal variability of watershed characteristics and precipitation patterns, and the number of geomorphological parameter that are involved in the modeling processes.

Various methods have been developed to simulate the rainfall runoff process in the catchment. They can be classified as conceptual model and data driven model. The conceptual models are based on the several assumptions so as to simplify the model as there may be many variables which are difficult to consider all and also to have acceptability along with their assumption. These models require data to evaluate their performance and acceptability, for example unit hydrograph by SHERMAN (1932). On the other hand data driven models are developed and validated completely based only on the length of the data series, for example ANN and regression model.

It has been observed that most of the Indian catchments are ungauged due to high recurring expenditure. As a result, it is difficult to develop conceptual model and data driven model over these catchments. Therefore this study evaluates the performance of the rainfall-runoff model developed for a particular catchment on a geomorphologic similar catchment.

In this study, rainfall runoff model is then developed using ANN and regression model for the catchment of each group. The performance of developed ANN and regression model is evaluated for the other catchment of their group.

## **(3) REGRESSION ANALYSIS FOR RAINFALL-RUNOFF MODEL:-**

**(1) YELLAMGHAT** river shows following Rainfall-Runoff pattern for regression model, after using several input and output,

Fig (1.1) shows the phenomenon of six days of rainfall and one day runoff and in the equation of fig (1.1) whereas

$Q(t+1)$  is next day's runoff,

$X_1R(t), R(t-1), R(t-2), R(t-3) + X_5R(t-4) + X_6R(t-5)$  is the previous 6 days rainfall,

$X_7Q(t)$  is previous one day runoff,

$X_i$  is the regression coefficient, and  $C$  is constant (intercept).

Fig (1.2) shows the regression analysis using artificial neural network tools on mat lab and presents the training, validation results and gives the value of regression 'R'.

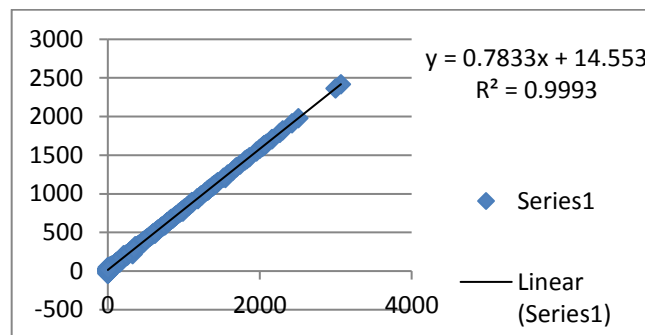


Fig (1.1) for RR Equation  $Q(t+1) = C = X_1R(t) + X_2R(t-1) + X_3R(t-2) + X_4R(t-3) + X_5R(t-4) + X_6R(t-5) + X_7Q(t)$

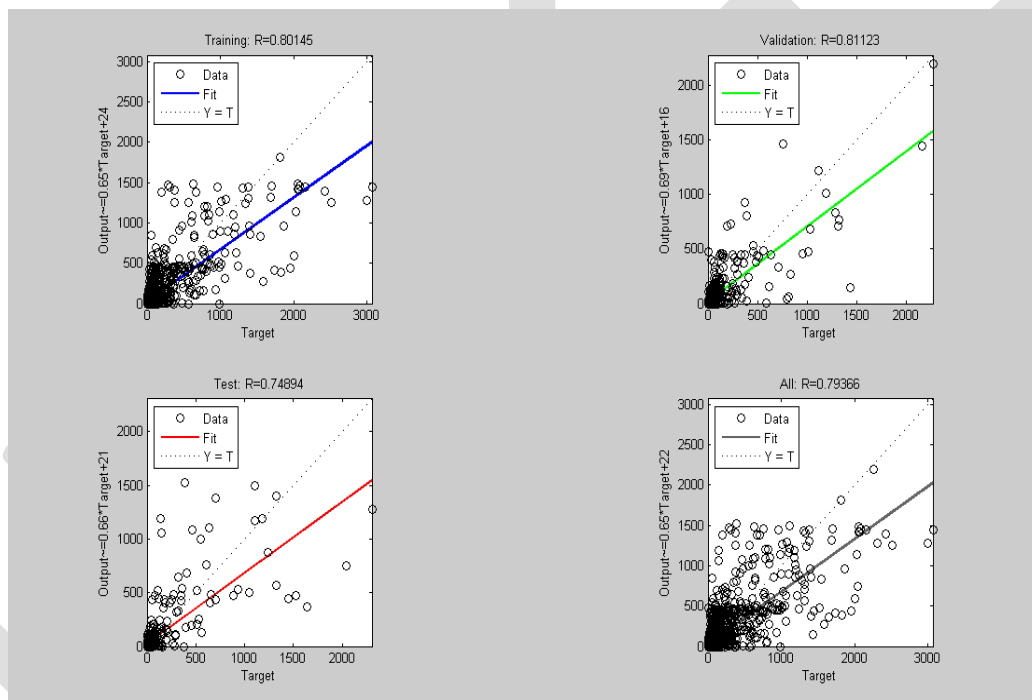


Fig (1.2) Regression by artificial neural network for YELLAMGHAT

(2) NALEGAON river shows following Rainfall-Runoff pattern for regression model, after using several input and output,

Fig (2.1) shows the phenomenon of six days of rainfall and one day runoff of NALEGAON and in the equation of fig (2.1) whereas

$Q(t+1)$  is next day's runoff,

$X_1R(t), R(t-1), R(t-2), R(t-3) + X_5R(t-4) + X_6R(t-5)$  is the previous 6 days rainfall,

$X_7Q(t)$  is previous one day runoff,

$X_i$  is the regression coefficient, and C is constant (intercept).

Fig (2.2) shows the regression analysis using artificial neural network software on mat lab and presents the training, validation results and gives the value of regression 'R'.

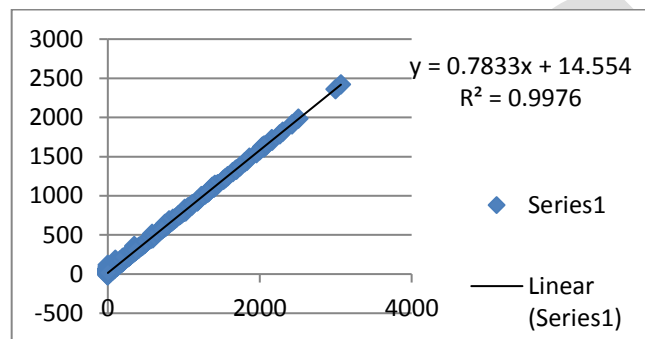


Fig (2.1) for RR Equation  $Q(t+1) = C + X_1R(t) + X_2R(t-1) + X_3R(t-2) + X_4R(t-3) + X_5R(t-4) + X_6R(t-5) + X_7Q(t)$

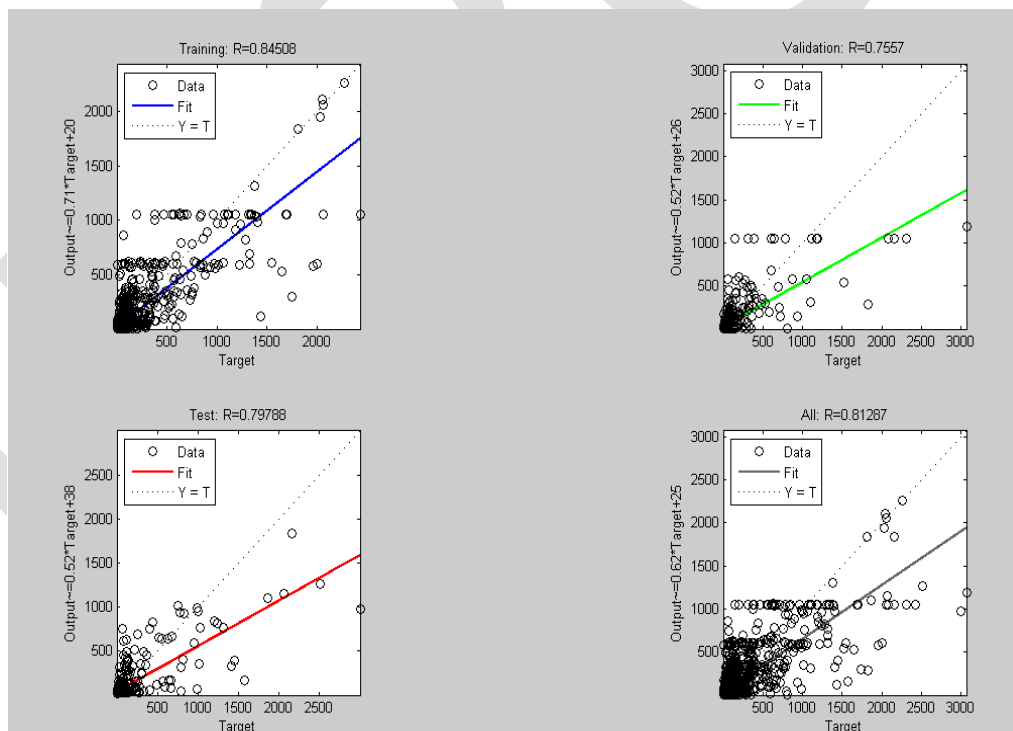


Fig (2.2) Regression by artificial neural network for NALEGAON

**TABLE 1 REGRESSION ANALYSIS ON MS EXCEL FOR VARIOUS CATCHMENTS:**

This table shows the values by regression analysis on ms excel for various catchments. Input 7(6-1) shows, 6 days of rainfall and 1 day of runoff, same as various inputs are proceeding.

On applying various inputs of rainfall-runoff equations we see that the value of 'R<sup>2</sup>' varies. For example if we discuss about the GHARNI catchment we find the best value of 'R<sup>2</sup>' for 6 days of rainfall and 1 day of runoff because the value of 'R<sup>2</sup>' should be closer to 1 for perfect regression analysis.

Similarly for LIMBGANES, NITUR, NALEGAON and YELLAMGHAT, we use the best value of 'R<sup>2</sup>' for analysis.

S.N.	CATCHMENTS	INPUT (Rainfall- Runoff)	LINEAR EQUATION	VALUE OF 'R <sup>2</sup> '
1	GHARNI	7 (6-1)	$y = 0.785x + 14.45$	0.943
2	GHARNI	6 (5-1)	$y = 0.785x + 14.45$	0.908
3	GHARNI	5 (4-1)	$y = 0.785x + 14.45$	0.908
4	GHARNI	4 (3-1)	$y = 0.785x + 14.45$	0.91
5	GHARNI	3 (2-1)	$y = 0.785x + 14.45$	0.913
6	LIMBGANESH	7 (6-1)	$y = 0.783x + 14.55$	0.991
7	LIMBGANESH	6 (5-1)	$y = 0.783x + 14.55$	0.991
8	LIMBGANESH	5 (4-1)	$y = 0.783x + 14.55$	0.991
9	LIMBGANESH	4 (3-1)	$y = 0.783x + 14.55$	0.991
10	LIMBGANESH	3 (2-1)	$y = 0.783x + 14.55$	0.991
11	NALEGAON	7 (6-1)	$y = 0.783x + 14.55$	0.997
12	NALEGAON	6 (5-1)	$y = 0.783x + 14.55$	0.997
13	NALEGAON	5 (4-1)	$y = 0.783x + 14.55$	0.997
14	NALEGAON	4 (3-1)	$y = 0.783x + 14.55$	0.998
15	NALEGAON	3 (2-1)	$y = 0.783x + 14.55$	0.999
16	NITUR	7 (6-1)	$y = 0.783x + 14.56$	0.982

17	NITUR	6 (5-1)	$y = 0.783x + 14.56$	0.982
18	NITUR	5 (4-1)	$y = 0.783x + 14.56$	0.982
19	NITUR	4 (3-1)	$y = 0.783x + 14.56$	0.982
20	NITUR	3 (2-1)	$y = 0.783x + 14.56$	0.982
21	YELLAMGHAT	7 (6-1)	$y = 0.783x + 14.55$	0.999
22	YELLAMGHAT	6 (5-1)	$y = 0.783x + 14.55$	0.999
23	YELLAMGHAT	5 (4-1)	$y = 0.783x + 14.55$	0.999
24	YELLAMGHAT	4 (3-1)	$y = 0.783x + 14.55$	0.999
25	YELLAMGHAT	3 (2-1)	$y = 0.783x + 14.55$	0.999

**Table 1**

**TABLE 2: REGRESSION ANALYSIS ON MATLAB BY ANN TOOLS FOR VARIOUS CATCHMENTS:**

This table shows value of 'R' by artificial neural network for validation, test, training and overall regression for 5 catchments of Maharashtra.

S. N.	CATCHMENTS	VALUE OF 'R'			
		TRAINING	VALIDATION	TEST	ALL
1	GHARNI	0.85196	0.80846	0.88913	0.8541
2	LIMBGANESH	0.8008	0.72922	0.777	0.77437
3	NALEGAON	0.84508	0.7557	0.79788	0.81287
4	NITUR	0.86562	0.72123	0.85452	0.82407
5	YELLAMGHAT	0.80145	0.81123	0.74894	0.70366

**Table 2**

**(4) RESULT:**

**(4.1) SIMILARITY B/W GHARNI and 07047800 St. Francis River at PARKIN, AR**

As we have grouped the catchments of all rivers by self organizing map tool based on their geomorphological parameters as obtained from USGS site, we found river GHARNI and Francis in same group. After applying regression equation of GHARNI river catchment on St. Francis River the validation results were satisfactory with  $R^2$  value as 0.699 as shown below fig. 4.1.

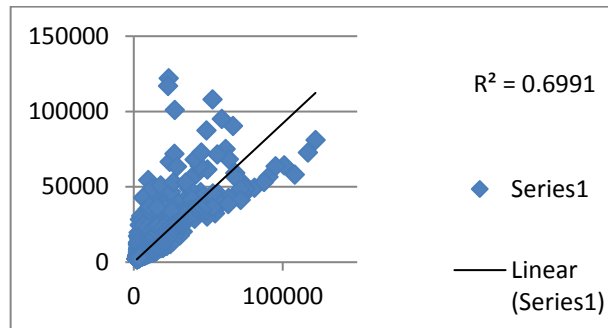


FIG 4.1

#### (4.2) SIMILARITY B/W LIMBGANESH catchment and 07050500 Kings River near Berryville, AR

Similarly 4.1, as we have grouped the catchments of all rivers by self organizing map tool based on their geomorphological parameters as obtained from USGS site, we found river LIMBGANESH and Kings in same group. After applying regression equation of LIMBGANESH river catchment on Kings River the validation results were satisfactory with  $R^2$  value as 0.636 as shown below fig. 4.2.

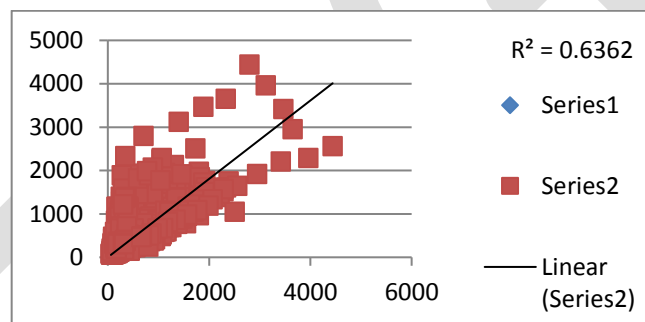


FIG 4.2

#### (4.3) SIMILARITY B/W NITUR catchment and 07056000 Buffalo River near St. Joe, AR

Similarly 4.1, as we have grouped the catchments of all rivers by self organizing map tool based on their geomorphological parameters as obtained from USGS site, we found river NITUR and Buffalo in same group. After applying regression equation of NITUR river catchment on Buffalo River the validation results were satisfactory with  $R^2$  value as 0.590 as shown below fig. 4.3.

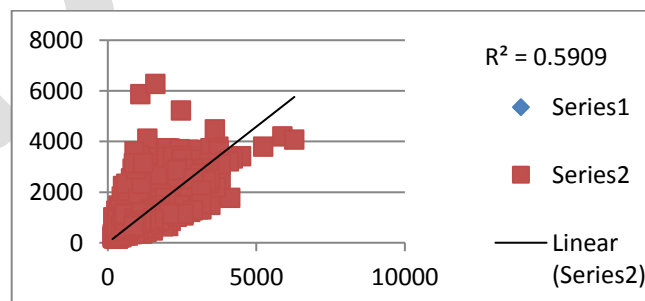


FIG 4.3

#### (4.4) SIMILARITY B/W YELLAMGHAT catchment and 07260640 Petit Jean River near Centerville, AR

Similarly 4.1, as we have grouped the catchments of all rivers by self organizing map tool based on their geomorphological parameters as obtained from USGS site, we found river YELLAMGHAT and Petit Jean in same group. After applying regression equation of YELLAMGHAT river catchment on Petit Jean River the validation results were satisfactory with  $R^2$  value as 0.836 as shown below fig. 4.4.

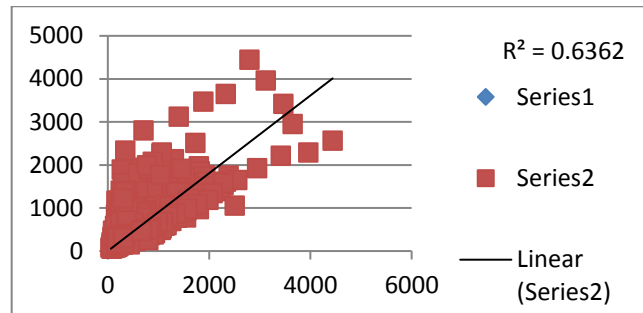


FIG 4.4

#### (4.5) SIMILARITY B/W NALEGAON catchment and 01480870 East Branch Brandywine Creek below Downingtown, PA

Similarly 4.1, as we have grouped the catchments of all rivers by self organizing map tool based on their geomorphological parameters as obtained from USGS site, we found river NALEGAON and East Branch Brandywine Creek in same group. After applying regression equation of NALEGAON river catchment on East Branch Brandywine Creek River the validation results were satisfactory with  $R^2$  value as 0.97 as shown below fig. 4.5.

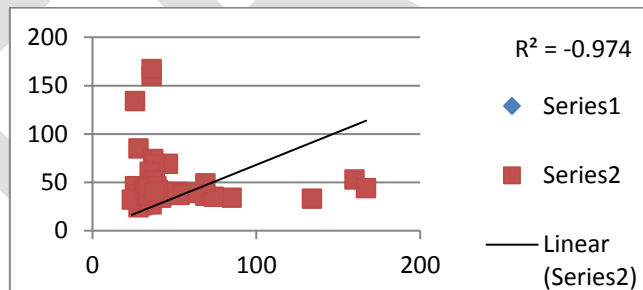


FIG 4.5

#### (5) CONCLUSION:

This study present a methodology to classify the watershed based on the geomorphological parameters. Self organizing map (SOM) is used to classify the watershed around 16 geomorphological parameter are used in the study. ANN model is then developed to simulate the rainfall runoff model of the catchment. It is also studied the applicability of the ANN and linear regression model on the similar watershed which has been grouped based on the geomorphological parameters. It has been observed that the classification done on the basis of catchment area, is more appropriate and the hydrological models developed using ANN and linear regression are applicable to those catchments.

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# Application of FACTS devices in wind farm

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**Abstract-** The problem of voltage dip due to load is common in the system where wind farm based on SCIG is connected to a weak network and the main reason of problem, reactive power capability of network is insufficient to meet the demand of wind farm. Now a days power electronics based FACTS devices are more popular for reactive power compensation in power system network to provide voltage stability. This paper analysis the application of FACTS devices in wind farm using squirrel cage induction generator. FACTS devices are used to enhance the voltage stability of wind farm based on squirrel cage induction generator and thereby protecting SCIG-based wind farm interconnected to the power system from isolating during and after disturbances. Here we are using STATCOM and SVC to provide reactive compensation for maintaining voltage stability in power system having wind farm connected to a grid system. The power system model is simulated in MATLAB / SIMULINK.

**Keywords-** Wind Farm, Grid, SCIG, Flexible AC transmission system (FACTS), STATCOM, SVC, voltage stability

## I. INTRODUCTION

The concept of wind farm is based on fixed speed wind turbine. A squirrel cage induction generator (SCIG) based wind farm is used. Only very small rotational speed variation is accepted by this generator; therefore these wind turbines are considered to operate at fixed speed. Here we are analyzing a Wind Farm based on squirrel cage induction generator (SCIG) connected to a grid and effect of load that create the problem of voltage stability. Because this generator type can't provide adjustable Reactive power control it can't fulfill the demanding grid code requirements [1] without additional devices. During voltage dips the induction generators may consume a large amount of reactive power as their speed deviates from the synchronous speed, which can lead to a voltage collapse in the network. Due to advance technology in power electronics FACTS devices are invented. FACTS devices used to mitigate the problem of voltage stability and help to protect SCIG based wind farm from tripping due to disturbances. Here we are using FACTS devices like STATCOM and SVC. STATCOM is a type of FACTS device that provide reactive power compensation and improve voltage stability [2] and also help in transient stability. SVC is also a FACTS device that provide reactive power compensation and improve system voltages but STATCOM response to problem faster than SVC.

## II. STATIC COMPENSATOR (STATCOM)

STATCOM systems essentially consist of a DC voltage source behind self commutated inverters using insulated gate bipolar transistor (IGBT), gate turn-off (GTO), or gate commutated turn-off (GCT) thyristors and an interconnecting transformer. The voltage source inverter set connects to the power system via a multi-winding or two winding inverter transformer, depending upon the application. The figure here shows the basic STATCOM configuration. An inductor representing the leakage reactance of the transformer connects the two voltage sources. The output voltage phase of the thyristor-based inverter,  $V_i$  is controlled in the same way as the system voltage,  $V_s$ .

The STATCOM is a static var generator whose output can be varied so as to maintain or control certain specific parameters of the electric power system. The STATCOM is capable of generating continuously variable inductive or capacitive shunt compensation at a level up its maximum MVA rating. It is a power electronic component that can be applied to the dynamic control of the reactive power. The reactive output power of the compensator is varied to control the voltage at given transmission network terminals, thus maintaining the desired power flows during possible system disturbances and contingencies.

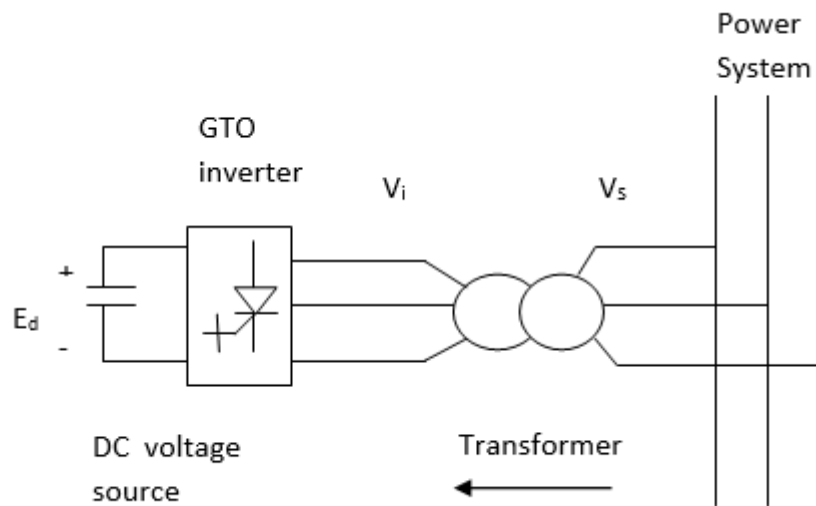


Fig.2.1 Basic arrangement of STATCOM in circuit

VI characteristic of STATCOM

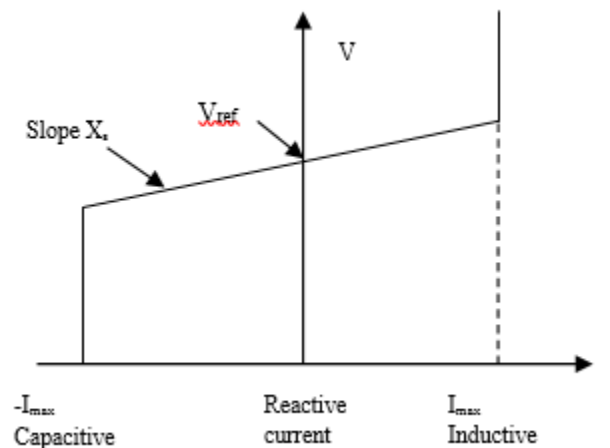


Fig.2.2 VI characteristics of STATCOM

### III. STATIC VAR COMPENSATOR (SVC)

A static VAR compensator is a set of electrical devices for providing fast-acting reactive power on high-voltage electricity transmission networks. SVCs are part of the Flexible AC transmission system device family, regulating voltage, power factor, harmonics and stabilizing the system. Unlike a synchronous condenser which is a rotating electrical machine, a static VAR compensator has no significant moving parts (other than internal switchgear). Prior to the invention of the SVC, power factor compensation was the preserve of large rotating machines such as synchronous condenser or switched capacitor banks. The SVC is an automated impedance matching device, designed to bring the system closer to unity power factor

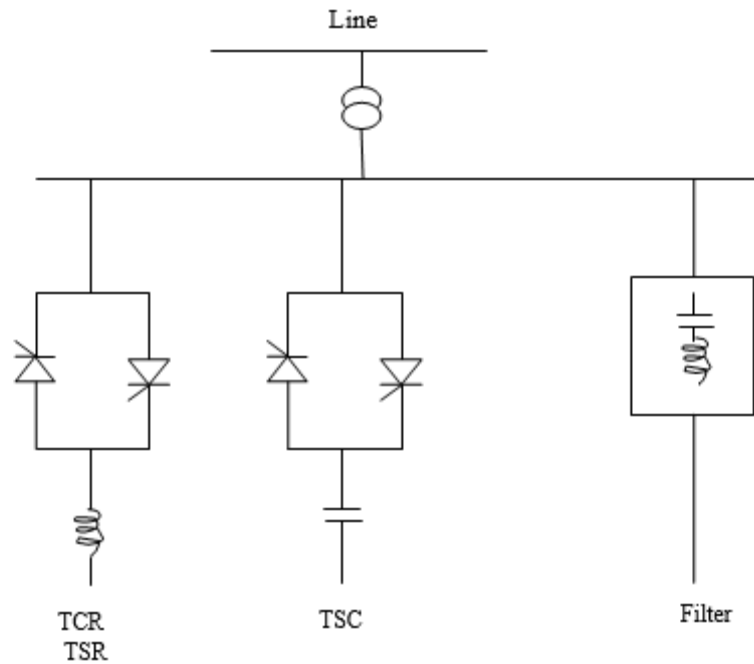


Fig. 3.1 Static Var compensator

VI characteristics of SVC

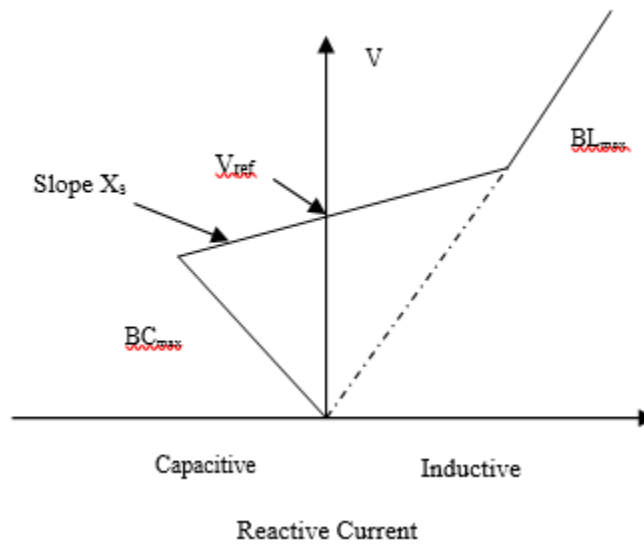


Fig. 3.2 VI Static Var compensator

#### IV. SINGLE LINE DIAGRAM OF TEST SYSTEM

A 9 MW wind farm is connected to Grid through a 30km line and Grid voltage 132KV is step down to 33KV using transformer of 62.5 MVA rating . Two loads are connected at bus 1 and bus 2. Here we are checking the application of FACTS device STATCOM and SVC in voltage stability and its improvement during different load conditions.

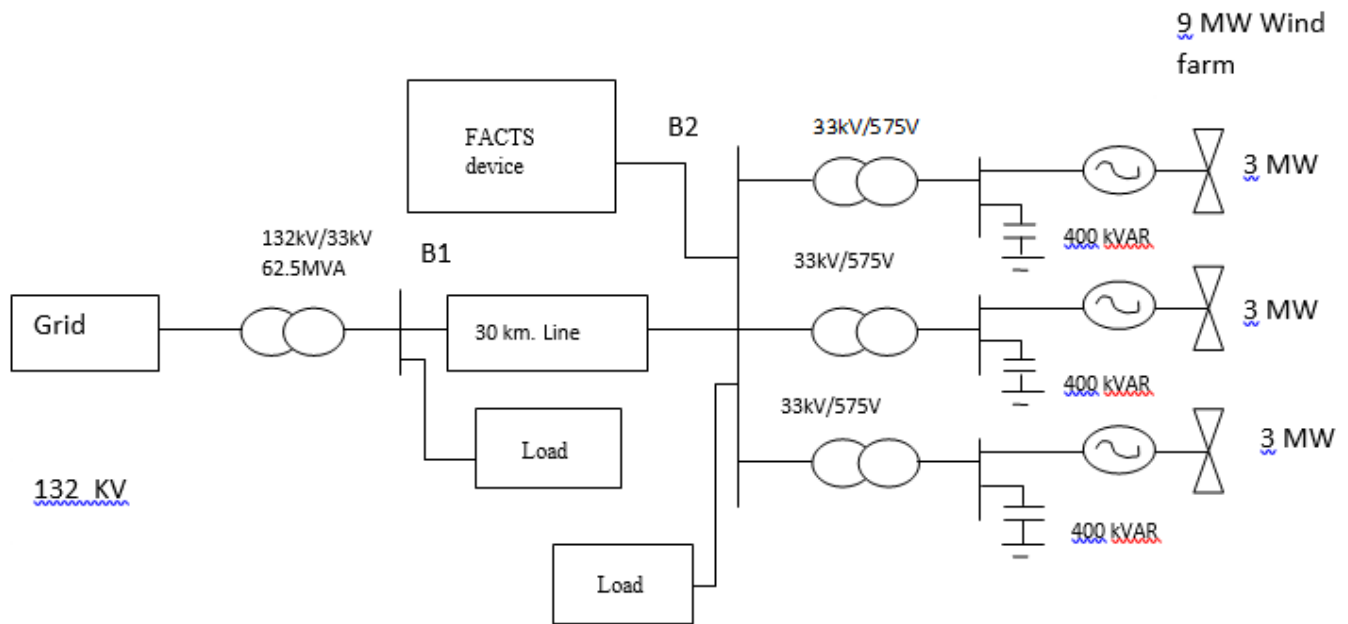


Fig 4.1 Single line diagram of test system

## V. SIMULATION RESULTS WITHOUT FACTS DEVICE

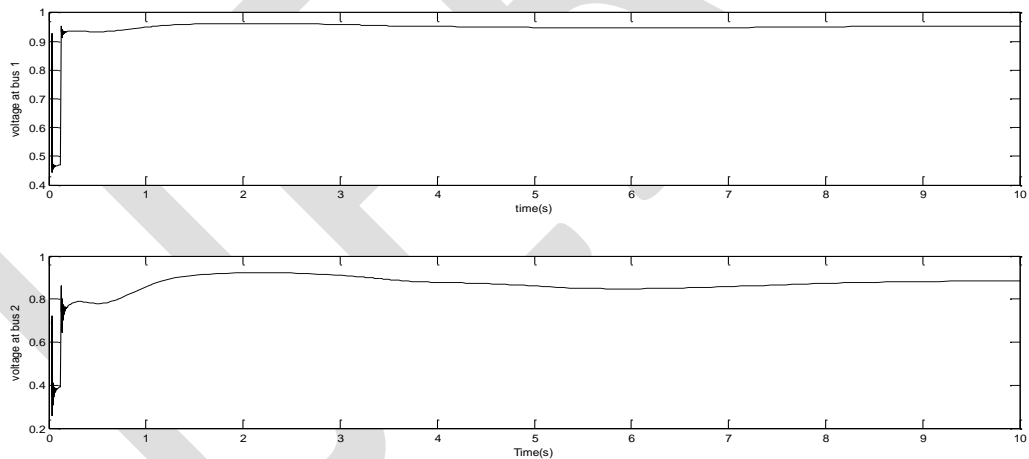


Fig.5.1 Voltage at bus 1 and bus 2 without FACTS device

Output waveform shows when there is no FACTS device is the system then voltage at bus 1 and bus 2 in (pu) respectively are 0.9537 and .88852

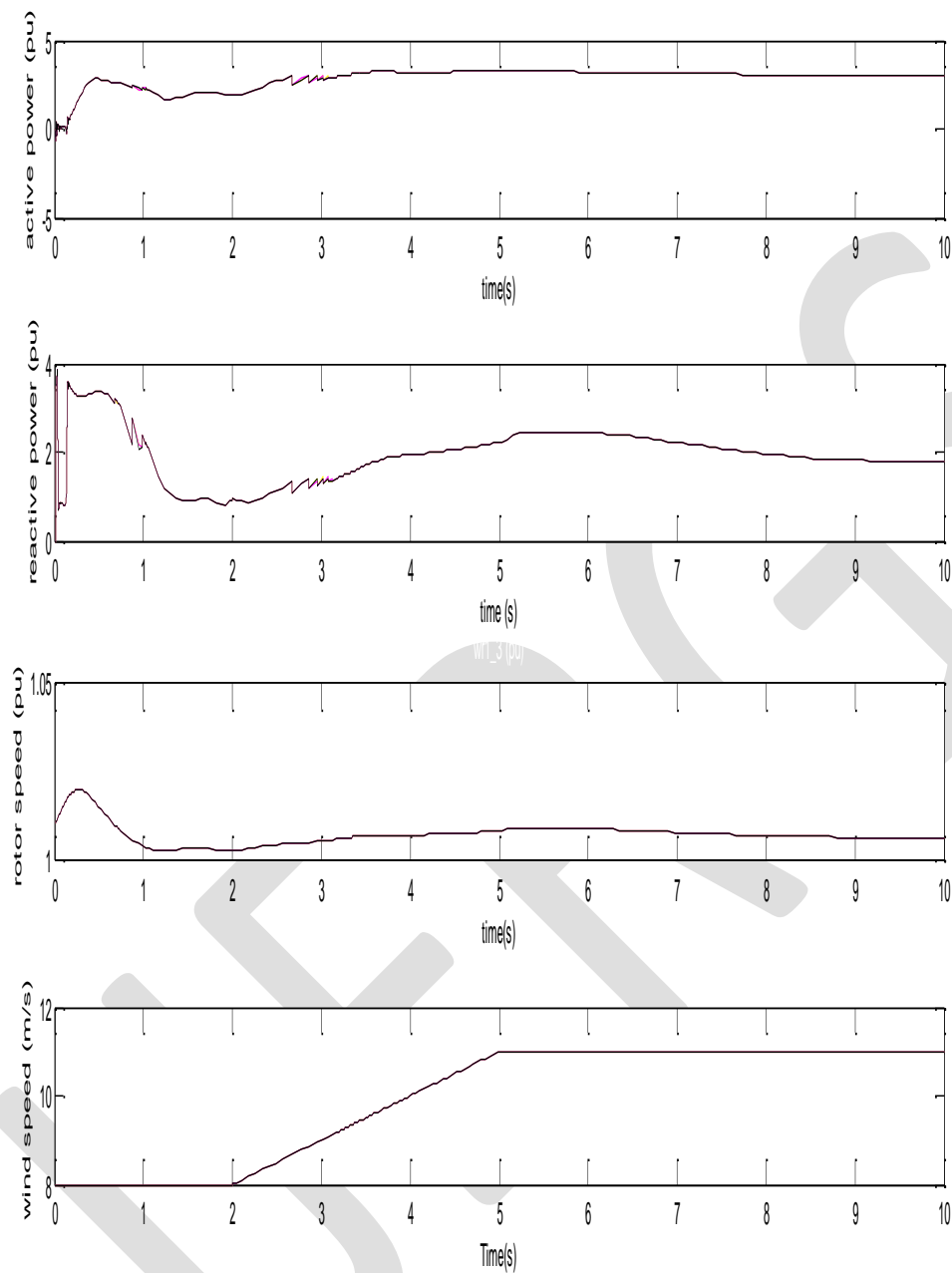


Fig.5.2 Active power, reactive power, rotor speed and wind speed without FACTS device

## VI. SIMULATION RESULTS WITH STATCOM

Output waveforms of voltages at bus 1 and bus 2 with STATCOM are observed as

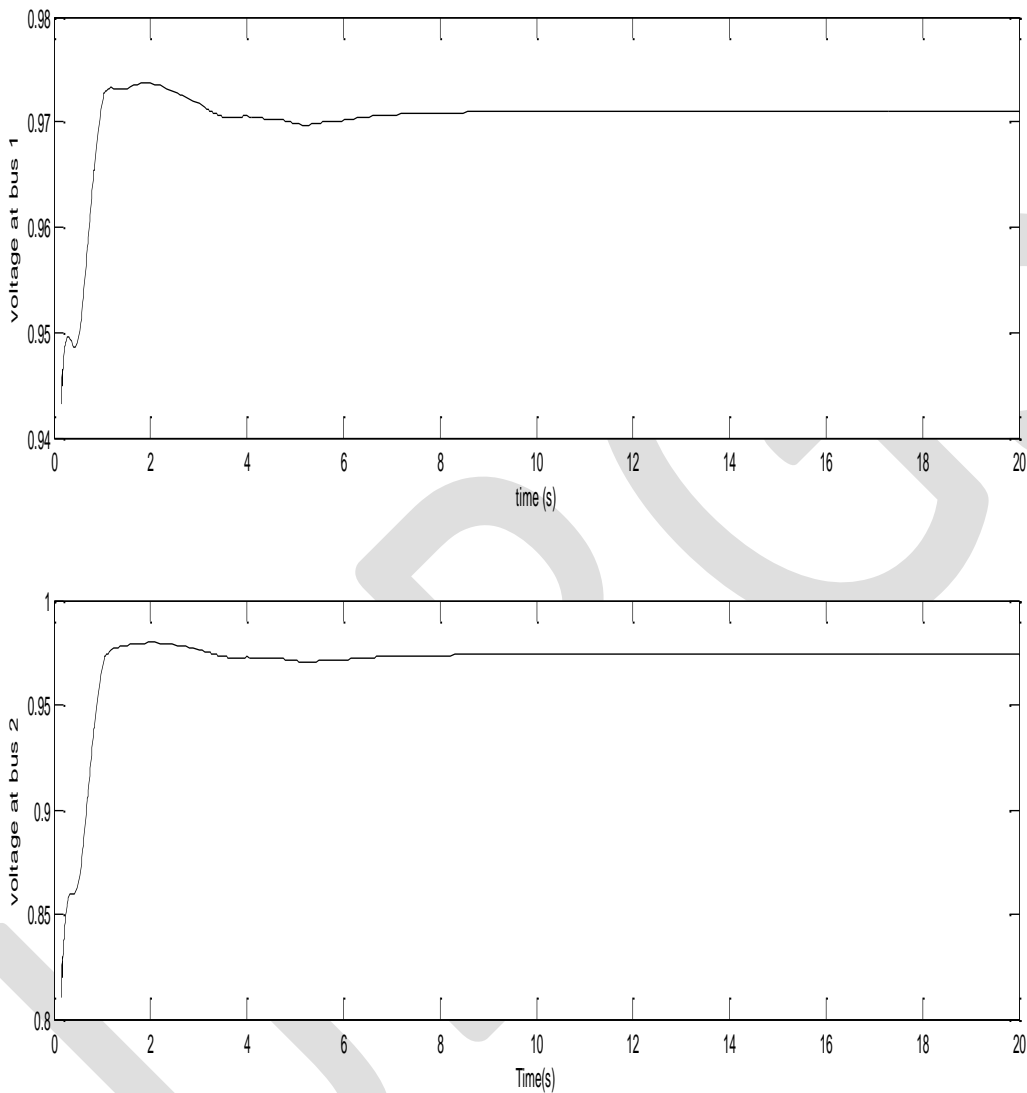


Fig.6.1 Voltage at bus 1 and bus 2 with STATCOM

Output waveform shows Effect of STATCOM in the system. The voltage at bus 1 and bus 2 in (pu) respectively are 0.9711 and .9743. This can be compared to voltage of system without FACTS device and we can see voltage at both bus 1 and bus 2 is improved

Wind farm output Active power , Reactive power , rotor speed and wind speed

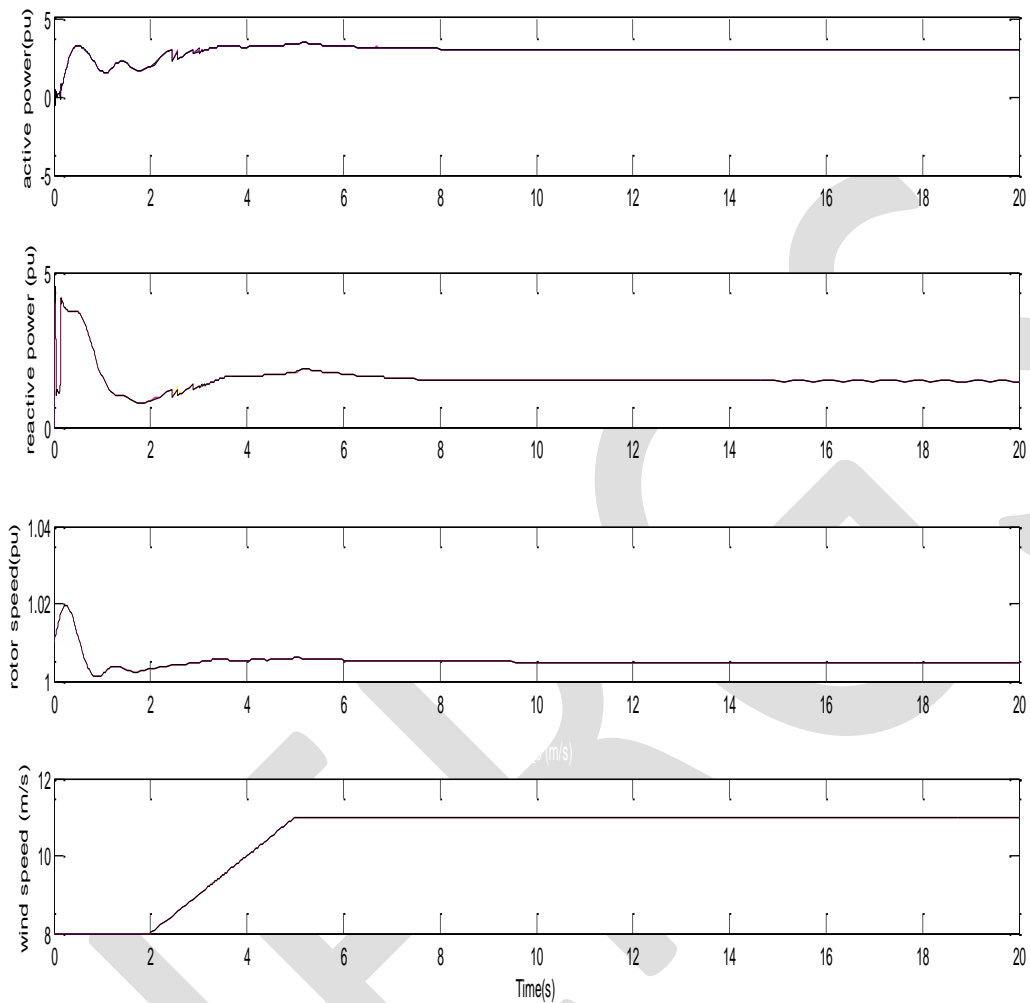


Fig.6.2 Active power, reactive power, rotor speed and wind speed with STATCOM

Output waveform shows when STATCOM is used in system then Active and reactive power of wind farm in (pu) respectively are 3.0 and 1.486.

## VII. SIMULATION RESULTS WITH SVC

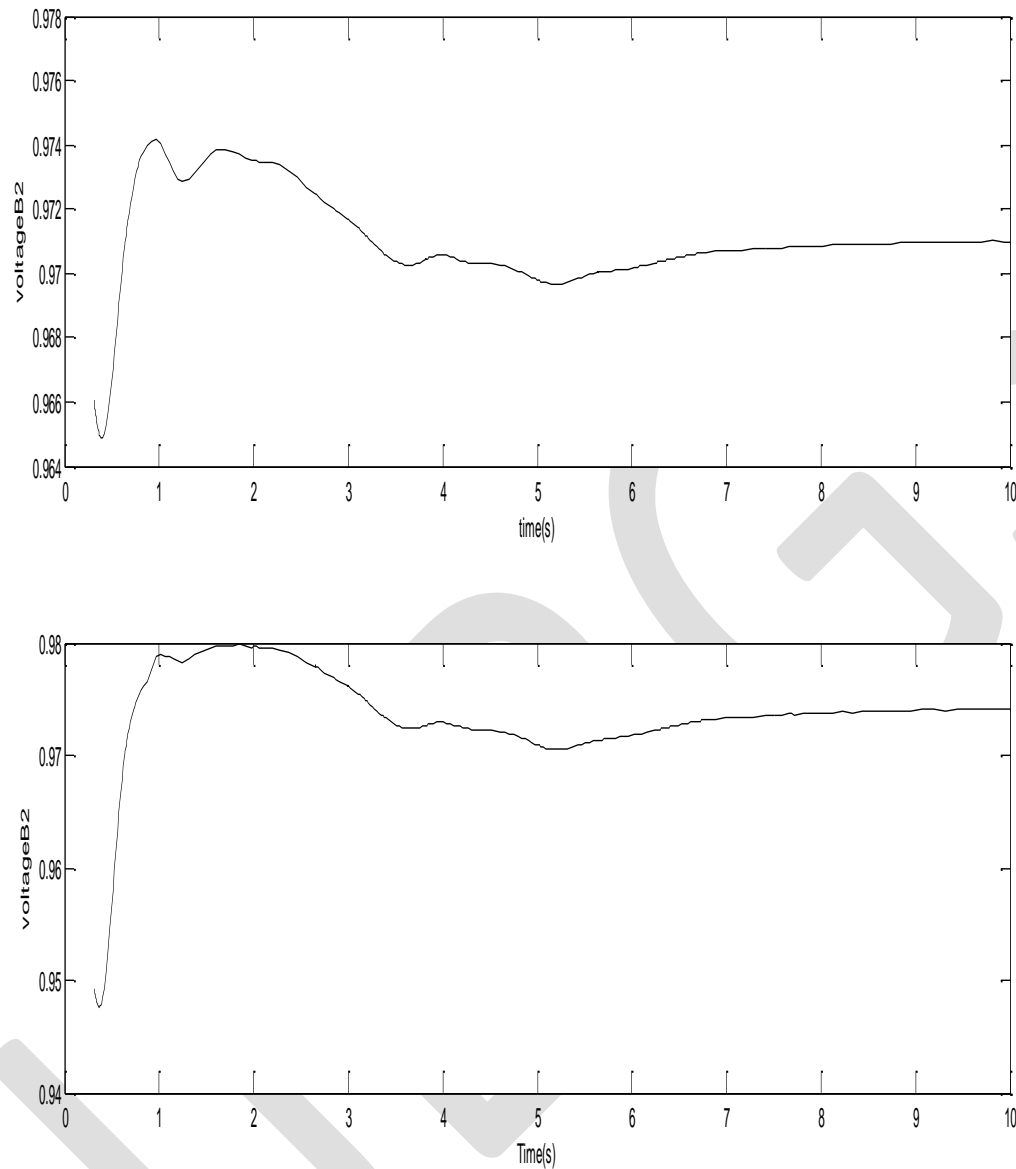


Fig.6.1 Voltage at bus 1 and bus 2 with SVC

Output waveform shows Effect of SVC on the system voltage at bus 1 and bus 2 .Results shows that initially fluctuation in voltages is more compared to STATCOM effect but voltage level improved as compared to without FACTS device.

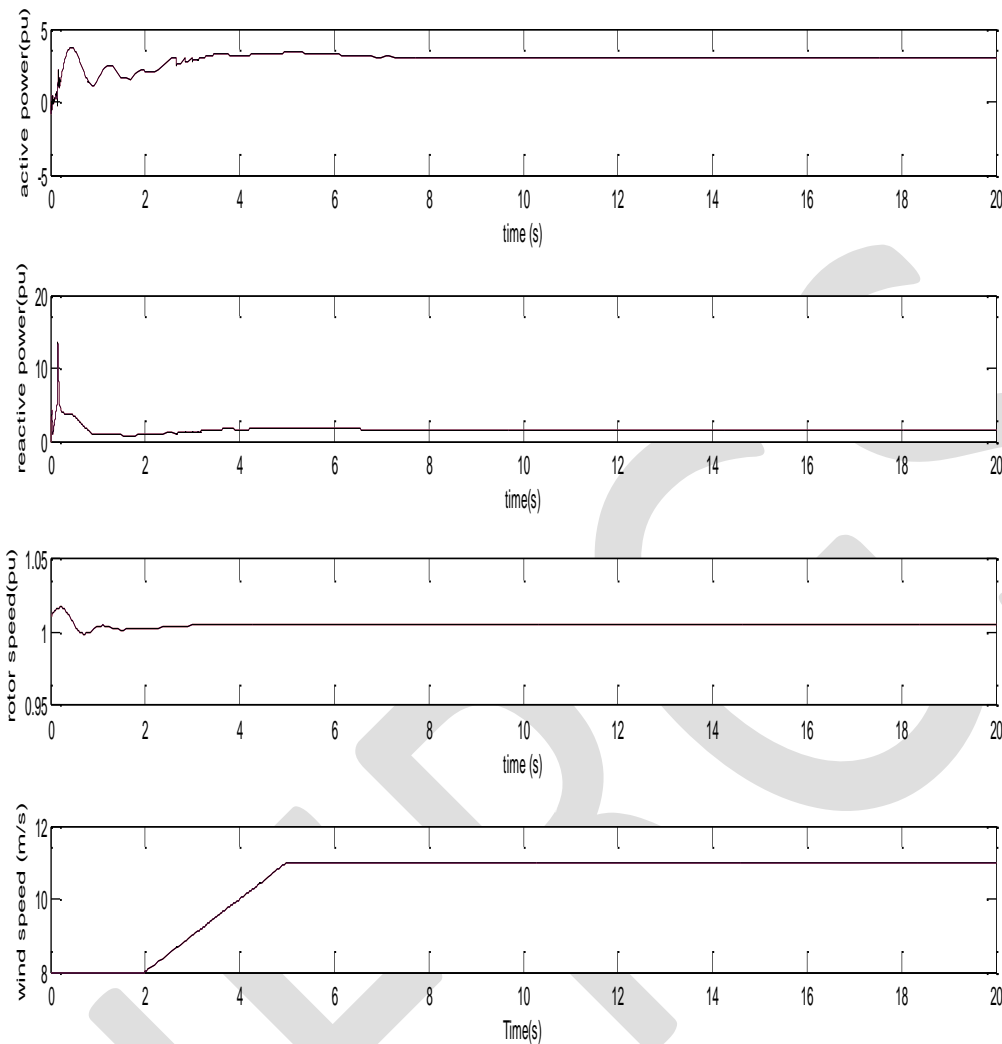


Fig.6.1 Active power, reactive power, rotor speed and wind speed with SVC

## VII. CONCLUSION

Simulation results without FACTS device and with FACTS device is presented in this paper. When a wind farm is connected to a weak power grid, it is necessary to provide efficient power and voltage control during normal operating conditions and enhanced support during load changes. FACTS devices are very advantageous in Wind Farm consists of SCIG that operate at fixed wind speed connected to a Grid system to improve voltage stability at bus bar. There is need to study the system during different loads condition. Study includes the FACTS devices that are used in this paper are STATCOM and SVC. Output waveforms for voltages, active power reactive power, rotor speed and wind speed are shown without FACTS devices and with FACTS devices. Voltage profile at bus 1 and 2 is observed and Active power, reactive power, rotor speed and wind speed are observed for wind farm and waveform clearly shows that FACTS device help in maintaining voltage stability at the bus 1 and 2 and provide reactive support to the wind farm. Model is simulated in MATLAB/SIMULINK

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# Asphalt concrete modeling using discrete element method

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**Abstract:** Pavement is a complex multi phase system which consists of aggregates, binder, filler material and sufficient air voids content. Primary function of a pavement is to transfer loads to the sub base and underlying soil. Pavement failure is one of the major problems associated with asphalt concrete performance. In present the continuous and increasing traffic volume causes pavement failure in asphalt concrete. The main causes of pavement failure are related to material properties, construction techniques, and different traffic loading pattern in term of mode, volume, moisture, and different environmental conditions. To recognize pavement distress or failure phenomena of asphalt concrete like fatigue, rutting, and cracking some advanced modeling techniques are used. These models offered an opportunity for more realistic pavement design procedure with mathematical and computational mechanics improved ability to predict pavement response to traffic load and environment effect. In this paper we discussed about an advanced and valuable modeling approach discrete element modeling (DEM) for asphalt concrete and provide a realistic behavior of pavement performance in term of materials characteristics, methods of testing, temperature, loading rate on specimen, loading time and different environmental conditions.

**Keywords:** Asphalt concrete, Pavement failure, Fatigue, Rutting, Asphalt modeling, Realistic Design, Discrete element method.

## INTRODUCTION:

Pavement is an important transportation infrastructure which has dominant position amongst the various modes of transportation infrastructures due to its flexibility, door-to-door service, reliability and speed. Pavement is highly desirable transportation mode which contributes to movement of people, goods and development of industrial and social activities. Pavement is a complex system which consists of various layers. Asphalt concrete is composite multi phase material consists of aggregates, binder, filler and air voids then laid down in layers and compacted [1] Asphalt concrete used in road construction, parking lot and airport pavement. In present traffic volume is increasing very fast day by day, which is responsible for pavement deterioration. It is a major task for a pavement engineer to construct a long life pavement performance under economic aspect. A realistic prediction of pavement behavior and long term service life is difficult and not an easy task for pavement engineers [2]. Asphalt concrete has various performance parameters in terms of surface durability, workability, tire wear, temperature variation and drainage. Asphalt concrete pavement performance is depend on the behavior of asphalt concrete in field conditions under high traffic intensity, over loading of vehicles, material characteristics and significant variation in daily and seasonal temperature.

For achieving long lasting and good performance pavement better mix design of asphalt concrete is needed. The life of a pavement can be increased through good mix design, construction and maintenance practices. During design process measure the traffic on a road, types of loading, material properties, temperature variation, moisture and different environmental conditions. Lack of these factors resulted in deterioration of pavement and various distress symptoms were observed in pavement surface. Pavement distress is a result of gradual deterioration that may take place throughout the pavement life. Pavement deterioration or distress symptoms can include fatigue, rutting, thermal cracking, pothole, raveling, stripping, and grade depressions. These distress conditions have affected the mechanical, physical, and rheological properties of pavement. Rutting, fatigue, and cracking are the serious distress symptoms in asphalt concrete pavement. The serviceability of asphalt concrete is reduced by these distresses [3]. Asphalt concrete is consider viscoelastic behavior in nature and these complex behavior of asphalt concrete requires determined their micro structural and stress-strain behavior of the binder [4].

The prediction of asphalt concrete behavior is based on pavement response model and pavement performance model. Pavement response model is based on stress and strain distribution and performance model such as permanent deformation model (rutting), fatigue cracking, and fracture under different laboratory and field loading condition in pavement. To understanding these pavement distress behaviors some modeling techniques are required. The model should be able to predict major distresses associated with asphalt failure such as rutting, fatigue cracking, thermal Cracking, and reflection cracking from basic pavement responses. The considerable cost and resource consumption in construction and rehabilitation can be reduced by distress modeling. Asphalt modeling for asphalt concrete is an advanced approach to recognize the actual long term pavement performance with help of numerical and computational method.

## ASPHALT MODELING:

In the asphalt modeling approach behavior of asphalt mixture is modeled numerically. Different models are used to predict the mechanical behavior of the asphalt concrete and long term pavement performance for road distress symptoms like rutting, fatigue, raveling, and cracking. Asphalt concrete is a complex composition of many layers of different materials. In layer system layers receives loads from the above layer and passes to the next layer. As discussed earlier asphalt concrete is behave like viscoelastic material and determined through different modeling techniques. The performance of asphalt concrete pavement is related to

performance of asphalt concrete and models developed to capture the effects of different factors such as rate of loading, loading time, mode of loading, aging, stress-strain behavior and moisture on asphalt concrete pavements [5].

In asphalt concrete pavement main design factors are stress due to different loading condition and temperature variations. The stress strain behavior of asphalt concrete is understood by two approaches: macro mechanical approach, and second is micro mechanical approach [6]. Model is a numerical device which is to enable to predict the effect of change and behavior of system and modeling is the process of producing a model. Mathematical models can be classified into two categories: first is deterministic (variables are fixed) or stochastic (one variable is probabilistic) and second is static or dynamic. Most of the models are stochastic and dynamic in nature. Models are typically conceptual, existing as an idea, a computer program or a set of mathematical formulas [7]. A numerical model should be a close prediction of the real system. Asphalt modeling is most important to evaluate the complex behavior of asphalt concrete and comparison between realistic and experimental data's. These models are based on the micro-structural behavior of materials and asphalt concrete. The modeling of asphalt concrete is more realistic mathematical tool to predict the performance of materials and pavement behavior. Modeling of asphalt concrete for design consists of some modeling approaches which are used widely: empirical design, mechanistic design and mechanistic empirical design. Empirical method is based on the results of experience or experiment and it requires number of observation to obtain the relationship between input and outcome variables. In empirical method of asphalt concrete pavement, characteristics relate to actual pavement performance and more reliable performance prediction of asphalt concrete is done. The major disadvantage of these empirical methods is that mixture performance in the field is not directly related to properties measured in the laboratory. Mechanistic empirical models are based on an understanding of the behavior of a system through mathematical and computational analysis. Mechanistic-Empirical method of modeling is based on the mechanics of materials that relates input wheel load to an output pavement response and distress modeling using vertical strain. The models are based on simplification of reality and used the value of the calculated stresses, strain, and deflections, are reasonably close to stresses and strain in real pavement results in pavement failure for realistic pavement performance [8]. Mechanistic-empirical methods are an intermediate step between empirical and mechanistic methods. To predict the micro structural and viscoelastic behavior of asphalt concrete different modeling approaches like finite element modeling, discrete element modeling, continuum damage approach, multi scale modeling, artificial neural network, and finite difference modeling and so on are introduced by various researchers. With the help of these modeling approaches a realistic pavement performance prediction has been done in an accurate and simple manner. In this paper only discrete element modeling approach is discussed in next section.

## LITERATURE REVIEW:

In this section discussion about discrete element modeling and implementation of discrete element modeling in asphalt concrete pavement to predict micro structural behavior and realistic pavement performance is done.

Discrete element method:

The discrete element method is first proposed by Cundall in 1971 to problems in rock mechanics and it is also known as distinct element method. The discrete element method (DEM) is a mathematical method which is used to compute the stress and displacement in a volume containing a large number of small particles and based on Newton's second law and finite differences method concept. The granular material is modeled as an assembly of rigid particles and the interaction between each particle is considered. The basic assumption of the method is that the material consists of separate and discrete particles and these particles have different shape and properties. The discrete element method utilizes the breakage of individual structure units or bonds to directly represent damage. With the help of this discrete element model many researchers observed the complex behavior of asphalt concrete in simple and realistic manner in long term pavement performance [9] investigated the complex mechanical interaction of a discontinuous system to detect and categorize contacts between three dimensional particles. This method detects the contact between blocks of any arbitrary shape and represents the geometrical and physical characteristics for the contact [10] presented micro fabric two dimensional discrete element modeling approach to predict asphalt concrete complex modulus, particle and interface properties, such as normal and shear stiffness and strength in extension and compression with different range of test temperature and load frequencies. This modeling approach determined better complex modulus across a range of test temperature and load frequencies compared to more traditional calibration method [11]. Determined dynamic mechanical behavior of asphalt mastic for different binder and filler material and discussed on the effect of binder stiffness and filler volume fraction on the overall mastic stiffness by discrete element modeling method. [11] proposed an advanced discrete element modeling method called particle flow code in two dimensions (PFC2D) for modeling the micromechanical behavior of asphalt mastic and hot mix asphalt concrete under various loading condition. The main objective of this study to analyze the effect of fillers in stiffening mastics and the effect of binder type on the viscoelastic and tensile properties of hot mix asphalt. It was observed that cracking due to high concentration of stresses has occurred at the interface between the aggregate and binder and depends on binder film thickness. [6] proposed a micromechanical approach for viscoelastic response of asphalt mixture.

This methodology has the advantage of accounting for the aggregate shape, and distribution with asphalt mixture and provided the connection between the performance of asphalt mixtures and material properties of their constituents. It was observed discrete element model gave mix phase angle higher than the experimental results. [12] proposed modified discrete element model like contact force prediction method that make a larger time step possible for complex mechanical interaction between particles. This method

determined the predicted values of contact force at every contact point which are actual solution of differential equations that represent two particle contacts and accelerate discrete element modeling calculation three to eight time. [13] presented a methodology to predict and simulate the permanent deformation resistance behavior of asphalt concrete under uniaxial loading by discrete element method. This report introduced new automated digital image processing (DIP) algorithm, called volumetric based global minima (VGM) algorithm. This algorithm identified boundary thresholds between air, mastic, and aggregate phases with reference to volumetric information. Investigated fractures mechanisms in asphalt concrete at low temperature by discrete element method. The modeling approach provide details of the fracture test process, heterogeneity on crack path, and the effects of local material strength and fracture energy on fracture test response. [14] developed three dimensional microstructure based discrete element model of asphalt mixture to study the dynamic modulus from the stress- strain response under compressive loads.[15] presented a viscoelastic model of asphalt mixtures with the discrete element method, where the viscoelastic behaviors of asphalt mastics, fine aggregates, fines, and asphalt binder, are represented by a Burger's model. A series of equations are developed to express the Correlation between the micro scale discrete element model parameters and the Macro scale material properties of asphalt mastics and aggregates Measured in the laboratory. [16] proposed the discrete element model to predict the asphalt mixture dynamic modulus in the hollow cylindrical specimen with different range of test temperature and load frequencies.[17] introduced an approach to analyze the combined effects of aggregate gradation, shape, stiffness, and strength on asphalt concrete resistance to fracture. The model was used to measured the internal forces in asphalt mixture and determine their relationship to aggregate fracture. [18] proposed a discrete element model to investigate the isolated effects of the aggregate spehericity index, fractured faces, and orientation angles on the creep stiffness of hot mix asphalt mixture. [19] developed a user defined micromechanical model using discrete element method to investigate the cracking behavior of asphalt concrete. The effects of air void content and aggregate volumetric fraction on the cracking behavior of asphalt concrete were evaluated.

## CONCLUSION:

In the above section some literature review on asphalt modeling using discrete element modeling method are presented and gives a clear indication that asphalt concrete modeling is an important tool for realistic observation of pavement performance. In present discrete element method is becoming widely accepted as an effective mathematical tool of addressing engineering problem related to prediction of asphalt concrete pavement performance. This model advances in computing power and numerical algorithms which numerically simulate millions of particles on a single processor. Discrete element modeling simulation is advantageous in describing the effect of aggregate shape and distribution on the susceptibility of asphalt mixtures to permanent deformations especially at high strain levels. Discrete element method is discontinuum analysis method, which can model the deformation process of joint systems and dynamic condition and provide a more detailed study of the microstructure dynamics of asphalt concrete and other granular materials. Limitation in discrete element method is the maximum number of particles; duration of a simulation is limited by computational power.

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# SOME CHARACTERIZATIONS OF QUADRATIC HAZARD RATE – GEOMETRIC (QHR-G) DISTRIBUTION

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## ABSTRACT

A more flexible quadratic hazard rate-geometric (QHR-G) distribution having four parameters is characterized through the hazard function, Mills ratio, the reverse hazard function, Elasticity function and ratio of truncated moments. The applications of characterizations of QHR-G distribution will be constructive for scientists in diverse areas of science.

**Keywords:** Quadratic Hazard Rate; Mills Ratio; Elasticity; Geometric Distribution; Characterization,

## 1. INTRODUCTION

Bain (1974) developed quadratic hazard rate (QHR) distribution from the following quadratic function

$$A(x) = \alpha + \beta x + \gamma x^2, x > 0. \quad (1)$$

The cumulative distribution function (cdf) of random variable  $X$  with QHR distribution and parameters  $\alpha, \beta$  and  $\gamma$  is

$$G(x) = 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}, \alpha > 0, \gamma > 0, \beta > -2\sqrt{\alpha\gamma}, x \geq 0. \quad (2)$$

The probability density function (pdf) of random variable  $X$  with QHR distribution and parameters  $\alpha, \beta$  and  $\gamma$  is

$$g(x) = (\alpha + \beta x + \gamma x^2) e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}. \quad (3)$$

The geometric distribution with parameter  $\theta$  has the following probability mass function

$$P(N=n) = (1-\theta)\theta^{n-1}, 0 \leq \theta < 1 \quad n=1,2,\dots \quad (4)$$

## 2. QUADRATIC HAZARD RATE GEOMETRIC DISTRIBUTION

The quadratic hazard rate-geometric (QHR-G) distribution is developed with mixture of QHR distribution and geometric distribution. The cdf for mixture of continuous probability distribution and geometric distribution is given as

$$F_X(x) = (1-\theta)G(x)(1-\theta G(x))^{-1}. \quad (5)$$

The pdf for mixture of continuous probability distribution and geometric distribution is given as

$$f_X(x) = (1-\theta)g(x)(1-\theta G(x))^{-2}. \quad (6)$$

Okasha et.al (2016) studied QHR-G distribution along with its applications in reliability. But characterizations of QHR-G distribution are yet to do.

### 2.1 Probability Density Function of QHR-G Distribution

The pdf of random variable  $X$  with QHR-G distribution and parameters  $\alpha, \beta, \gamma$  and  $\theta \in (0,1)$  is

$$f_X(x) = (1-\theta)(\alpha + \beta x + \gamma x^2) e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \left(1 - \theta \left(1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right)^{-2}, x > 0. \quad (7)$$

## 2.2 Cumulative Distribution Function and Other Properties of QHR-G Distribution

The cdf for random variable  $X$  with QHR-G distribution and parameters  $\alpha, \beta, \gamma$  and  $\theta \in (0,1)$  is

$$F_X(x) = (1-\theta) \left[ 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right] \left[ 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right]^{-1}. \quad (8)$$

The hazard rate function for random variable  $X$  with QHR-G distribution is

$$h_F(x) = \frac{(1-\theta)(\alpha + \beta x + \gamma x^2)}{1 - \theta - \theta e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}}. \quad (9)$$

The reverse hazard rate function for random variable  $X$  with QHR-G distribution is

$$r_F(x) = (\alpha + \beta x + \gamma x^2) \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right)^{-1}. \quad (10)$$

The mills ratio of QHR-G distribution is

$$m(x) = (1-\theta)(\alpha + \beta x + \gamma x^2) \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right)^{-1}. \quad (11)$$

The elasticity of QHR-G distribution is given by

$$e(x) = \frac{d \ln F(x)}{d \ln x} = x r_F(x) = x (\alpha + \beta x + \gamma x^2) \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right)^{-1}. \quad (12)$$

The elasticity of QHR-G distribution shows behavior of accumulation of probability in the domain of random variable.

The rest of paper is composed as follows. QHR-G distribution is characterized through the hazard function, Mills ratio, the reverse hazard function, Elasticity function and ratio of truncated moments.

## 3. CHARACTERIZATION

In order to develop a stochastic function for a certain problem, it is necessary to know whether function fulfills the theory of specific underlying probability distribution, it is required to study characterizations of specific probability distribution. Different characterization techniques have developed. Glanzel (1987, 1988 and 1990), Hamedani (1993, 2002, 2011 and 2015), Ahsanullah and Hamedani (2007, 2012), Ahsanullah et al. (2013), Shakil et al. (2014), and Merovci et al. (2016) have worked on characterization.

### 3.1 Characterization Based On Hazard Function

Definition 3.1.1: Let  $X: \Omega \rightarrow (0, \infty)$  be a continuous random variable with pdf  $f(x)$  if and only if the hazard function  $h_F(x)$ , of a twice differentiable function  $F$ , satisfies equation

$$\frac{d}{dx} [\ln f(x)] = \frac{h'_F(x)}{h_F(x)} - h_F(x).$$

#### Proposition 3.1.1

Let  $X: \Omega \rightarrow (0, \infty)$  be a continuous random variable with pdf (7) if and only if the hazard function (9) twice differentiable function satisfies equation

$$\left[ h'_F(x) \left( 1 - \theta + \theta e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) - h_F(x) \left( \theta (\alpha + \beta x + \gamma x^2) e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right] = [\beta + 2\gamma x - \theta(\beta + 2\gamma x)]$$

#### Proof

For random variable  $X$  having QHRG distribution with hazard rate function (9), we obtain the following equation

$$\left[ h'_x(x) \left( 1 - \theta + \theta e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) - h_x(x) \left( \theta (\alpha + \beta x + \gamma x^2) e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right] = [\beta + 2\gamma x - \theta(\beta + 2\gamma x)].$$

After simplification we obtain as

$$\frac{d}{dx} \left[ h_x(x) \left( 1 - \theta + \theta e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right] = \frac{d}{dx} [(1 - \theta)(\alpha + \beta x + \gamma x^2)].$$

From above equation we obtain as

$$h_x(x) = \frac{(1 - \theta)(\alpha + \beta x + \gamma x^2)}{1 - \theta - \theta e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)}}. \quad (13)$$

After manipulation, integrating (13), and simplifying, we obtain as

$$F_x(x) = (1 - \theta) \left[ 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right] \left[ 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right]^{-1}.$$

This is cdf of QHRG distribution.

### 3.2 Characterization Based on Mills Ratio

In this sub-section, we characterize QHR-G distribution via the Mills ratio.

**Definition 3.2.1:** Let  $X: \Omega \rightarrow (0, \infty)$  be a continuous random variable having absolutely continuous cdf  $F(x)$  and pdf  $f(x)$  if and only if the Mills ratio,  $m(x)$ , of a twice differentiable function  $F$ , satisfies equation

$$\frac{d[\ln f(x)]}{dx} + \frac{[m'(x) + 1]}{m(x)} = 0.$$

**Proposition 3.2.1:** Let  $X: \Omega \rightarrow (0, \infty)$  be continuous random variable. The pdf of  $X$  is (7) if and only if the mills ratio fulfills the first order differential equation

$$m'(x) \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right) - m(x) \theta (\alpha + \beta x + \gamma x^2) e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} = (1 - \theta)(\beta + 2\gamma x).$$

#### Proof

If  $X$  has pdf (7), then above differential equation surely holds. Now if differential equation holds

then

$$\frac{d}{dx} \left[ m(x) \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right) \right] = (1 - \theta) \frac{d}{dx} [(\alpha + \beta x + \gamma x^2)].$$

After integration of above equation, we reach at

$$m(x) \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right) = (1 - \theta)(\alpha + \beta x + \gamma x^2),$$

$$m(x) = (1 - \theta)(\alpha + \beta x + \gamma x^2) \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right)^{-1}.$$

This is the Mills ratio of QHR-G distribution.

**Proposition 3.2.2:** Let  $X:\Omega \rightarrow (0, \infty)$  be continuous random variable. The pdf of  $X$  is (7) if and only if the mills ratio fulfills the first order differential equation

$$m'(x)(\alpha + \beta x + \gamma x^2)^{-1} - (\beta + 2\gamma x)(\alpha + \beta x + \gamma x^2)^{-2} = (1-\theta)\theta(\alpha + \beta x + \gamma x^2)e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\left(1-\theta\left(1-e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right)^{-2}.$$

**Proof**

If  $X$  has pdf (7), then above differential equation surely holds. Now if differential equation holds

then 
$$\frac{d}{dx}\left[m(x)(\alpha + \beta x + \gamma x^2)^{-1}\right] = (1-\theta)\frac{d}{dx}\left(1-\theta\left(1-e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right)^{-1},$$

or 
$$m(x)(\alpha + \beta x + \gamma x^2)^{-1} = (1-\theta)\left(1-\theta\left(1-e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right)^{-1}.$$

$$m(x) = (1-\theta)(\alpha + \beta x + \gamma x^2)\left(1-\theta\left(1-e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right)^{-1}, \text{ this is Mills ratio of QHR-G distribution.}$$

### 3.3 Characterization Based Reverse Hazard Function

In this sub-section, we characterize QHR-G distribution via reverse hazard function.

**Definition 3.3.1:** Let  $X:\Omega \rightarrow (0, \infty)$  be a continuous random variable with pdf  $f(x)$  if and only if the reverse hazard function  $r_F(x)$ , of a twice differentiable function  $F$ , satisfies equation

$$\frac{d}{dx}[\ln f(x)] = \frac{r'_F(x)}{r_F(x)} + r_F(x).$$

**Proposition 3.3.1:** Let  $X:\Omega \rightarrow (0, \infty)$  be a continuous random variable with pdf (7) if and only if the reverse hazard function (10) twice differentiable function satisfies equation

$$\left[r'_F(x)\left(1-\theta+\theta e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right) + r_F(x)\theta(\alpha + \beta x + \gamma x^2)^2 e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right] = [\beta + 2\gamma x].$$

**Proof**

For random variable  $X$  having QHR-G distribution with reverse hazard rate function (10), we obtain the following equation

$$\left[r'_F(x)\left(1-\theta+\theta e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right) + r_F(x)\theta(\alpha + \beta x + \gamma x^2)^2 e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right] = [\beta + 2\gamma x].$$

After simplification we obtain as 
$$\frac{d}{dx}\left[r_F(x)\left(1-\theta+\theta e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right] = \frac{d}{dx}[\alpha + \beta x + \gamma x^2].$$

From above equation we obtain as  $r_F(x) = \frac{f_X(x)}{F_X(x)} = \frac{(\alpha + \beta x + \gamma x^2)}{\left(1 - \theta \left(1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right)}$ .

After manipulation, integrating above equation, and simplifying, we obtain as

$$F_X(x) = (1 - \theta) \left[ 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right] \left[ 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right]^{-1}.$$

This is cdf of QHRG distribution.

### 3.4 Characterization Based On Elasticity Function

In this sub-section, we characterize QHR-G distribution via elasticity function.

**Definition 3.4.1:** Let  $X: \Omega \rightarrow (0, \infty)$  be a continuous random variable having absolutely continuous  $F(x)$  and pdf  $f(x)$  provided the elasticity function  $e_F(x)$  is twice differentiable function satisfying differential equation

$$\frac{d}{dx} [\ln f(x)] = \frac{e'(x)}{e(x)} + \frac{e(x)}{x} - \frac{1}{x}.$$

**Proposition 3.4.1** Let  $X: \Omega \rightarrow (0, \infty)$  be continuous random variable. The pdf of X is (6) provided that its elasticity function,  $e_F(x)$  satisfies the first order differential equation

$$e'(x) \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right) + e(x) \theta (\alpha + \beta x + \gamma x^2) e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} = (\alpha + 2\beta x + 3\gamma x^2). \quad (14)$$

#### Proof

If X has pdf (7), then (14) surely holds. Now if (14) holds, then

$$\frac{d}{dx} \left[ e(x) \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right) \right] = \frac{d}{dx} \left[ (\alpha x + \beta x^2 + \gamma x^3) \right].$$

$$e(x) = x (\alpha + \beta x + \gamma x^2) \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right)^{-1},$$

which is the elasticity function of QHR-G distribution.

**Proposition 3.4.2:** Let  $X: \Omega \rightarrow (0, \infty)$  be continuous random variable. The pdf of X is (6) provided that its elasticity function,  $e_F(x)$  satisfies the first order differential equation

$$e'(x) (\alpha + \beta x + \gamma x^2)^{-1} - (\beta + 2\gamma x) (\alpha + \beta x + \gamma x^2)^{-2} e(x) = \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right)^{-1} + x \theta (\alpha + \beta x + \gamma x^2) e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \left( 1 - \theta \left( 1 - e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)} \right) \right)^{-2}. \quad (15)$$

## Proof

If  $X$  has pdf (7), then (15) surely holds. Now if (15) holds, then

$$\frac{d}{dx} \left[ e(x) (\alpha + \beta x + \gamma x^2)^{-1} \right] = \frac{d}{dx} \left[ x \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right)^{-1} \right],$$

or  $e(x) = x (\alpha + \beta x + \gamma x^2) \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right)^{-1}$ , the elasticity function of QHR-G distribution.

## 3.5 Characterization through Ratio of Truncated Moments

In this section, we characterize GLBXII distribution using Theorem 1 (Glanzel; 1987) on the basis of simple relationship between two functions of  $X$ . Theorem 1 is given in appendix A.

**Proposition 3.5.1:** Suppose that random variable  $X : \Omega \rightarrow (0, \infty)$  is continuous. Let

$$h_1(x) = \frac{1}{(1-\theta)} \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right)^2 \quad \text{and} \quad h_2(x) = \frac{2e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)}}{(1-\theta) \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right)^{-2}}, \quad x > 0.$$

The pdf of  $X$  is (7) if and only if  $p(x)$  has the form  $p(x) = \exp \left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right) x > 0$ .

## Proof

For random variable  $X$  having QHRG distribution with pdf (7) and cdf (8), we proceed as

$$(1 - F(x)) E(h_1(x) / X \geq x) = e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \quad x > 0$$

$$(1 - F(x)) E(h_2(x) / X \geq x) = e^{-2\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \quad x > 0$$

$$p(x) = e^{\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \quad \text{and} \quad p'(x) = (\alpha + \beta x + \gamma x^2) \exp \left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)$$

$$s'(t) = \frac{p'(t) h_2(t)}{p(t) h_2(t) - h_1(t)} = 2(\alpha + \beta x + \gamma x^2) \quad \text{and} \quad s(t) = 2 \left( \alpha x + \beta \frac{x^2}{2} + \gamma \frac{x^3}{3} \right)$$

Therefore in the light of Theorem 1,  $X$  has pdf (7)

**Corollary 3.5.1:** Suppose that random variable  $X : \Omega \rightarrow (0, \infty)$  is continuous and

$$h_2(x) = \frac{2e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)}}{(1-\theta) \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right)^{-2}} \quad \text{for } x \in (0, \infty). \text{ The pdf of } X \text{ is (7) provided functions } p \text{ and } h_1 \text{ satisfy equation}$$

$$\frac{p'(t)}{p(t) h_2(t) - h_1(t)} = (1-\theta) (\alpha + \beta x + \gamma x^2) e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \left( 1 - \theta \left( 1 - e^{-\left( \alpha x + \frac{\beta}{2} x^2 + \frac{\gamma}{3} x^3 \right)} \right) \right)^{-2}.$$

**Remarks 3.5.1:** The solution of above equation is

$$p(t) = \exp\left(-2\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)\right) \int \left(-h_1(x)(1-\theta)(\alpha + \beta x + \gamma x^2)e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\left(1-\theta\left(1-e^{-\left(\alpha x + \frac{\beta}{2}x^2 + \frac{\gamma}{3}x^3\right)}\right)\right)^{-2}\right) dx + D \text{ where } D \text{ is constant.}$$

#### 4. CONCLUDING REMARKS

We presented characterizations of QHR-G distribution through hazard function, Mills ratio, reverse hazard function, Elasticity function and ratio of truncated moments.

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#### Appendix A

**Theorem 1:** Suppose that probability space  $(\Omega, \mathcal{F}, P)$  and interval  $[d_1, d_2]$  with  $d_1 < d_2$  ( $d_1 = -\infty, d_2 = \infty$ ) are given. Let continuous random variable  $X : \Omega \rightarrow [d_1, d_2]$  has distribution function  $F$ . Let real functions  $h_1$  and  $h_2$  be continuous on  $[d_1, d_2]$  such that  $\frac{E[h_1(X) | X \geq x]}{E[h_2(X) | X \geq x]} = p(x)$  is real function in simple form. Assume that  $h_1, h_2 \in C([d_1, d_2])$ ,  $p(x) \in C^2([d_1, d_2])$  and  $F$  is two times continuously differentiable and strictly monotone function on  $[d_1, d_2]$ : As a final point, assume that the equation

$h_2 p(x) = h_1$  has no real solution in  $[d_1, d_2]$ . Then  $F(x) = \int_{\ln k}^x K \left| \frac{p'(t)}{p(t)h_2(t) - h_1(t)} \right| \exp(-s(t)) dt$  is obtained from the

functions  $h_1, h_2, p(t)$  and  $s(t)$ , where  $s(t)$  is obtained from equation  $s'(t) = \frac{p'(t)h_2(t)}{p(t)h_2(t) - h_1(t)}$  and  $K$  is a constant, picked to

make  $\int_{d_1}^{d_2} dF = 1$ .

#### Remarks

- (a) The interval  $[d_1, d_2]$  need not be necessarily close in Theorem 4.1.
- (b) The function  $p(x)$  should be in simple form.

# Load Frequency Control in a Deregulated Power System Using IPP Design

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**Abstract-** This paper deals with a load frequency control in a deregulated power system, in which the independent generator utilities may or may not participate. A suitable method has been developed for analyzing the performance of such a system. The load frequency control is performed by this method on the basis of parameters set by the participating genera tor companies. The method is based on an Independent System Operator (ISO). The participated companies are generators utility and Independent Power Producer (IPP). The generator utilities define which units will be under load frequency control , while the independent power producer may or may not participate in the load frequency control. The generator utility defines the generation limits, rate of change and economic participation. The ISO gets this information. The ISO also controls the interconnected system operation while at the same time allows the utilities to economically dispatch system.

**Keywords:** Area control error (ACE), load frequency control(LFC), deregulated system.

## Introduction

The world – wide many electric utilities and power companies have been forced to change their way of operation and business, from vertically integrated utilities to open market systems. For developing countries the demand of power has been increased ,complexity is associated with it like management and irrational tariff policies. This has affected the availability of financial resources to support investments in improving generation and transmission capacities. In such circumstances, many utilities were forced to restructured their power sectors under pressure. The restructured or deregulated system is more economical and beneficial to the consumers, but the problem of load frequency control is associated with it. The power systems are interconnected and their operation has an important aspect of load frequency control problem. In an interconnected system operation load frequency control needs the technical consideration. The area control error (ACE)has the ability to monitor the load-generation-and-frequency. On the basis of the ACE value the generating units of the system are controlled. At least after few minutes utilities have been operated in such a way that the area control error of each utility would reached to zero, meaning that the load and generation balance each other and the frequency is equal to the normal . Due to this the system performance increases but it influences the cost of the system. The increased cost is not preferable of the infrastructure, required for the feedback. From the frequency control action the wear and tear occurs on the power plant equipment. The system gives the excellent performance as all the utilities are participating in the load frequency control problem. The excellent performance justifies the increased cost of the load frequency control.

Now a days the electric utilities preferred deregulated or restructured system for trading. The load frequency control in the open market and deregulated environment has become a commodity which can be traded. In such a system the generating utilities may or may not preferred to take part in the bidding competition of load frequency control. If they will participate in the load frequency control provide service for which they must be paid or compensated. Otherwise, the generating units can apt not to participate in the load frequency control service for which they must be penalized or have to compensate the rest of the system from where supposed to received the services. Thus such a services can be offered or received by any generating unit. For such a operation the choice for real time option is available. The generating capacity participating in the load frequency control may vary in the real time. Such an operating system have the better performance. The performance of such a system is to maintain nearly constant frequency and closely monitoring the load. Thus for large deviation of load at a time the load frequency control is low compared to the load.

This paper suggests the model for the evaluation of the performance of the load frequency control problem in an environment where the units may select to offer or receive the service.

## Deregulated Power System for LFC

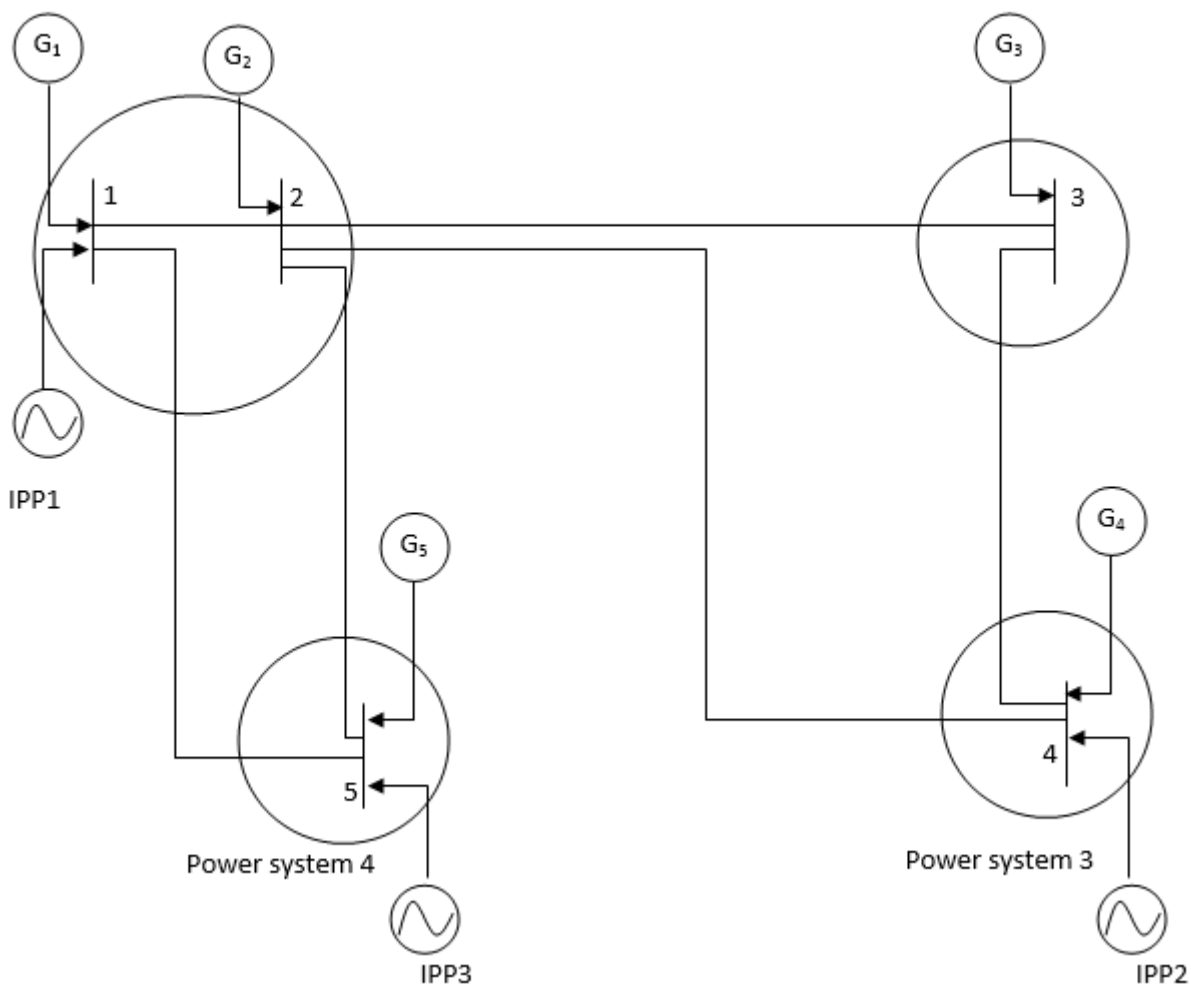
The vertically integrated utility are not attracted by the market. For existing into the competitive environment the vertically integrated utility needs to restructured. The restructured system consists of Generating companies (GENCOs), Distribution companies (DESCOs), Transmission companies (TRANSCOs) and independent system operators (ISO). The goal is to control the load frequency

in the power system i.e. restoring the frequency and the net interchanges to their desired values for each control area, still remain. For the load frequency control, a flexible method is required which should be suitable for the simulation of the operation of the system. Two specific control loops have been applied (a) utility control loop which performs economic dispatch and provides the parameters to the independent system operator for the load frequency control, and (b) the load frequency control is performed by the independent system operator control loop. The independent power producers (IPP) and utilities provide the information or parameters to the independent system operator on the basis of which it controls the load frequency in the power system. For the specific conditions the model computes the load frequency of the system. System performance is measured in two types (a) utility control error and (b) independent unit – load balance. These two types are correlated with the traditional area control error. It is observed that in order to have suitable performance, a certain percentage of the generating unit must participate in the load frequency control.

The interconnected power system is shown in the figure. The model consists of four interconnected Power systems with three independent power producers. The power system 1 has two generator at bus number 1 and 2 and it is interconnected with power system 2, 3 and 4 through 4 tie lines. The IPP1 is also connected at bus number 1. The Power system 2 has one generator at bus number 3 and it is connected with two tie lines to power system 1 and 3. The Power system 3 has one generator at bus number 4 and it is connected to power system 1 and 2 through two tie lines. The bus number 4 is also connected with IPP2. Finally, the power system 4 has one generator at bus number 5 and it is connected to power system 1 with two tie lines. The IPP3 is also connected with bus number 5. For the proposed model each generator model is important.

Power system 1

Power system 2



The model incorporates the generator circuit together with the dynamics of the generator rotor. The generator input is mechanical power and is represented by the variable  $u_3(t)$ . Here the voltage regulator of the generator, controls the generated voltage to a constant level. From the above equations transient analysis can be studied. The modification is needed for the proposed method. The variables available at the network level are the generator terminal voltages, currents, the rotor position  $\delta(t)$  and the input mechanical power. The method is a time – domain solution that computes these quantities as they evolve with time. The meters assess the real power flow in the tie lines and the frequency of the power system at each generating plants, as the solution progresses. The different generating unit have the different frequency under transient condition at any instant of time. The area control error for this system can be computed from the tie line flows and the average of the frequency of all generators in a system. The generator who will participate in the load frequency control will be distributed by the area control error. For the independent power producer similar procedure will be followed, if they decide to participate in the load frequency control competition. If not, the mechanical power input is set to a constant level. Normally their real power output may fluctuate based on the natural response of the generator during system transient. Thus Independent system operator computes the area control error for each unit (utility or IPP) and transmits it to the appropriate party.

### Conclusion

It is observed that if the number of participating generating unit in the load frequency control method is less, the system performance is not satisfactory which is unacceptable. But in the deregulated environment it is the choice of the generating unit to participate or not to participate in the load frequency control operation. It is thus recommended that there must be a minimum participation. The minimum participation depends up the system establishment. There is a need of further study to establish a minimum acceptable limit of the nonparticipating unit to the load frequency control problem.

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# DEVELOPMENT AND EVALUATION OF VARIOUS PROPERTIES OF CERAMIC BASED BRICK COMPOSITES FROM NATURAL MUD AT DIFFERENT SINTERING TEMPERATURE

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**Abstract**— In the present scenario, considerable research have been carrying on towards the development of ceramic based insulating materials for high voltage (HV) applications. To meet such demands, we made an attempt to develop ceramic based brick composites through conventional powder metallurgy technique from natural mud for using as a substitute of high strength conventional ceramic based insulator for HV applications. This research is directed towards the development of brick based composites from local mud with optimizing its sintering temperature based on its physical as well as mechanical properties. The surface morphology of the developed composites were observed and reported.

**Keywords**— Brick based composite, Ceramic matrix, Powder Metallurgy, Surface morphology, Shrinkage, Density, Porosity, Hardness.

## 1. INTRODUCTION

Ceramic matrix composites are only the oldest and newest materials widely demanded in all the sector of thermal, electrical and structural applications due to outstanding performance at high temperature, high hardness, and chemical inertness [1-3]. Ceramics generally made protective barriercoating during fabrication which makes them preferable for harsh environment application [4].

Brick, made from natural mud is an oldest member of ceramic family and traditionally used in the sector of civil, mechanical and electrical applications as masonry construction (means structural), protective or insulating materials respectively. Now-a-days, china clay have been used extensively in different commercial purpose such as insulating material in all the sector of electrical and electronics industries along with HV transmission due to their attractive feature such as---- high strength, high stiffness, with low density [3-4].

Mud based composite are preferred when component weight reduction is the key objective [1-3]. Powder metallurgy is an art and technique for developing low density material with exact dimension along with improvement of structural properties [5-6] of the developed material with low cost.

This study mainly focuses on the development of ceramic based brick composites at various sintering temperatures and finally optimize this sintering temperature based on its various physical and mechanical properties.

## 2. EXPERIMENTAL PROCEDURE

### 2.1 Development of Ceramic Based brick Composite by Powder Metallurgy Technique

In this present study, mud is the only component material which was collected from the river side of Ganga at North 24 Parganas district in West Bengal, India. This mud was clean, dried and finally shaped for making brick utilizing 600°C for 6 hours in muffle furnace (made by Nascor Technologies Private Limited, Howrah, West Bengal, India) at open atmosphere. This bricks are crushed by using crusher and made fine powder, mesh size around -300 µm using ball mill. The compact powder was uniaxially hard-pressed using a steel mold having an internal diameter of 15 mm at a pressure of 200 MPa, with a 2-ton press for five minutes from PEECO hydraulic pressing machine (PEECO Pvt Ltd, M/C NO.-3/PR2/HP-1/07-08). Finally the samples were sintered in the same muffle furnace at temperature 900°C, 1000°C, 1100°C and 1150°C for 2 hours at a constant heating rate of 5°C/min. After operation, samples were permitted for cooling in the same furnace.

## 2.2 Testing and Characterization

### 2.2.1 Microstructure

After sintering, samples were mirror polished and microstructures were observed at 100 X magnification by LEICA Optical Microscopy model no DM-2700M Image Analyzer.

### 2.2.2 SEM Analysis

SEM image were taken for each polished sample using JEOL MAKE SEM model JSM 6360, operated by PCSEM software.

### 2.2.3 Physical Property Measurement

Weight and dimension were taken for each sample to calculate various physical properties. Apparent Porosity was measured for each sample using the universal porosity measurement technique.

### 2.2.4 Micro hardness Survey

Hardness was taken by employing Vickers diamond pyramid indenter with 250 gf loads and 15 sec dwell time. Hardness was taken in four different positions and finally average the hardness values for precise measurement by using Leco Micro Hardness tester (Model LM248SAT).

## 3. RESULTS AND DISCURSION

### 3.1 Microstructure

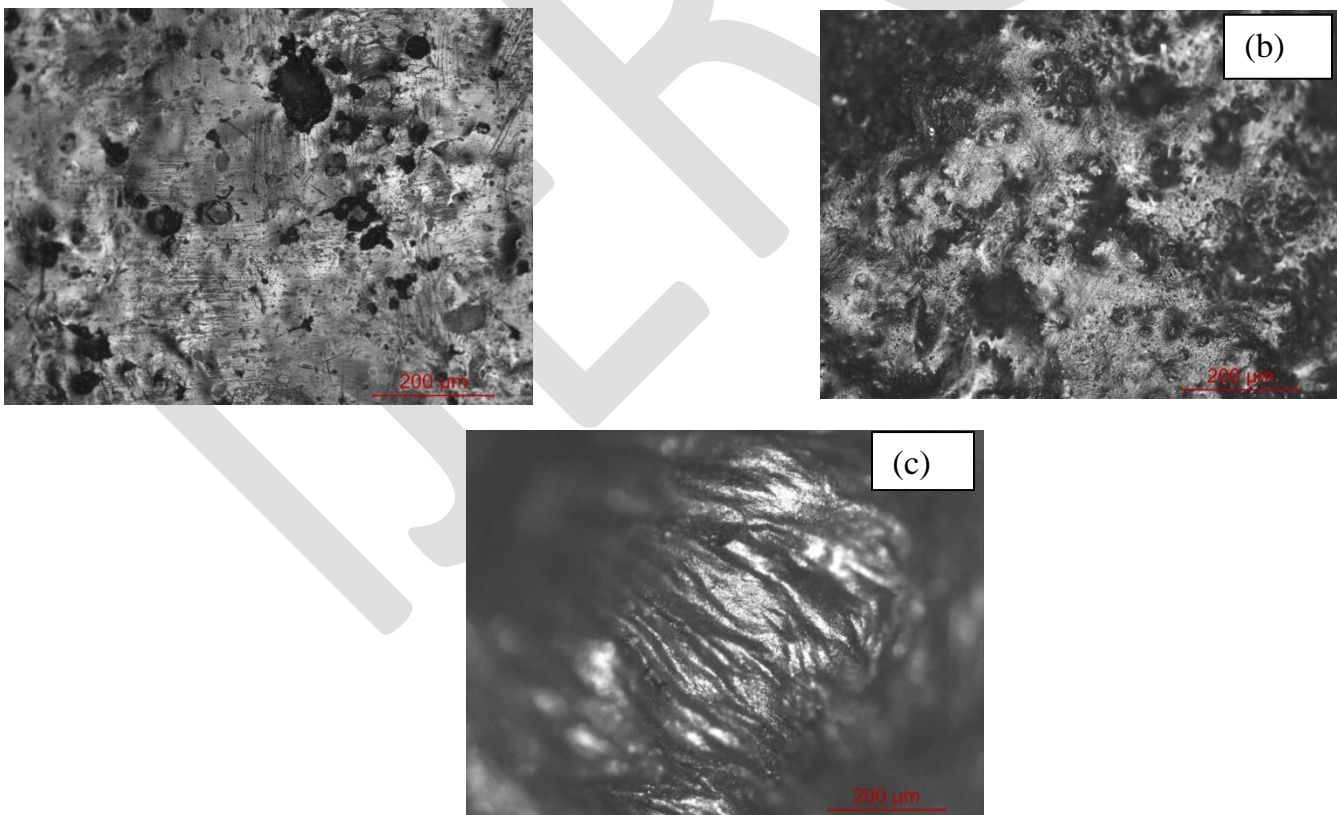


Fig. 1: Microstructure of ceramic based brick composite at 100 X magnification, sintered at (a) 1000°C, (b) 1100°C and (c) 1150°C

Figure 1 shows the surface morphology at 100X magnification for the sample sintered at 1000°C, 1100°C and 1150°C for two hours.

### 3.2 SEM Analysis

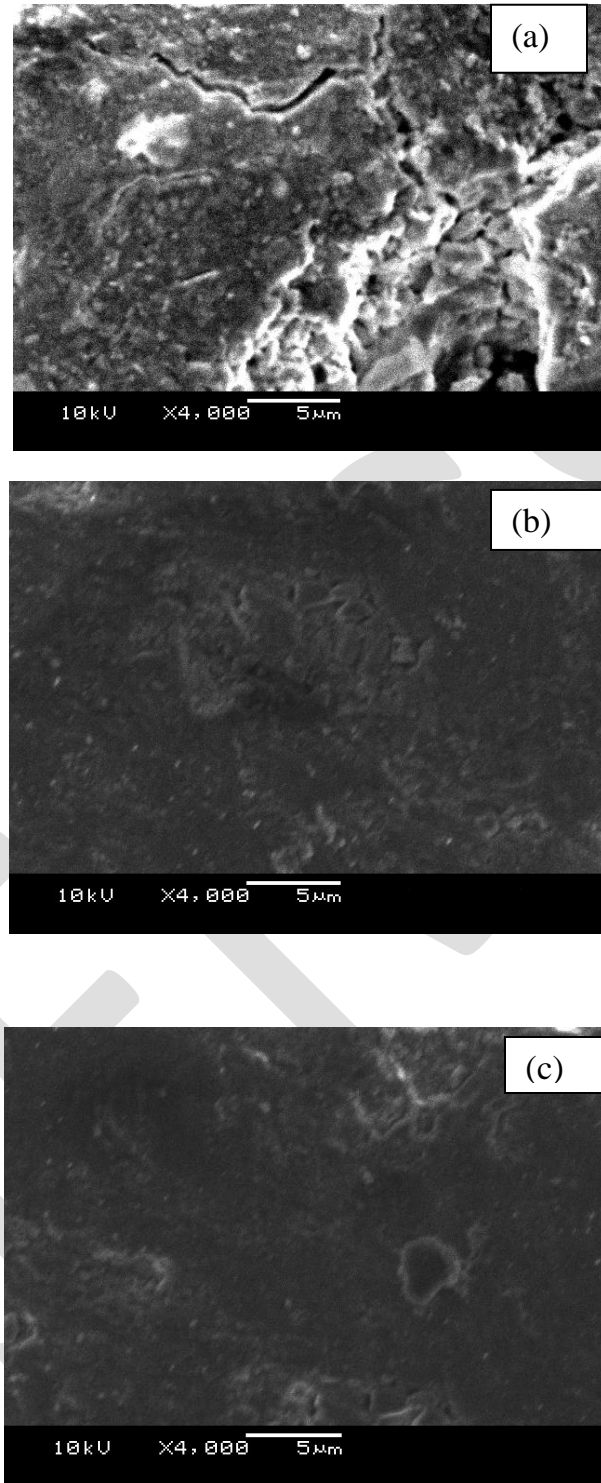


Fig. 2: SEM image of ceramic based brick composites sintered at (a) 1000°C, (b) 1100°C and (c) 1150°C

SEM image was taken for studying the surface morphology of developed material comparatively high magnification than optical microscopy. Figure 2 shows that the tendency of pore formation decreases with increment of sintering temperature.

### 3.3 Shrinkage Measurement

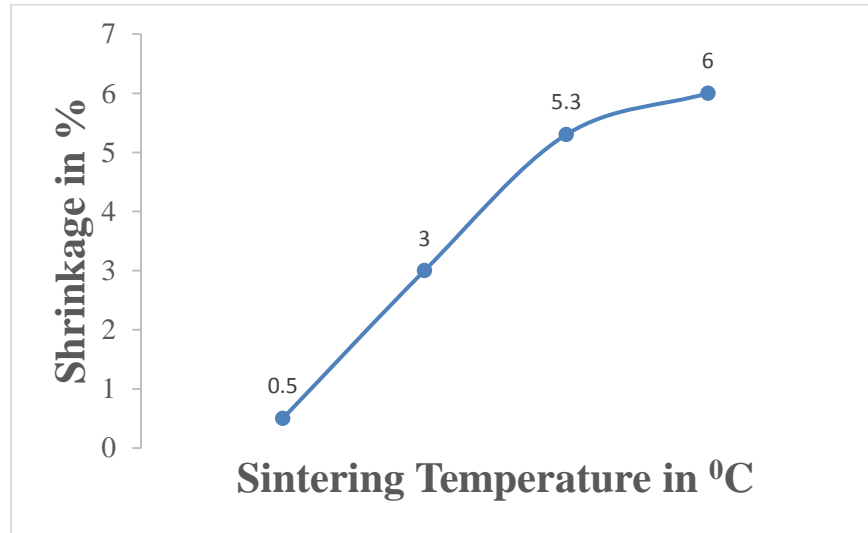


Fig. 3: Variation of Shrinkage with sintering temperature

From fig. 3, it is seen that maximum shrinkage value was obtained for the sample sintered at temperature 1150°C, and the shrinkage value is almost equal to the sample sintered at temperature 1100°C. From the measurement, it is observed that the shrinkage value increases gradually with the increment of sintering temperature.

### 3.4 Density Measurement

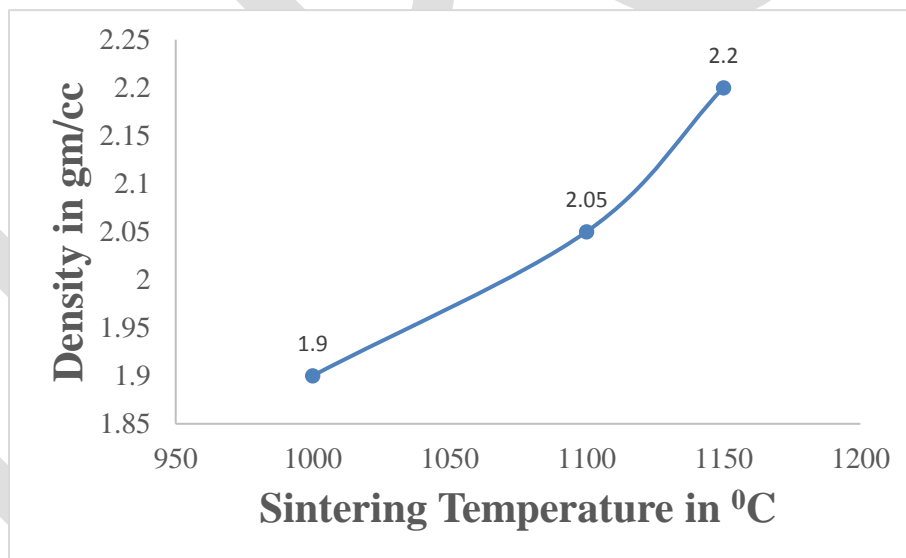


Fig. 4: Density of ceramic based brick composites sintered at different temperatures

Figure 4 shows that sintered density of brick based composite increases with the increment of the sintering temperature and the sample sintered at 1150°C shows maximum density.

### 3.5 Apparent Porosity

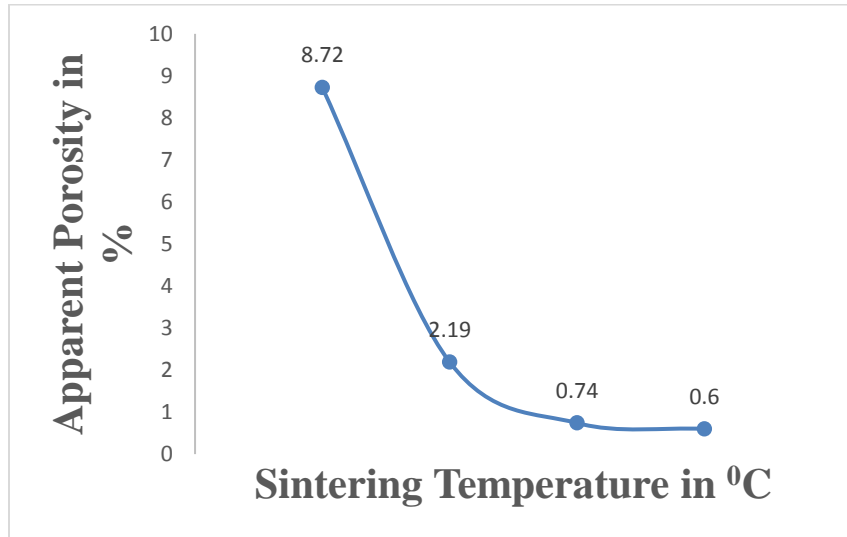


Fig. 5: Apparent Porosity for ceramic based brick composites sintered at different temperatures

From the data obtained, it is seen that apparent porosity value decreases with the increasing of sintering temperature as shown in fig. 5. Sintering was carried on number of steps with crystalline silica and the sample which was sintered at temperature 900°C, gives 8.72 % porosity while the sample sintered at temperature 1150°C gives minimum porosity. From fig. 5, it is also seen that the sample sintered at temperature 1150°C gives almost same apparent porosity as that of the sample sintered at temperature 1100°C.

### 3.6 Hardness

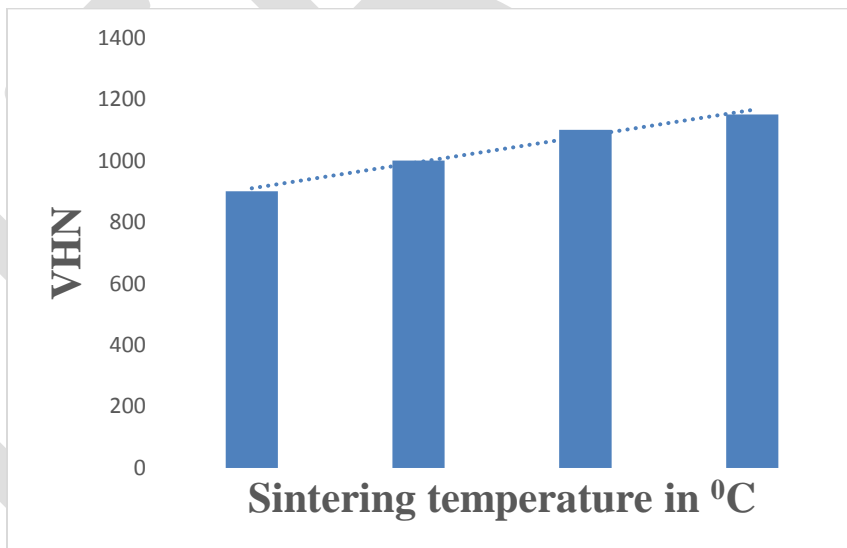


Fig. 6: Micro-Hardness Graph for ceramic based brick composites sintered at different temperatures

From the hardness data obtained, it is seen that hardness value increases gradually with the increment of sintering temperature as shown in fig. 6.

### CONCLUSION

The significant conclusions of the study ceramic based brick composites are as follows:

- Ceramic based brick composites were developed successfully from natural mud by adopting powder metallurgy technique.

- From all the experimental data obtained, it is found that by analyzing different parameters like--shrinkage, density, apparent porosity and hardness---- optimum sintering temperature for this composite is obtained which is 1150°C.
- For ceramic based brick composites, micro – hardness value also increases with the increment of sintering temperature.
- It is noted that percentage of shrinkage value were increased with the increment of sintering temperature.
- From all physical and mechanical behavior of the developed composites, it is expected that there must be formation of strong bonding with temperature (manufacturing issue). Actually, by physical observing, this was happened due to formulation of protective barrier surrounded the sample, sintered at 1100°C or above. Hence, Properties are not improved so much beyond this temperature, ie 1100°C. Optimum property of the developed material was observed in that sintering temperature.

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# CLASSIFICATION OF DISEASES ON THE LEAVES OF COTTON USING GENERALIZED FEED FORWARD (GFF) NEURAL NETWORK

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**Abstract-** In this paper a new classification algorithm is proposed for the Identification of cotton leaf diseases Using Generalized Feed Forward Neural Network. In order to develop algorithm 40 captured 5 type of cotton diseases images of cotton have been considered, With a view to extract features from the cotton captured images after image processing, an algorithm proposes WHT transformed 128 coefficients. The Efficient classifiers based on Generalized feed forward (GFF) Neural Network. A separate Cross-Validation dataset is used for proper evaluation of the proposed classification algorithm with respect to important performance measures, such as MSE and classification accuracy. The Average Classification Accuracy of GFF Neural Network comprising of one hidden layers with 43 PE's organized in a typical topology is found to be superior for Training. Finally, optimal algorithm has been developed on the basis of the best classifier performance. The algorithm will provide an effective alternative to traditional method of cotton leaf images analysis for Classify the five type cotton leaf diseases .

**Keywords**—Signal & Image processing, GFF neural network, Transformed domain techniques, MATLAB, Microsoft Office Excel etc.

## 1.INTRODUCTION:

India is an agricultural country where about 70% of the population depends on agriculture. Farmers can select suitable fruits and vegetable crops from a wide range. The cultivation of these crops for superlative yield and quality produce is highly specialized. The management should keep a close supervision of crops so that diseases do not affect the production. Diseases are impairment to the normal state of the plant that modifies or interrupts its vital functions such as photosynthesis, transpiration, pollination, fertilization, germination etc. These diseases are caused by pathogens viz., fungi, bacteria and viruses, and due to adverse environmental conditions. Therefore, the early stage diagnosis of plant disease is an important task.

Farmers require continuous monitoring of experts which might be prohibitively expensive and time consuming. Therefore looking for fast less expensive and accurate method to automatically detect the diseases from the symptoms that appear on the plant leaf is of great realistic significance. This enables machine vision that is to provide image based automatic inspection, process control and robot guidance.

Through our project we are going to make a system which will detect and classify cotton leaves diseases. India was recognized as cradle of cotton industry. In Vidarbha (Maharashtra) region, Cotton is the most important cash crop grown on an area of 13.00 lacks hectars with production of 27 lack bales of cotton (2008-09). Disease on the cotton is the main problem that decreases the productivity of the cotton. The main source for the disease is the leaf of the cotton plant. About 80 to 90 % of disease on the cotton plant is on its leaves. So for that our study of interest is the leaf of the cotton tree rather than whole cotton plant.

In this paper their five type of cotton diseases are classified are

- 1) Bacterial disease: e.g. Bacterial Blight
- 2) Fungal diseases: e.g. Anthracnose, Leaf Spot
- 3) Viral disease: e.g. Leaf Curl, Leaf Crumple, Leaf Roll.
- 4) Diseases Due To insects: Whiteflies,
- 5) Diseases Due To insects :Leaf insects

Out of the above types of disease these diseases dramatically affect the leaf of cotton plant and its leaves. So that we proposed a system which helps in detecting the diseases of cotton leaves which will help the farmers to detect disease and take proper prevention to enhance the production of cotton. We took the pictures of diseased cotton leaves and performed various preprocessing techniques on them for removing the boundary of the leaf. The main target is to identify the disease in the leaf spot of the cotton crops. In this regard, It is discussed that about 80 to 90percentage disease on the Cotton crops are on its leaf spot. Consequently an area of interest is that identifying the leaf of the cotton rather than whole cotton. We used ANN as the classifier for testing the input test image with the database image so that proper disease can be detected. The main objective of the proposed work is to detect diseases in cotton leaves. It is very necessary to detect the diseases in cotton leaves. Detection of cotton leaf diseases can be done early and accurately using Artificial neural network.

## 2.Research Methodology:

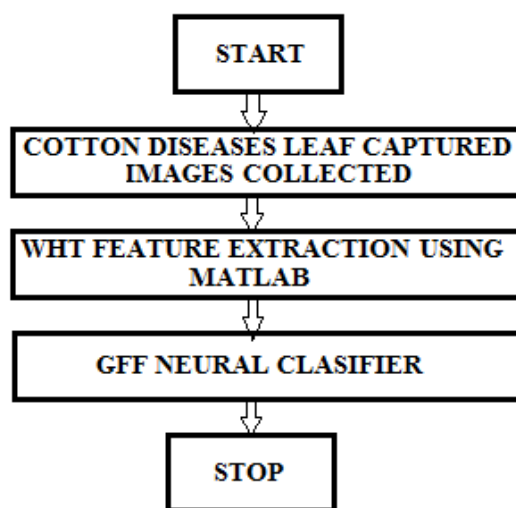


Figure2 Methodology of work

In this paper to study Cotton diseases classification Using Generalized Feed Forward Neural Network. Data acquisition for the proposed classifier designed for the classification of Cotton diseases shall be in the form of cotton leaf captured images. The most important un correlated features as well as coefficient from the images will be extracted .In order to extract features, statistical techniques, image processing techniques, WHT transformed domain will be used.

## 3.NEURAL NETWORKS

Following Neural Networks are tested: Feed-Forward Neural Networks

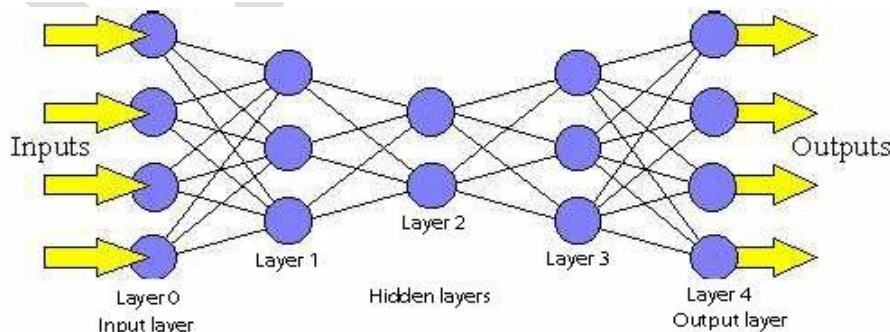


Figure 3 feed-forward network.

Feed-forward networks have the following characteristics:

1. Perceptrons are arranged in layers, with the first layer taking in inputs and the last layer producing outputs. The middle layers have no connection with the external world, and hence are called hidden layers.
2. Each perceptron in one layer is connected to every perceptron on the next layer. Hence information is constantly "fed forward" from one layer to the next., and this explains why these networks are called feed-forward networks.
3. There is no connection among perceptrons in the same layer.

A single perceptron can classify points into two regions that are linearly separable. Now let us extend the discussion into the separation of points into two regions that are not linearly separable. Consider the following network:

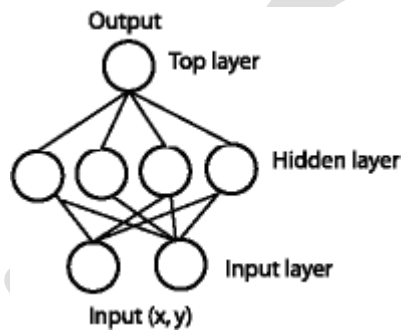


Figure. 3.2 A feed-forward network with one hidden layer.

The same  $(x, y)$  is fed into the network through the perceptrons in the input layer. With four perceptrons that are independent of each other in the hidden layer, the point is classified into 4 pairs of linearly separable regions, each of which has a unique line separating the region.

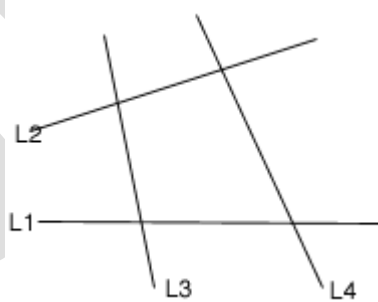


Figure 3.3 lines each dividing the plane into 2 linearly separable regions.

The top perceptron performs logical operations on the outputs of the hidden layers so that the whole network classifies input points in 2 regions that might not be linearly separable. For instance, using the AND operator on these four outputs, one gets the intersection of the 4 regions that forms the center region.

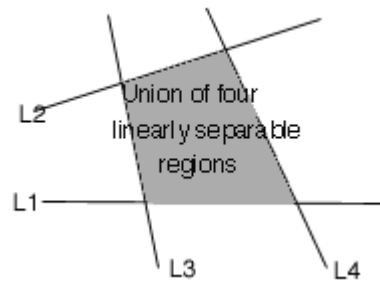


Figure 3.4 Intersection of 4 linearly separable regions forms the center region.

By varying the number of nodes in the hidden layer, the number of layers, and the number of input and output nodes, one can classification of points in arbitrary dimension into an arbitrary number of groups. Hence feed-forward networks are commonly used for classification.

#### 4. Learning Rules used:

##### ➤ Momentum

Momentum simply adds a fraction  $m$  of the previous weight update to the current one. The momentum parameter is used to prevent the system from converging to a local minimum or saddle point. A high momentum parameter can also help to increase the speed of convergence of the system. However, setting the momentum parameter too high can create a risk of overshooting the minimum, which can cause the system to become unstable. A momentum coefficient that is too low cannot reliably avoid local minima, and can also slow down the training of the system.

##### ➤ Conjugate Gradient

CG is the most popular iterative method for solving large systems of linear equations. CG is effective for systems of the form  $Ax=b$  (1) where  $x$  is an unknown vector,  $b$  is a known vector, and  $A$  is a known, square, symmetric, positive-definite (or positive-indefinite) matrix. (Don't worry if you've forgotten what "positive-definite" means; we shall review it.) These systems arise in many important settings, such as finite difference and finite element methods for solving partial differential equations, structural analysis, circuit analysis, and math homework.

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from  $u_i$  to  $u_j$  is given by:  $\Delta w_{ij} = r * a_i * e_j$ , where  $r$  is the learning rate,  $a_i$  represents the activation of  $u_i$  and  $e_j$  is the difference between the expected output and the actual output of  $u_j$ . If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

It has been shown that for networks with linear activation functions and with no hidden units (hidden units are found in networks with more than two layers), the error squared vs. the weight graph is a paraboloid in  $n$ -space. Since the proportionality constant is negative, the graph of such a function is concave upward and has a minimum value. The vertex of this paraboloid represents the point where the error is minimized. The weight vector corresponding to this point is then the ideal weight vector.

##### ➤ Quick propagation

Quick propagation (Quickprop) [1] is one of the most effective and widely used adaptive learning rules. There is only one global parameter making a significant contribution to the result, the  $e$ -parameter. Quick-propagation uses a set of heuristics to optimise Back-propagation, the condition where  $e$  is used is when the sign for the current slope and previous slope for the weight is the same.

### ➤ Delta by Delta

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from  $u_i$  to  $u_j$  is given by:  $\Delta w_{ij} = r * a_i * e_j$ , where  $r$  is the learning rate,  $a_i$  represents the activation of  $u_i$  and  $e_j$  is the difference between the expected output and the actual output of  $u_j$ . If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

It has been shown that for networks with linear activation functions and with no hidden units (hidden units are found in networks with more than two layers), the error squared vs. the weight graph is a paraboloid in  $n$ -space. Since the proportionality constant is negative, the graph of such a function is concave upward and has a minimum value. The vertex of this paraboloid represents the point where the error is minimized. The weight vector corresponding to this point is then the ideal weight vector. [10]

## 5. RESULT

The GFF neural network has been simulated for 40 different images of cotton leaf out of which 33 were used for training purpose and 7 were used for cross validation.

The simulation of best classifier along with the confusion matrix is shown below :

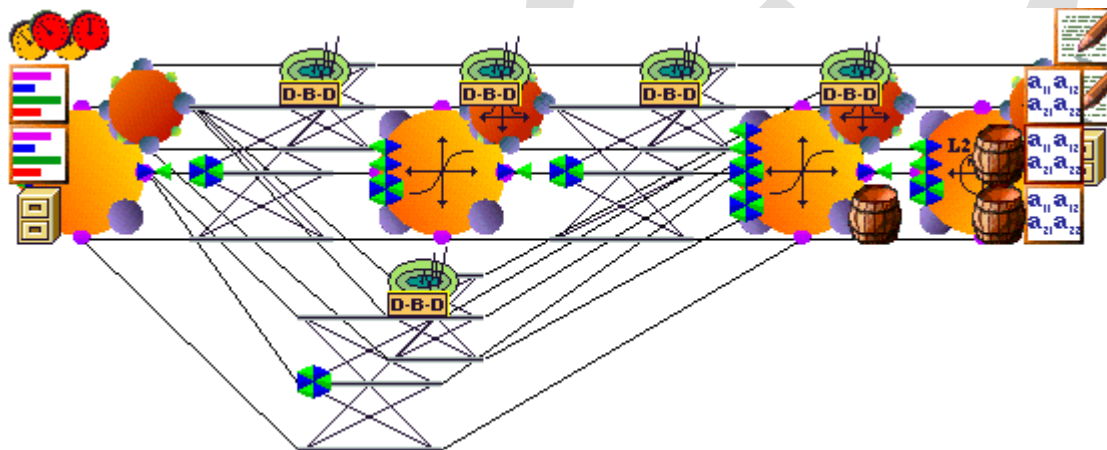


Fig.3.1 GFF neural network trained with DBD learning rule

Output / Desired	NAME(VIRAL DISEASES)	NAME(INSECT DISEASE(W))	NAME(INSECT DISEASE(L))	NAME(FUNGAL DISEASE)	NAME(BACTERIAL DISEASE)
NAME(VIRAL DISEASES)	1	0	0	0	0
NAME(INSECT DISEASE(W))	0	1	0	0	0
NAME(INSECT DISEASE(L))	0	0	1	0	0
NAME(FUNGAL DISEASE)	0	0	0	2	0
NAME(BACTERIAL DISEASE)	0	0	0	0	2

Table I. Confusion matrix on CV data set

<b>Output / Desired</b>	<i>NAME(VIRAL DISEASES)</i>	<i>NAME(INSECT DISEASE(W))</i>	<i>NAME(INSECT DISEASE(L))</i>	<i>NAME(FUNGAL DISEASE)</i>	<i>NAME(BACTERIAL DISEASE)</i>
<i>NAME(VIRAL DISEASES)</i>	3	0	0	0	0
<i>NAME(INSECT DISEASE(W))</i>	0	4	0	0	0
<i>NAME(INSECT DISEASE(L))</i>	0	0	6	0	0
<i>NAME(FUNGAL DISEASE)</i>	1	0	0	9	0
<i>NAME(BACTERIAL DISEASE)</i>	0	0	0	0	10

TABLE II. Confusion matrix on Training data set

Here Table I and Table II Contend the C.V as well as Training data set.

<b>Performance</b>	<i>NAME(VIRAL DISEASES)</i>	<i>NAME(INSECT DISEASE(W))</i>	<i>NAME(INSECT DISEASE(L))</i>	<i>NAME(FUNGAL DISEASE)</i>	<i>NAME(BACTERIAL DISEASE)</i>
MSE	0.003502326	0.005589084	0.079955832	0.17433369	0.108121481
NMSE	0.02860233	0.045644182	0.65297263	0.854235083	0.529795257
MAE	0.050577721	0.06220967	0.1389038	0.29452856	0.148613715
Min Abs Error	0.005251159	0.007578511	0.007714629	0.005173916	0.009514855
Max Abs Error	0.11060234	0.155716946	0.741059901	0.694447492	0.866460327
R	0.988277329	0.980244718	0.936379849	0.488353526	0.787603815
Percent Correct	100	100	100	100	100

TABLE III. Accuracy of the network on CV data set

<b>Performance</b>	<i>NAME(VIRAL DISEASES)</i>	<i>NAME(INSECT DISEASE(W))</i>	<i>NAME(INSECT DISEASE(L))</i>	<i>NAME(FUNGAL DISEASE)</i>	<i>NAME(BACTERIAL DISEASE)</i>
MSE	0.000420875	0.000707553	0.000136332	0.034983502	0.001004076
NMSE	0.003951148	0.006642462	0.000916452	0.176375154	0.004754083
MAE	0.012495808	0.01780273	0.005755934	0.06070842	0.022096759
Min Abs Error	4.47669E-05	0.000172183	8.2842E-06	0.000141984	0.000481886
Max Abs Error	0.051128465	0.055535121	0.053406065	1.052568774	0.055239122
R	0.998307613	0.997495344	0.999571658	0.920490138	0.998710596
Percent Correct	75	100	100	100	100

TABLE IV. Accuracy of the network on training data set

Here Table III and Table IV Contain the C.V and Training result.

## 6.CONCLUSION

This paper demonstrated how artificial neural networks(ANN)could be used to build accurate cotton diseases classifier. In order to train the neural network we extract shape features from real cotton leaf images that we captured at earlier time. We use Generalized Feed-Forward Network as classification. The result show that in training four diseases 100% accept viral diseases is 75% accuracy but in cross-validation result 100% accuracy.

## 7. ACKNOWLEDGMENT

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# Design & Analysis of Savonius VAWT for 50W Rated Power output

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**Abstract**— World energy demand rate is continuously increasing due to the more industrialization and demands in developing countries for the rural electrification so the usage of conventional sources has increased. To avoid the bad effect of fossil fuels and to meet the demand of world energy more emphasis is given on Non conventional sources of energy. Wind energy is one of the good sources of energy. Wind power is the conversion of wind energy into a useful form of energy, for example to make electrical power, mechanical power, wind pumps for water pumping or drainage, or sails to propel ships etc. There are mainly two types of wind turbine i.e. Horizontal Axis Wind Turbine and Vertical Axis Wind Turbine. The objective of this project is to design and analysis of Savonius VAWT for the rated 50W power output due to its advantages over the other wind turbine like it require low wind speed to rotate, low manufacturing cost and Survive in all weather condition. A prototype rotor blade was fabricated, tested and efficiency checked. The blades are designed by the use of Pro-E software and analyzed by the use of Ansys-14 software.

**Keywords**— Wind turbine, HAWT & VAWT, Savonius VAWT, design parameters, Glass fiber, PRO-E, Ansys-14, efficiency of rotor blade.

## 1. INTRODUCTION

World energy use increased more than ten times before over the 20th century, predominantly from fossil fuels (i.e. coal, oil and gas) and with the addition of electricity from nuclear power. In the 21st century, further increases in world energy consumption can be expected, much for rising industrialization and demand in developing countries for the rural electrification. For solving the world energy problem and the bad effect of conventional sources of energy on environment more attention all over the world is giving on the use of renewable energy sources. Purchases of energy account for 5–10% of gross national product in developed economies. [1] The need of renewable energy become more significant now a days due to several issues such as global environment problem, the depleting of fossil fuel thus raise the oil price as well and economic concern. In this situation, government already takes smart action in promoting, enforcing and enhancing the renewable energy by the policy or act. The study of the impact of wind energy on the future and product development should be performed to ensure that it will be very profitable to satisfy the electricity demand of the community. [2] Wind power is the conversion of wind energy into a useful form of energy, for example to make electrical power, mechanical power, wind pumps for water pumping or drainage, or sails to propel ships etc. Large wind farms consist of hundreds of individual wind turbines which are connected to the electric power transmission system. Offshore wind farms are more frequent and powerful winds than the other available land-based installations but construction costs are considerably higher & also maintenance. Small onshore wind facilities are used to provide electricity to isolated locations and utility companies increasingly buy surplus electricity produced by small domestic wind turbines. [3] [6] Wind turbine technology offers cost-effective solutions to eliminate costly use of conventional sources used to generate electricity. Additionally, this technology provides electrical energy without greenhouse effects or deadly pollution releases. Furthermore, wind turbine installation and electricity generating costs are lower compared to other electrical energy generating schemes. A wind turbine is the reverse of an electrical fan. Design & Analysis of Savonius VAWT for 50W Rated Power output 2. A wind turbine converts the kinetic energy of the wind into electrical energy. Wind turbines come in different sizes and types, depending on power generating capacity and the rotor design employed. [4] There are two kinds of wind turbines according to the axis of rotation to the ground, horizontal axis wind turbines (HAWT) and vertical axis wind turbines (VAWT). VAWTs include both a drag type configuration like Savonius wind turbine and a lift-type configuration like Darrieus wind turbine. Savonius wind rotor has many advantages over others in that its construction is simpler and cheaper. It is independent of the wind direction and has a good starting torque at lower wind speeds. [5] The objectives of this research were thus to design and develop a Savonius rotor blade for 50watt rated power output with locally available materials and compare its performance and production cost with the existing blades. The blades were made using glass reinforced fibre because of the material's light weight. This factor enabled the rotor to rotate at very low wind speeds, it is also long lasting and does not rot hence can survive in all weather conditions. A prototype rotor blade was fabricated, tested and efficiency checked. The blades are designed by the use of Pro-E software and analyzed by the use of Ansys-14 software.

## 2. LITERATURE REVIEW

Muhammad Mahmoud Aslam Bhutta et.al, [5] in this paper a review on the different configuration and design techniques has been studied by the author. It was learned that coefficient of power (CP) for various configurations is different and can be optimized with reference to Tip Speed Ratio. Latest emerging design techniques can be helpful in this optimization. Furthermore, flow field around the blade can also be investigated with the help of these design techniques for safe operation. He concluded that various vertical axis wind turbines can offer solution to the energy requirements ranging from 2 kW to 4 MW with a reasonable payback period. Coefficient of power can be maximized by selecting a suitable TSR range for various configurations. VAWTs offer good

possibility of building integrated designs. Cross flex type VAWT can be used on high rise buildings in the cities where free stream velocity greater than 14 m/s is available.

Frederikus Wenehenubun et.al, [7] has conducted an experimental study on performance of Savonius wind turbine related to number of blade. In this experiments he compare 2, 3, and 4 blades wind turbines to show tip speed ratio, torque and power coefficient related with wind speed. A simulation using ANSYS 13.0 software will show pressure distribution of wind turbine. The results of study showed that number of blades influence the performance of wind turbine. Savonius model with three blades has the best performance at high tip speed ratio. The highest tip speed ratio is 0.555 for wind speed of 7 m/s. Also Wind turbine rotor with four blades has high torque compared with two or three blades wind rotor. He concluded that four blades wind turbine has good performance at lower tip speed ratio, but three blades wind turbine has the best performance at higher tip speed ratio.

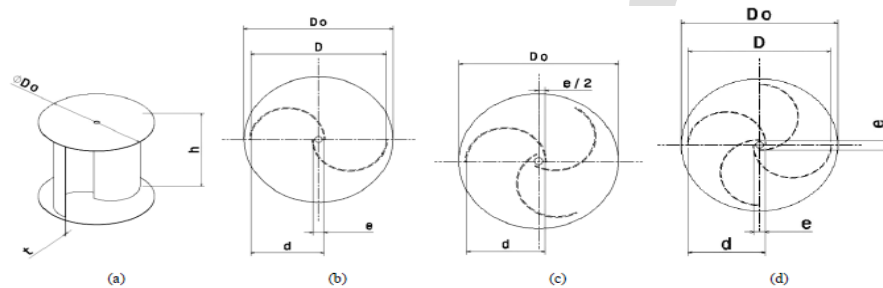


Figure 2.1 Design of wind turbine model (a) and the cross section of turbines with (b) two blades (c) three blades, and (d) four blades.  
[7]

Widodo et.al, [11] presents the design and analysis of the Savonius rotor blade to generate 5 kW power output. The relevant design parameters and theories were studied in this paper and used to determine related design geometry and requirements of the Savonius rotor blade. The Savonius rotor was designed with the rotor diameter of 3.5 m and the rotor height of 7 m. The 3D model of Savonius rotor blade was created by using Solid Works software. Computational Fluid Dynamics (CFD) analysis and structural Finite Element Analysis (FEA) are presented in this paper. CFD analysis was performed to obtain the pressure difference between concave and convex region of the blade while FEA was done to obtain the structural response of the blade due to the wind load applied in term of stresses and its displacements.

M.A. Kamoji et.al, [12] He made the experimental investigation on single stage modified Savonius rotor to improve the coefficient of power and to obtain uniform coefficient of static torque. To achieve these objectives, the rotors are being studied with and without central shaft between the end plates. Tests in a closed jet wind tunnel on modified form of the conventional Savonius rotor with the central shaft is reported to have a coefficient of power of 0.32. Investigation is undertaken to study the effect of geometrical parameters on the performance of the rotors in terms of coefficient of static torque, coefficient of torque and coefficient of power. The parameters studied are overlap ratio, blade arc angle, and aspect ratio and Reynolds number. The modified Savonius rotor with an overlap ratio of 0.0, blade arc angle of  $124^\circ$  and an aspect ratio of 0.7 has a maximum coefficient of power of 0.21 at a Reynolds number of 1, 50,000, which is higher than that of conventional Savonius rotor (0.19). Correlation is developed for a single stage modified Savonius rotor for a range of Reynolds numbers studied.

U.K. Saha et.al, [13] He conducted a Wind tunnel tests to assess the aerodynamic performance of single, two and three-stage Savonius rotor systems. Both semicircular and twisted blades have been used in either case. A family of rotor systems has been manufactured with identical stage aspect ratio keeping the identical projected area of each rotor. Experiments were carried out to optimize the different parameters like number of stages, number of blades (two and three) and geometry of the blade (semicircular and twisted). A further attempt was made to investigate the performance of two-stage rotor system by inserting valves on the concave side of blade. All the tests have been conducted in the range 6–11 m/s. He concludes that the optimum number of blades is two for the

Savonius rotor whether it is single-, two- or three-stage. Twisted geometry blade profile had good performance as compared to the semicircular blade geometry. Two-stage Savonius rotor had better power coefficient as compared to the single- and three-stage rotors. Valve-aided Savonius rotor with three blades shows better performance coefficient as compared to the conventional three-bladed rotor.

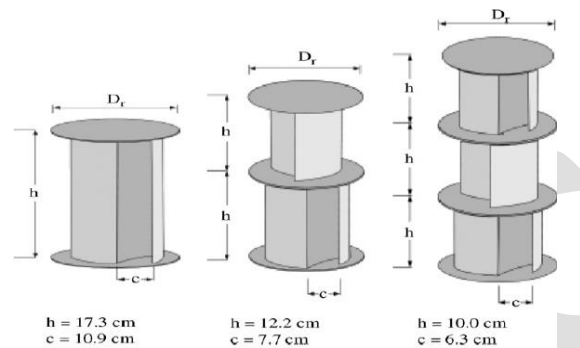


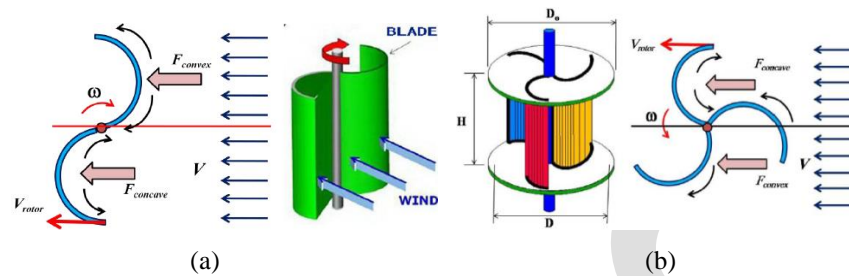
Figure 2.2 Solid models of single-, two- and three-stage rotor system. <sup>[13]</sup>

Sukanta Roy et.al, [14] He made a computational study to assess the influence of overlap ratio on static torque characteristics of a vertical axis wind turbine. The study is performed with the help of a finite volume based computational fluid dynamics (CFD) software package Fluent 6.3. The computational model is a two-bladed conventional VAWT having overlap ratios of 0, 0.10, 0.15, 0.20, 0.25 and 0.30. Initially, a comparative analysis is made using various  $k$  turbulence models and then the results are compared with the experimental data available in literature. The flow field around the turbine model is also studied with the help of static pressure contour analysis. Based on this computational study, it is realized that an overlap ratio of 0.20 eliminates the effects of negative static torque coefficient, provides a low static torque variation at different turbine angular positions and also gives a higher mean static torque coefficient as compared to the other overlap ratios. An optimum mean static torque coefficient of 0.224 is obtained with  $\delta = 0.20$  at  $U = 10.44$  m/s. The increase of the static torque with the increase of overlap ratio is mainly due to increased pressure on the concave side of the turbine returning blade.

N.H. Mahmoud et.al, [15] in this paper author has studied experimentally different geometries of Savonius VAWT in order to determine most effective operational parameters like number of blades of two blades (2b), three blades (3b) and four blades (4b); single stage (1st.) and double stages (2st.); overlap ratios (b) of 0, 0.2, 0.25, 0.3 and 0.35 and aspect ratios of 0.5, 1, 2, 4 and 5 besides the existence and absence of end plates. The blades of rotors are made from light plastic (PVC) tubes with different diameters (0.3, 0.2, 0.1 and 0.08 m). The end plate is fabricated from light wood plates with 2.5 mm thickness. The diameter of the end plate ( $D_o$ ) is greater than the rotor diameter by 10% in order to have a good performance as recommended previously by Mojola, Menet& Blackwell et al. The steel shaft which is used here has 14 mm in diameter and 62 cm in length for all models. He found that, the two blades rotor is more efficient than three and four ones. The rotor with end plates gives higher efficiency than those of without end plates. Double stage rotors have higher performance compared to single stage rotors. The rotors without overlap ratio (b) are better in operation than those with overlap. The results show also that the power coefficient increases with rising the aspect ratio (a). The conclusions from the measurements of the static torque for each rotor at different wind speeds verify the above summarized results of this work.

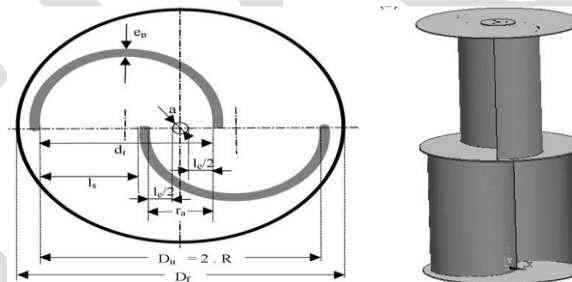
Mohammed Hadi Ali [16] made an experimental comparison and investigations to study the performance and to make a comparison between two and three blades Savonius wind turbine. For this purpose, two models of two and three blades were designed and fabricated from Aluminum sheet, each of them has an aspect ratio of ( $As = H/D = 1$ ), the dimension is ( $H = 200$  mm height and diameter  $D = 200$  mm) and the blades were made of semi – cylindrical half of diameter ( $d = 100$  mm). The two models were assembled to have (overlap  $e = 0$  and a separation gap  $e' = 0$ ). These two models were tested and investigated by using a subsonic

wind tunnel that was fabricated for this purpose under a low wind speed due to many reason mostly that the Savonius wind turbine has its maximum performance at ( $\lambda = \text{TSR} = 1$ ) and a high starting torque at low wind speed. It was observed from the measured and calculated results that the two blades Savonius wind turbine is more efficient, it has higher power coefficient under the same test condition than that of three blades Savonius wind turbine.



**Figure 2.3 (a) Schematic drawing showing the drag forces exert on two blade Savonius**  
(b) Schematic drawing showing the drag forces exert on three blade Savonius. [16]

J.-L. Menet [17] studied a double step Savonius rotor for local production of electricity. He design, develop and ultimately build a prototype of such a rotor, which was considered as a complete electromechanical system. The building data were calculated on the basis of the nominal wind velocity  $V = 10$  m/s. Particular care was necessary to choose the appropriate generator, which was finally a rewind conventional car alternator. It is clear that this kind of rotor is cheaper to build than a conventional horizontal axis wind machine (airscrew). Besides, it should produce enough electricity to charge a conventional “starting battery”. Thus it is particularly adapted to local production of electricity, such as in sailing applications, to generate electricity on a sailboat.



**Figure 2.4 Scheme of the present prototype. [17]**

### 3. PROBLEM IDENTIFICATION & OBJECTIVES

#### 3.1 Problem Identification

Now a day's every country facing the problem of energy, as the prizes are increasing day by day. Many developing country have faces the problem of energy production as well as scarcity. Lots of people in remote area have faces problem of electricity at their home. Four out of five people without electricity live in rural areas of the developing world, especially in peripheral urban and isolated rural areas. Climate changed now have been another problem for developing countries as due to increasing in electricity consumption, during the generation of electricity about 940 gm of Carbon Dioxide gets emitted to environment and this  $\text{CO}_2$  increases the temperature of environment and green house effect. Global energy-related  $\text{CO}_2$  emissions are set to grow by 52% between 2003-30. This green house effects damage the ozone layers.

#### 3.2 Barriers to Small Wind Turbine Technology

##### 3.2.1 Technology Barriers, High Cost of Wind Turbine, Power Electronics Issues

3.2.2 Market Barriers, Lack of effective standards, Information about the wind resource , Insufficient capitalization , Complicated financial impact

#### 3.3 Objective and Scope of Present Work

1. In order to reduce the cost of the turbine, and to make wind energy more attractive for rural electrification.
2. The manufacturing of wind mill blade by using epoxy materials is best suited. It is relatively light weight material and having excellent fatigue properties.

The objectives of this dissertation are;

- 1) To design, develop and ultimately build a Prototype of such 50 Watt Savonius VAWT rotor blade for domestic used.
- 2) Analyzed the design blade for impacting drag and lift force.

## 4. WINDMILL

### 4.1 Working of Windmill

The working of wind mill is very simple as the air comes in the structure the working blades rotates which is connected to main rotor shaft by the supporting arms the main rotor is coupled to a generator from where we can get the output. The power in the wind can be extracted by allowing it to blow past moving wings that exert torque on a rotor. The amount of power transferred is directly proportional to the density of the air, the area swept out by the rotor, and the cube of the wind speed. [4][8]

### 4.2 Components of a Wind Turbine

The wind turbine usually has six main components, the rotor, the gear box, the generator, the control & protection system, the tower and power system. These main components are shown in the figure.

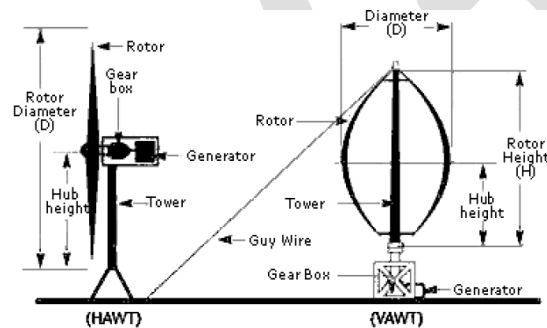


Figure 4.1 Wind turbine components [8]

## 5. METHODOLOGY

### 5.1 Design Theory

#### 5.1.1 Power in Wind

The energy transferred to the rotor by the wind depends on the air density, the swept area of the rotor and wind speed. A wind flow, can be understood as a set of moving particles, which develops a energy flow (flow of air through a turbine) or wind power (power available in the air) stream through the area A, defined by the square-cube law:

$$P_{\text{wind}} = \frac{1}{2} \rho A V^3 \dots \dots \dots [1] \quad [6][9]$$

#### 5.1.2 Power Coefficient

When a wind turbine is crossed by a flow of air, it can get the energy of the mass flow and convert it in rotating energy. This conversion presents some limits, due to the Betz' law,  $C_p=0.59$ . Power coefficient  $C_p$  is given by

$$C_p = P / (0.5 \rho A V^3) \dots \dots \dots [2]$$

The maximum power coefficient,  $C_p$  for Savonius rotor is 0.30. Hence, the  $C_p$  value used in this project is 0.30 and the power output, P with considering the power efficiency is:

$$P = 0.15 \rho A V^3 \dots \dots \dots [3] \quad [8] [9]$$

There are various factors which are going to affecting on the performance of the Savonius vertical axis wind turbine. The performance of VAWT is given in terms of co-efficient of performance indicated by  $C_p$ . Here are the fish bone diagram or cause effect diagram which shows the various factors which are affecting on the performance of the Savonius vertical axis wind turbine.

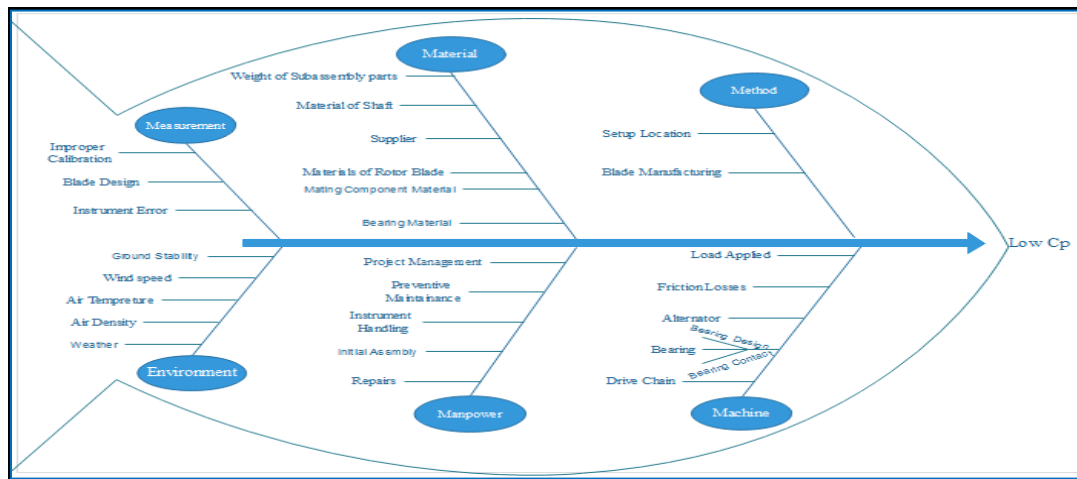


Figure 5.1 Fishbone Diagram

### 5.1.3 Important Wind Speed Consideration

These all speed parameters are depending on the average wind speed. For design of the rotor the average speed of air is consider as 4 m/s[AccuWeather.com].The details of cut-in speed, rated wind speed and cut-out speed as summarize in table below:

Table 5.1: Wind Speed Parameters Calculation

Wind Speed Parameter	Equation	Calculation
Cut-In Speed	$V_{cut-in} = 0.5 V_{avg}$	2 m/s
Rated Wind Speed	$V_{rated} = 1.5 V_{avg}$	6 m/s
Cut-Out Wind Speed	$V_{cut-out} = 3.0 V_{avg}$	12 m/s

### 5.1.4 Blade Diameter, Swept Area

The power is directly proportional to the swept area by the turbine rotor having the expression:

$$A = \pi R^2 \dots\dots\dots [4]$$

For the swept area for Savonius Wind Turbine blade is given below, the swept area for Savonius blade is obtained by multiplication of rotor diameter,  $D$  and the rotor height,  $H$ .

The power output of blade is improved with the swept area.

$$A = D H \dots\dots\dots [5]$$

Savonius rotor is designed with rotor height twice of rotor diameter this lead to better stability with proper efficiency. <sup>[14]</sup>

$$H = 0.82m$$

### 5.1.5 Aspect Ratio

The aspect ratio of Vertical axis wind turbine is defined as the ratio between blade length and rotor radius.

The aerodynamic performance of Savonius rotor can be evaluated by the aspect ratio. The aspect ratio for Savonius rotor is given by

$$AR = H/D \dots\dots\dots [6]$$

### 5.1.6 Tip Speed Ratio

The tip speed ratio is defined as the ratio of the speed of the extremities of a windmill rotor to the speed of the free wind.

Drag devices always have tip-speed ratios less than one and hence turn slowly, whereas lift devices can have high tip-speed ratios (up

to 16:1) and hence turn quickly relative to the wind. Savonius model with three blades has the best performance at high tip speed ratio. The highest tip speed ratio is 0.555 for wind speed of 7 m/s. [8]

High tip speed ratio improves the performance of wind turbine and this could be obtained by increasing the rotational rate of the rotor. [11]

$$\lambda = \omega.R / V \dots\dots\dots [7]$$

Where,

$\omega$ =angular velocity, R represents radius revolving part of the turbine, V = Undisturbed wind speed.

Maximum tip speed ratio that Savonius can reach is 1.

$$\lambda = 1 \dots\dots\dots [8]$$

### 5.1.7 Overlap Ratio

The overlap ratio of rotor in this study is 0 and given by the following equation [12]

$$\text{Overlap Ratio} = m/D \dots\dots\dots [9]$$

Where;

m=Distance between two rotor subtracted by shaft diameter, D=Rotor diameter

### 5.1.8 Solidity

Solidity is related to tip speed ratio. A high tip speed ratio will result in a low solidity. According to researcher solidity define as the ratio of blade area to the turbine rotor swept area; also solidity is usually defined as the percentage of the area of the rotor, which contains material rather than air. High solidity machines will have a low tip-speed ratio and vice versa.

**Table 5.1: Solidity ratios of various rotors [3]**

Types Of Rotor	Solidity	Types Of Rotor	Solidity
Savonius Rotor	1	High Speed Horizontal axis Rotor	0.01 to 0.1
Multi-blade water pumping wind rotor	0.7	Darrieus Rotor	0.01 to 0.3

### 5.1.9 Number of blades

It was found that, the two blades rotor is more efficient than three and four ones. [13][14][15]

**Table 5.2: Summaries of Rotor Blade Design**

Parameter	Value	Parameter	Value
Power Generated	50 watts	Tip Speed Ratio	1
Swept Area	0.38m <sup>2</sup>	Solidity	2.11
Rated Wind Speed	6 m/sec	Diameter	0.41 m
Aspect Ratio	2	Height	0.82 m
Number of Blade	2		

### 5.1.10 Effect of end plates

To study the effect of end plates, rotors with and without end plates are tested at constant values of other considered parameters. Rotors with end plates give higher mechanical power than rotors without end plates. This is because the existence of end plates increases the amount of air which strikes the blades of Savonius rotor.

## 5.2 Calculation of the Shaft and the Bearings

It is possible to estimate the compressive stresses on the shaft of the rotor, due to the axial loading, using for example the empirical Johnson Eq. [23], and to choose the diameter which ensures a safe load:  $a=14$  mm. This shaft, which has been made by machining a steel bar, is completely described in reference [17]. Note that it must set the bearings. The complete calculation of the bearings can be found in reference [17].

### 5.3 Choice of the Generator

The car-alternator which was used is a TATA INDICA and was modified as follows: It is provided with charging lamp for to notify the charging status. The testing of the alternator for three angular velocities (100,200, 300) while charging a classical 12 V battery.

### 5.4 Material Usage in Current Wind Turbine

In general the materials used for wind turbines are Steel, Aluminum, Copper and Reinforced Plastic. Because Glass / Epoxy has a lower value of density as compared to Aluminum and a high strength to weight ratio. The best VAWT blade design can be achieved by choosing a material which has low density and high strength. Composite materials, with a right orientation of plies, are best choice to achieve these features. These features help to achieve a high strength to weight ratio which in turn reduces the overall weight of the blade and centrifugal forces acting on it.<sup>[18][19]</sup> By using Hand layup method glass fiber reinforced material is prepared for rotor blade. In this project we have used E-glass fiber. The following are certain important properties present in the materials. <sup>[11]</sup>

## 6. MODELING & ANALYSIS

The modeling for exist design is carried out in Pro/ENGINEER software and Finite elements analysis in ANSYS-14.0.

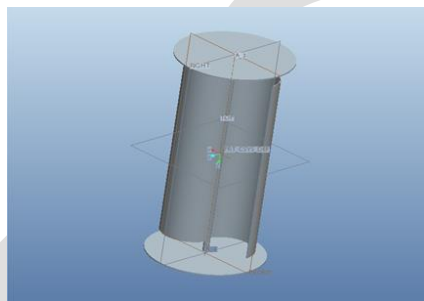


Figure 6.1 3D model of Savonius rotor

Table 6.1: Summaries of rotor blade design and the material properties of E-glass fiber

Parameter	Value	Parameter	Value
Swept Area (A)	0.38 m <sup>2</sup>	End Plate Thickness (tf)	1 mm
Rotor Diameter (D)	0.41 m	Density	1.85e9kg/m3
Rotor Height (H)	0.82 m	Young's modulus	3.33 e5Gpa
End Plate Diameter(Df)	0.41 m	Poisson's ratio	0.09
Chord Length (d)	0.37 m	Tensile strength	217 – 520 Mpa
Overlap Distance (e)	0	Compressive strength	276 – 460 MPa
Blade Thickness (t)	2 mm		

## 6.1 Physics of Problem

### 6.1.1 Modeling

In this section the brief process for modeling is describe. The basic steps in modeling can be divided as follows:

1. Set the Preferences
2. Pre-Processing
3. Solution
4. Post Processing

2.1 Define element types ,Defining material properties, Creating a model, Mesh the give area, Apply displacement constrains

### 6.1.2 Pre-processor

Whether the element lies in 2D or 3D space. For analysis of blade we select the SHELL63 elements. SHELL63 can be adjusted for Non uniform materials. In this section the problem of physics such as stress and deflection are calculated when the blade undergoes the uniformly distributed load of wind.

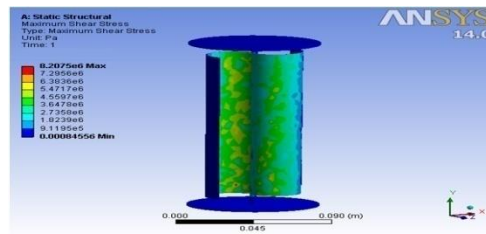


Figure 6.2 Maximum Shear Stress of Blade in ANSYS

The model which has to be design having the thickness of 2 mm, diameter 410 mm, chord length 370 mm and length of 820 mm.

- **Generating the Mesh**

**Free Mesh:** It has no element shape restrictions. The mesh does not follow any pattern. It is suitable for complex shape areas and volumes.

**Mapped Mesh:** It restricts element shapes to quadrilaterals for areas and hexahedra (bricks) for volumes. It typically has a regular pattern with obvious rows of elements. It is suitable only for “regular” areas and volumes such as rectangles and bricks.

The two Savonius rotor blades are symmetry, the analysis is performed on blade, the fixed constraints fixtures are applied on the top, bottom and center of the shaft, the fixtures constrained all translational and all rotational degrees of freedom. Therefore, the blade is stay in a static and fixed position. The load for this analysis is force with 2.93 N obtained from the aerodynamic analysis and equally distributed on the concave.

### 3. Solution

The stresses, strain developed and the total deformation due to force applied on blade are shown below

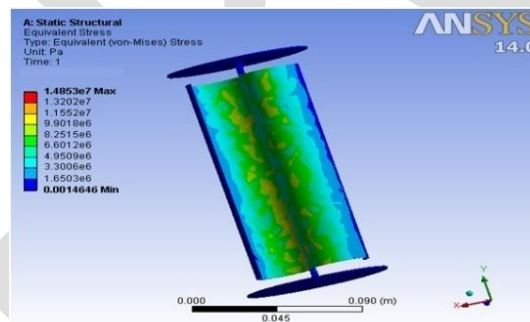


Figure 6.3 Equivalent Elastic Strain for Savonius Rotor Blade

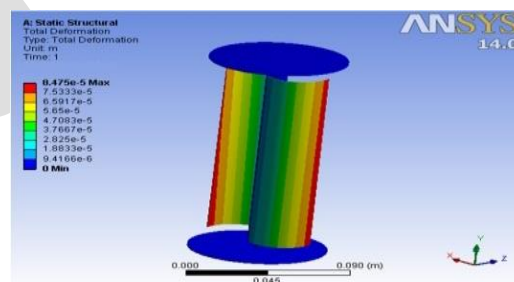


Figure 6.4 Maximum Deformation

The maximum and minimum Von Misses stress for the Savonius rotor blade are  $1.04853 \times 10^{-7}$  Pa and  $1.46 \times 10^{-3}$  Pa respectively. Figure shows the deformation of the model under the given load, the maximum displacement is 0.847 mm at the edge of the blade. The deformation is acceptable because it is small in relation to the overall size of the blade structure.

### 6.2.1 Computational Flow Analysis

The blade of Savonius rotor blade experience the drag force as the solid model is fully surrounded by the flow. This fluid flow is bounded by the Computational Domain boundaries. After the input data is ready, the model then is entering the meshing process. The contour cut plot display the higher pressure region and lower pressure region as red and blue color respectively as shown in figure The pressure is high near the concave surface and is low near the convex surface. The maximum pressure is found 112.02 kPa. The density of air over the concave and convex surfaces is equally distributed. The red spotted region shows the maximum density of air. The maximum density of flow air found to be  $1.23 \text{ kg/m}^3$ .

### 7. Experimental Setup

The experimental setup is shown in figure 7.1. The experimental setup consists of alternator, wind turbine blade, shaft. The blades are attached to the shaft with nut & bolt. The alternator is attached to battery for storing the charges. The different reading was noted for equal interval of type. The voltmeter and ammeter is used to note down the current and voltage. The present experimental investigations are concerned with geometry of Savonius VAWT which is test at open air condition to predict performance with different parameters like existence & absence of end plates; with & without separation gap.

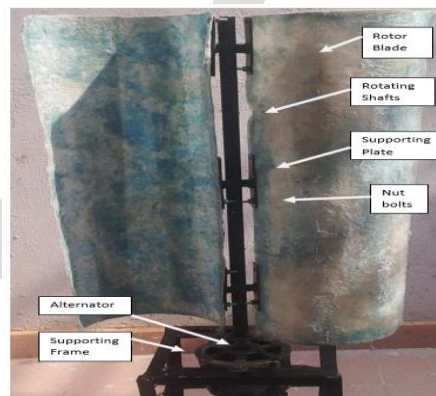


Figure 7.1 Experimental Setup

#### Measuring Instrument:-

**Digital laser tachometer-** Angular velocity was measured in units of revolutions per minute (rpm) using a digital laser tachometer. The operational range of this instrument is 2.5 to 99,999 rpm and is accurate to  $\pm 0.05\%$ . This model was capable of measuring wind speeds up to 30 m/s, at an accuracy of  $\pm 0.1 \text{ m/s}$

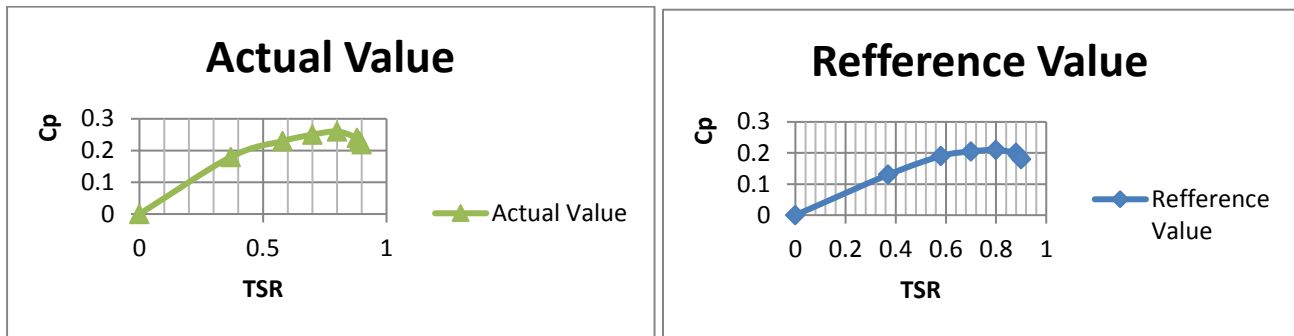
**Digital Multimeter-**Digital multimeters, also known as DMMs, are among the most widely used electronic testing instruments. DMMs are often referred to as the tape measure of the new millennium.

**Digital anemometer-**The hand-held digital anemometer, shown in Figure 31, measured the wind speed at the turbines face. This model was capable of measuring wind speeds up to 30 m/s, at an accuracy of  $\pm 0.1 \text{ m/s}$

## 8. RESULTS AND DISCUSSION

### 8.1 Experimental Results

The experimental results were noted and calculated for study out the maximum power delivered by the wind mill and computational analysis gives structural stability of the prototype. Readings shows the good performance by using the composite material as compared to PVC material. Here with PVC material got the highest  $C_p$  value of 0.21 at the TSR 0.8 where as I got the maximum value of  $C_p$  is 0.26 at the TSR 0.8. That means the performance of the composite rotor blade is good as compared to the PVC rotor blade at low wind speed.



Graph 8.1 Comparative Graph TSR Vs Cp

## 8.2 Validation of Experimental and Computational Results

The validation of results is very important to accepting the results. The validation of experimental results is presented on the basis of comparison between previous research studies, while the computational results are validated using the analytical calculation. The following table 8.1 show the comparison of results obtained analytically and computationally.

Table 8.1: Summary of Computational and Analytical Results

Sr.No.	Parameters	Computational	Analytical
1	Shear Stress (Pa)	0.0008455-8.55e6	24.19
2	Maximum Deformation (mm)	0.847	0.8131

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**Raghunath M Khandagale**

## 9. CONCLUSION

Finite Element Analysis method is used to obtain the maximum deformation and stress experienced by the rotor blade. The structure of the Savonius rotor blade is analyzed using ANSYS software and Pro-E Software is used to generate three dimensional model of blade. The maximum power output is obtained 13.91 W at wind speed of 6.5 m/s. It is clear from the experimentation the performance would be improved with medium flow of wind speed.

For finite element analysis E-glass fiber material is taken into consideration. From the CFD analysis, it is found that the concave region of blade experiences high pressure while the convex blade region experiences low pressure for two blades of Savonius rotor. The maximum pressure from flow analysis is 112.03 kPa. The high pressure region produces 2.93 N of drag force that is spinning the Savonius wind turbine. The maximum deformation of the Savonius rotor blade is 0.847 mm.

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# Religiosity on Consumer Behaviour, special reference to green food consumption

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**Abstract-** Religiosity as it relates to consumer behaviour has been under-researched (Cleveland & Chang, 2009; Swimberghe, Flurry, & Parker, 2011). This means that there is a need to develop a more robust theoretical understanding of how individual religiosity impacts consumer behaviour (Vitell, 2009). Therefore this study specially investigates the influence of Religiosity and Consumer Behaviour on green food consumption.

The descriptive research was used to 150 respondents resides in Manmunai North Divisional Secretariat Area in Batticaloa District in Sri Lanka as the convenient sample and the cross-sectional design was used to analyze the collection of data. The study considers Religiosity (intrinsic religiosity and extrinsic religiosity) as independent variable and Consumer behaviour as dependent variable. Data were collected through closed ended questionnaires and the analysis was conducted by SPSS Statistics, which are Univariate, Bivariate, Multivariate analysis.

The study found that this religiosity influences on Consumer Behaviour. The findings of the study suggest that the extrinsic religiosity influences high on consumer behaviour on green products consumption.

**Key Terms:** Religiosity, Intrinsic Religiosity, Extrinsic religiosity and Consumer Behaviour

## 1. Introduction

Marketers are keen to sell the green products to customers, and the consumers are keen to buy the green products. There are immense knowledge on environment, ecological, health and green products among the consumers. Environment friendly, healthy, organic, green products are becoming very popular among the consumers irrespective of age, education and gender. Marketers are also very keen in segmenting their market scientifically in order to achieve huge profit by providing the supplies of the consumers. The consumers are also very much concern over the generation, health issues, obesity, long living, brain function and innovative ideas generations are very keen in green food. Moreover consumers are willing to “pay for the privilege of buying green” (Mintu-Wimsatt and Bradford, 1995).

There is a progressive increase in the consumption of the green products specially food. Marketers of different industries are taken leadership in green in their relevant field such as green hotel, green banking, green electronic products, and green automobiles and so on. This leads the academics to study and explore the factors of this immense change towards green products. Besides these efforts consumer awareness, knowledge about the green also encouraged consumers to go for green products. According to Coddington

(1993), there is a change in consumer perspectives. Consumers are worried about the environmental change and damage towards their health and safety. There are many reasons why consumers behave towards buying the green products. They behave because of their concerns towards the health issues or rather is there any influences from the religiosity.

Huffman (1988), stated that religiosity is a stronger determinant of the values than any other predictor. This is a major theme in functionalist theory as well. It is also appropriate to examine the relationship between the religiosity and the consumer Behaviour of green food.

Therefore this study is to investigate the relationship between religiosity and consumer behaviour of green food in Batticaloa District.

## **Literature Review and Hypothesis Development**

### **Religiosity**

Religion is an abstract concept that challenges scholars in defining the term (Guthrie, 1996). Religiosity is a belief in the existence of God and a commitment to attending to and complying with rules that members of that religion believe have been defined by God (McDaniel and Burnett, 1990). Religiosity can both directly and indirectly contribute to the formation and shaping of individuals' norms, thoughts, moral standards, opinions, attitudes, socializations, beliefs and decisions making (Y. Choi, 2010; Fam et al., 2004; Wilkes et al., 1986). Religiosity is categorized into two: intrinsic and extrinsic religiosity (Allport, 1950). Intrinsic religiosity is defined by internalized beliefs regardless of external consequences (Allport & Ross, 1967; Schaefer & Gorsuch, 1991). Extrinsic religiosity is a social convention, a self-serving instrumental method shaped to suit oneself (J. W. Clark & Dawson, 1996; Donahue, 1985a). Extrinsic religiosity further explained as personal extrinsic religiosity and social extrinsic religiosity. In this study intrinsic religiosity and extrinsic religiosity approach is used to measure religiosity because it is a highly relevant approach (Vitell, 2009),

### **Consumer behaviour**

Consumer behaviour is the study of individuals, groups, or organizations and the processes they use to select, secure, use, and dispose of products, services, experiences, or ideas to satisfy their needs and wants. Consumer behaviour blends elements from social factors, cultural factors, personal factors and psychological factors.

### **Hypotheses**

Hirschman (1981) was one of the first marketing academics to specifically investigate the link between religiosity and consumer behaviour (Cited in Cutler, 1991). His research into American Jewish ethnicity suggests that religious affiliation should be viewed as a variable with a large potential influence on marketing and consumer behaviour. In the literature, religiosity has been shown to affect consumer decision making, ethical beliefs and judgments. However, due to the sensitivity of religiosity as it relates to consumer behaviour has been under-researched (Cleveland & Chang, 2009; Swimberghe, Flurry, & Parker, 2011). Empirical studies suggest the need to integrate religiosity into consumer research (Delener, 1994, Delener and Schiffman, 1988, Essoo and Dibb, 2004, Mokhlis, 2009). Religiosity has been shown to influence consumption indirectly by significantly contributing to an individual's norms, ethical beliefs and values (Bailey & Sood, 1993; Essoo & Dibb, 2004; Muhamad & Mizerski, 2013). According to Allport (1950), 'intrinsic' and 'extrinsic' religious orientations are the most dominant conceptual paradigm of psychology of religion. The Allport and Ross (1967), 'Religious Orientation Scale' distinguishes considering religion as an end in itself as Intrinsic orientation versus considering religion as a means to the end as Extrinsic orientation. Intrinsic religiosity refers to the motivation arising from goals set forth by the

religion itself whereas Extrinsic religiosity refers to the inducement to pursue religious behaviour is driven more by selfish ends. Allport (1966) explained that extrinsically oriented people may be more egocentric, using religion to satisfy ulterior motives such as protection, attention, friendship, social acceptance and comfort. Nowadays the global trend to go for green products because it gives more health related outcomes. Therefore, extrinsics also would like to go for the green products because it gives much benefits to the self. Intrinsic, also are very serious about religious principles and are self-abnegating in religious matters. They are universally compassionate, and believe in brotherhood and sisterhood (Ryckman et al. 2004). Furthermore, there is a strong association between environmental attitudes and purchasing frequency and intention in the sense that more environmentally concerned individuals are more likely to buy green food with the perception that green products are healthier than conventional alternatives (Peattie, 2010; Vermeir and Verbeke, 2008; Zhou *et al.*, 2013).

Above statements indicate the value of religiosity in consumer behaviour need to be researched this marketing world. Therefore, from the review of literature the following hypotheses are being formed:

H1: There is a significant and positive relationship between intrinsic religiosity and green food consumption behaviour.

H2: There is a significant and positive relationship between extrinsic religiosity and green food consumption behaviour.



Figure 01: Conceptual Frame Work

## Methodology

The type of research is deductive and variables are measured with quantitative analysis. Primary data are collected through structured questionnaires with closed statements measured with Lickert's scale (1= strongly disagree and 5= strongly agree. One hundred and fifty (150) respondents who are consuming Green food are selected by convenience sampling technique. The summary of this is shown in Table 1.

Table 1: Summary of sampling framework

Study Setting	Consumers of green food in Batticaloa District
Unit of Analysis	Consumers in Manmunai North Divisional Secretariat Division
Sample Size	Hundred & Fifty (150) Consumers
Sample Method	Convenient Sampling Technique

Source: Survey Data, 2016

## Results and Discussion

### Intrinsic Religiosity and Extrinsic Religiosity as independent variables

Intrinsic religiosity as an independent variable has High Level attribute of the Consumer Behaviour (Mean  $X_1 = 4.0244$  and see Table 2). Extrinsic Religiosity also have high level of attribute to wards Consumer Behaviour (Mean  $X_2 = 4.0503$  and see Table 2). In addition, most of the consumers expressed generally a common opinion regarding the variables: Intrinsic Religiosity and Extrinsic Religiosity (Standard Deviation = .40949 and 0.32558 respectively). Religiosity has high level of attribute on consumer behaviour (Mean  $X_3 = 4.0608$  and Standard Deviation = .31107 see Table 2).

Table 2: Overall Measures of Independent Variables

Description	Intrinsic Religiosity $X_1$	Extrinsic Religiosity $X_2$	Religiosity $X_3$
Mean	4.0244	4.0503	4.0608
SD	.40949	.32558	.31107
Decision Attribute	High Level	High Level	High Level

Source: Survey Data, 2016

### Consumer Behaviour as Dependent Variable

Consumer Behaviour towards green food consumption has high level attribute toward consumer behaviour (Mean  $X_4 = 4.1667$  and see Table 3). In addition, most of the consumers expressed generally a common opinion regarding the variable of Consumer Behaviour (SD = .35464)

Table 3: Overall Measures of Dependent Variable

Description	Consumer Behaviour towards Green Food purchase $X_3$
Mean	4.1667
SD	.35464
Decision Attribute	High Level

Source: Survey Data, 2016

### Relationship between Intrinsic Religiosity and Consumer Behaviour towards green food purchasing

The correlation analysis is taken to explain the correlation between Intrinsic Religiosity and Consumer Behaviour towards Green Food. Results indicate that there is statistically linear significant and positive relationship ( $r = .441$ ,  $p < 0.01$ ) between them. Thereby, accept the Hypothesis  $H_1$ - i.e., Intrinsic Religiosity has a significant influence on Consumer Behaviour of green food purchasing. It reflects that Intrinsic Religiosity positively influences the Consumer Behaviour of Green Food purchasing. It is shown in Table 4.

Table 4: Correlation between Intrinsic Religiosity and Consumer Behaviour

Pearson Correlation		
Consumer Behaviour		
Intrinsic Religiosity	(Pearson Correlation)	.441**
	Sig. (2-tailed)	.000
**. Correlation is significant at the 0.01 level (2-tailed).		
List wise N=150		

Source: Survey Data, 2016

Further to know the impact of Intrinsic Religiosity on Consumer Behaviour of Green Food Purchasing, the liner regression analysis was undertaken and it's shown in the following table 5, as bellow:

Table 5: Multiple Liner Regression Analysis

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
				R Square Change	F Change	Sig.F Change
.441	.194	.189	.31937	.441	35.727	.000

Source: Survey Data, 2016

According to the table 4 indicates that the significance is at F Change (0.000) the Co-efficient of Determination ( $R^2$ ) is 0.441 and Adjusted R- Square is 0.189 indicates an Lower relationship between Intrinsic Religiosity on Consumer Behaviour of Green Food Purchasing. The multiple analysis indicate as 0.441 ie that the independent variable - Intrinsic Religiosity strongly predicts Consumer Behaviour of Green Food Purchasing. Also the  $R^2$  indicates the proportion of variance that can be explained as 19.4% of the dependent variable. And Adjusted  $R^2$  adjusts the value of  $R^2$  to accurately represent the interest of sample, in this analysis Adjusted  $R^2$  is 18.9%, more conservative than the unadjusted  $R^2$  of 19.4%. It is different enough from the unadjusted  $R^2$  to be worth reporting.

#### Relationship between Extrinsic Religiosity and Consumer Behaviour towards green food purchasing

The correlation analysis is taken to explain the correlation between Extrinsic Religiosity and Consumer Behaviour towards Green Food purchaing. Results indicate that there is statistically linear significant and positive relationship ( $r = .626$ ,  $p < 0.01$ ) between them.

Thereby, accept the Hypothesis H<sub>2</sub>- i.e., Extrinsic Religiosity has a significant influence on Consumer Behaviour of green food purchasing. It reflects that Extrinsic Religiosity positively influences the Consumer Behaviour of Green Food purchasing. It is shown in Table 6.

Table 6: Correlation between Extrinsic Religiosity and Consumer Behaviour

Pearson Correlation		
Consumer Behaviour		
Extrinsic Religiosity	(Pearson Correlation)	.626**
	Sig. (2-tailed)	.000
**. Correlation is significant at the 0.01 level (2-tailed).		
List wise N=150		

Source: Survey Data, 2016

Further to know the impact of Extrinsic Religiosity on Consumer Behaviour of Green Food Purchasing, the liner regression analysis was undertaken and it's shown in the following table 7, as bellow:

Table 7: Multiple Liner Regression Analysis

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
				R Square Change	F Change	Sig.F Change
.626	.392	.388	.27737	.626	95.573	.000

Source: Survey Data, 2016

According to the table 7 indicates that the significance is at F Change (0.000) the Co-efficient of Determination ( $R^2$ ) is 0.626 and Adjusted R- Square is 0.388 indicates moderate relationship between Extrinsic Religiosity on Consumer Behaviour of Green Food Purchasing. The multiple analysis indicate as 0.626 ie that the independent variable - Extrinsic Religiosity strongly predicts Consumer Behaviour of Green Food Purchasing. Also the  $R^2$  indicates the proportion of variance that can be explained as 39.2% of the dependent variable. And Adjusted  $R^2$  adjusts the value of  $R^2$  to accurately represent the interest of sample, in this analysis Adjusted  $R^2$  is 38.8%, more conservative than the unadjusted  $R^2$  of 39.2%. It is different enough from the unadjusted  $R^2$  to be worth reporting.

### Religiosity and Consumer Behaviour of Green Food Purchasing

Hypothesis test and ANOVA test analysis is performed to find out the result for the following research question: 'Does Religiosity influences on Consumer Behaviour of Green Food Purchasing in Batticaloa District?'

Table 8: ANOVA Test

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	10.994	1	10.994	210.048	.000 <sup>a</sup>
Residual	7.746	148	0.052		
Total	18.740	149			
a. Predictors: (Constant), Religiosity					
b. Dependent Variable: Consumer Behaviour					

Source: Survey Data, 2016

According to the table 8 specifies, ANOVA test p-value is .000, hence it is less than 0.05. Therefore, the decision is reject the  $H_0$ . Also the table 4 indicating that correlation between Intrinsic Religiosity and Consumer Behaviour towards Green Food Purchasing is .441, moderate positive relationships at the significant level of 0.000. And table 6 indicating that correlation between Extrinsic Religiosity and Consumer Behaviour towards Green Food Purchasing is .626, Strong positive relationships at the significant level of 0.000.

Therefore there is enough evidence to conclude that there is a significant influence of religiosity on Consumer Behaviour of Green Food purchasing.

## Conclusion and Recommendations

### 6.1 Conclusion

This study reflects Religiosity as an independent variable and as the Consumer Behaviour of Green Food purchasing as dependent variable. The both variables are individually having high level attributes of the customers and almost 76.6% of the further it is illustrated by the Pearson's Correlation analysis, indicates that positive significant linear relationship between these two variables. The correlation coefficient ( $r$ ) was 0.766 at the 1% level. This implies that Consumer Behaviour can be predicted with Religiosity. Based on the research findings Religiosity is influencing more on the Consumer Behaviour of Green Food Purchasing. The most noteworthy findings is consumer Behaviour of Green Food Purchasing explained variance, thus clearly influenced by the Religiosity. The study is, particularly surveyed the Green Food Purchasing the Manmunai North Divisional Secretariat area in Batticaloa District. A buyer's Behaviour can be influenced by Religiosity such as intrinsic as well as extrinsic religiosity. This study also has the same positive

effect of Religiosity on consumer Behaviour of Green Food Products. The consumption is beginning with the consumers' Behaviour of each individuals and the Religiosity of the consumers can influence on Green Food Purchasing.

### Recommendations

Based on the conclusion some suggestions are forwarded to the green food industry to improve their marketing activities in order to understand consumer behaviour. Marketers should understand that religiosity influences on consumer behaviour of green food purchasing. So marketers can understand the religiosity of the consumers and they can provide the green food products to the consumers. And further marketers should understand the religiosity of consumers to promote the green food products. Food industry should consider the influence of green food and the consumer behaviour of green food purchasing. Because it will be help to reduce health and medical issues and increase healthy life.

This study focuses on Religiosity as independent variable and Consumer Behaviour as dependent variable and their relationship between them. However, it is explicit that there may be other variable to be considered to explain this variation. Future studies can be devised to identify those additional variable for explaining the Consumer Behaviour.

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# COST AND TIME CONTROL FACTORS FOR HIGH RISE RESIDENTIAL CONSTRUCTION PROJECTS

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**Abstract** - Technology plays vital role to improve construction efficiency and productivity, hence resulting in project time line reduction. There are numerous factors which caused delay, however it is practically not possible to work on each and every factor. So more focus is required on those factors which contribute maximum delay. These factor may differ countrywide for example say due to environmental effects, environmental laws, and safety norms. Any kind of delay due to dispute, can lead to bad effects viz. entering in court of law for various parties, productivity loss, impact on income, and termination of contract. This paper shows key factors, which are delaying the in construction projects in Pune, India [17]. This paper study of listing down the various factor of delay & take inputs from experienced project managers, site engineers of the residential high rise building. Fourty eight experienced professionals from various companies participated in this study. Fourty five cost and time impact factors [15] were identified for preparing survey questionnaire. The outcome of study helps policy defining personnel and practicing agents to understand the actual factors causing cost increase & delay.

**Keywords:** High rise, cost factors, time factors, correlation, project control, survey, delay.

## INTRODUCTION

Objective of any project is to complete the project in time line, within stipulated budget along with achieving other project objective such as quality, zero accident during construction, low maintenance cost for future [14]. Project control techniques by project managers involves continuously measuring progress, evaluation of plans and taking corrective actions as and when required (Kerzner, 2003)[11]. Software viz. Microsoft Project, Microsoft excel, Primavera, etc. can be used to track projects. Practically so much of projects have problems on overruns parameters for time & cost, even though the software's are available. Across various countries study is already done to search the of affecting factors for overruns for cost and time for different projects. Survey for 50 agents viz. consultant, contractor and client was carried out at Nigeria and research analysis found major parameters creating delay in construction and cost overruns are financing, poor management of contracts and accounts payable, site condition changes, material shortage, changes in design and various suppliers. Major parameters affecting overrunning cost were found out as changes in price, incorrect estimation, and add on scope of work. Survey with 31 managers was done by Kaming (1997) [12] for these overrun parameters. Major six variables (changes in design, in efficient labours, improper plans, insufficient availability of raw material, gaps in estimation of material, less skilled labour etc.) were identified for time overrun. Major four variables (price rise because of inflation,

incorrect bill of quantity, short of project management and type of project experience) for cost overrun. Kumaraswamy and Chan (1998) [3] conducted exhaustive study for Hong Kong having four hundred questionnaires. Finding was major 4 causes of delay viz. design data, waiting time for approvals, inefficient site management, gaps in design data, etc.

## Research methodology

Fourty-five causes of delay were found after the interview and survey. A questionnaire survey was prepared to find the impact of on various organization for the defined causes. Information was collected from various construction organizations. Research questionnaire is divided into five levels such as very high, high, medium, low and very low and marks given as 5, 4, 3, 2, & 1 respectively. Each level rate the impact of factors through which the background for potential delay and cost control in the construction projects can be verified. These causes are shared with experienced professionals in order to have a clear idea. Based on previous studies two questions for each factor were asked:

- 1) What is the impact of each cause on Cost control? 2) What is the impact of each cause on Time control?

Major factors under study identified causes of delay [6] are design changes, conflict between project parties, inaccurate evaluation of projects time, project complexity. There are some causes which are related to country. This research included additional major delay factors which are identified as the Low skilled manpower, shortage of labor, insufficient drawings, inadequate planning & timeline for project, Cash flow problems and Government policies changes. There are many reasons why delays occur. For example, construction rework, poor organization, material shortage, equipment failure, change orders, act of God and so on. In addition, delays are often interconnected, making the situation even more complex. Many important reasons for delay related to owner decisions, performance indices for contractor, and advance planning during the project design step. The study reveals that main causes of delay were related to designing people, changes asked by user, weather condition, situation at site, not on time delivery, financial situation and rise in required quantity. The study guides to understand the specific attention to parameters will support various practicing people in reducing disputes for contracts. Delays have a direct relationship with non-performance of suppliers.

## Data collection

The data were collected from fourty eight individuals for various construction projects. The data can be analysed through the following statistical formulas, Here T = total respondents, who responded for the all parameters with value having range from 1 to 5. The relative importance index can be devised as below:

$$RII \text{ (Relative importance index)} = \text{Summation of } I \div (M \times T)$$

Where I is the total intensity or weightage given to every factor by responding persons. The scale for which is from 1 to 5. M is the maximum rank available (i.e. 5 in this case) and T is total number of respondents those who replied the question. [2]

Table No. 1

Cost Overrun Parameters

Below is the example for 3 respondents & total survey was carried out for 24 respondents

Project Name		Trirose					BLUEWOODS					Lifeville				
Construction Company		Yashada Developers					Yashada Developers					Govind Developers				
Sr. No.	Cost Overrun parameters	Very high	High	Medium	Low	Very Low	Very high	High	Medium	Low	Very Low	Very high	High	Medium	Low	Very Low
1	Insufficient contractor experience		4							2			4			
2	Difficulties in obtaining permits			3				4					4			
3	Fluctuation in labours, materials availability			3					3					3		
4	Delay in approving drawings			3				4						3		
5	Force majeure			3							1		4			
6	Lack of training and experience of PM	5							3			5				
7	Low skilled manpower		4					4				5				
8	Inappropriate methods for constructions.		4					4					4			
9	Restricted access				2					2						2
10	Poor site management & supervision				2					2				3		
11	Increases in scope of work		4						3				4			
12	Cash flow problems			3						2				3		
13	Speed of owner decision making progress			3						2				3		
14	Unforeseen condition on ground				2						1			3		
15	Strike		4						3				4			
16	Non-performance of subcontractors and selected suppliers	5							3			5				
17	Lowest bid win					1				2						2
18	Delay in progress payment			3					3				4			
19	Change in Design		4					4						3		
20	Government policies change				2					2				3		
21	Unpredictable weather conditions				2						1			3		
22	Quality of equipment & raw materials				2				3					3		
23	Liquidity of the organization				2				3					3		
24	Shortage of labour			3				4					4			
25	Rework due to errors during construction				2			4					4			
26	Complexity of Project			3				4				5				
27	Incorrect financial & payment methods	5							3				4			
28	Inaccurate cost estimation		4							2			4			
29	Inflation			3					3				4			
30	Flaws in design documents			3					3				4			
31	Delay in Design			3				4					4			
32	Inaccurate evaluation of projects timeline			3			5							3		
33	Natural calamities				2				3							1
34	Wastage of materials			3						2						1
35	Discrepancies in contract documentation		4					4					4			
36	Conflict between project parties	5						4					4			
37	Extra items in work order			3				4								1
38	Difficulties in project financing		4						3				4			
39	Insufficient experience of consultant				2				3					3		
40	Risk and uncertainty related with projects			3			5					5				
41	Late deliveries					1					1			3		
42	Equipment breakdown					1			3							2
43	Change in order by owner				2						1			3		
44	Quality control process				2				3							2
45	Insurance & accidents			3							1					1

Table No. 2

### Time Overrun Parameters

Below is the example for 3 respondents & total survey was carried out for 24 respondents

	Project Name	Trirose					BLUEWOODS					Lifeville				
	Construction Company	Yashada Developers					Yashada Developers					Govind Developers				
Sr. No.	Time Overrun parameters	Very high	High	Medium	Low	Very Low	Very high	High	Medium	Low	Very Low	Very high	High	Medium	Low	Very Low
1	Insufficient contractor experaince		4						3					3		
2	Difficulties in obtaining permits		4						3					3		
3	Fluctuation in labours, materials availability		4						3						2	
4	Delay in approving drawings		4					4						3		
5	Force majeure			3					3							1
6	Lack of training and experience of PM		4				5					5				
7	Low skilled manpower	5						4				5				
8	Inappropriate methods fo constructions.			3					3						2	
9	Restricted access					1					1				2	
10	Poor site management & supervision				2					2				3		
11	Increases in scope of work	5							3			5				
12	Cash flow problems	5							3					3		
13	Speed of owner decision making progress		4					4							2	
14	Unforeseen condition on ground			3						2				3		
15	Strike				2						1			3		
16	Non-performance of subcontractors and selected supplie	4					5					5				
17	Lowest bid win					1				2					2	
18	Delay in progress payment		4						3					3		
19	Change in Design	5						4				5				
20	Government policies change				2						1					1
21	Unpredictable weather conditions					1					1			3		
22	Quality of equipment & raw materials					1				2				3		
23	Liquidity of the organization		4								1			3		
24	Shortage of labour		4				5							3		
25	Rework due to errors during construction			3					3						2	
26	Complexity of Project		4				5					5				
27	Incorrect financial & payment methods		4					4				5				
28	Inaccurate cost estimation				2					2					2	
29	Inflation		4						3						2	
30	Flaws in design documents			3				4						3		
31	Delay in Design		4						3					3		
32	Inaccurate evaluation of projects timeline	5					5							3		
33	Natural calamities			3							1				2	
34	Wastage of materials				2					2					2	
35	Discrepancies in contract documentation		4					4					4			
36	Conflict between project parties		4				5							3		
37	Extra items in work order					1					1				2	
38	Difficulties in project financing		4								1				2	
39	Insufficient experience of consultant					1					1			3		
40	Risk and uncertainty related with projects		4				5						4			
41	Late deliveries					1					1				2	
42	Equipment breakdown				2						1				2	
43	Change in order by owner					1					1					1
44	Quality control process			3					3					3		
45	Insurance & accidents					1			3					3		

Table reflects the outcome for time control & cost control parameters used for the survey questions. Table also shows cost & time control parameter impact in scale of 1 to 5 according to the respondents. (5 being the higher impact and 1 is the lowest impact)

## Conclusion

With the analysis resulted from the questionnaire survey, the major project control affecting parameters were studied in deep by interviewing experienced people, which makes the project management and control very difficult. This further make a way to understand the measurable actions to minimise the risk due to these parameters. The purpose of the paper is achieved with number of interview with deep understanding, the same is listed in the survey questionnaire. Major five impacting parameters can be used with the primary focus due to their significant effect contributed. It is also worth noting that the measures may seem obvious to the experienced practitioner but will be useful to the less experienced and people new to the project management profession. The study should be viewed as the first effort of developing solutions for mitigating the major cost control and time control parameters. Clearly, further development is needed to cover more impacting factors beyond the top five. In addition, the effectiveness of these mitigating measures during the project control process needs to be investigated in future research.

## Future scope

The future scope of the paper is to analyse the fourty five parameters for cost control and time control for various sites. After this the relative importance index can be calculated to understand the relative positioning of factors for both time and cost control. Ranking of these factors can be done based on the relative importance index. Moreover this paper also has future scope to check on these parameters about whether how they are related for cost control and time control. We can calculate Coefficient of correlation to express the interrelation of these cost control and time control parameters. Here we will use a MS project software for scheduling and proposed a new different parameters for time and cost control.

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# CHARACTERIZATION OF CERTAIN UNIVARIATE CONTINUOUS DISTRIBUTIONS THROUGH LORENZ CURVE

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**ABSTRACT-** The Lorenz curve is a display of distributional inequality of a quantity. The Lorenz curve is a function of the cumulative percentage of ordered values plotted onto the corresponding cumulative percentage of their magnitude. The Lorenz curve for a probability distribution is continuous function. The Lorenz curve is a display of function  $L(G)$  with plotting cumulative percentage of people  $G$  along horizontal axis and cumulative percentage of total wealth  $L$  along vertical axis. In this paper, certain univariate continuous distributions are characterized through Lorenz curve.

**Key Words:** Characterization, Lorenz curve, Inequality

## 1. INTRODUCTION

The Lorenz curve is mostly applied for the display of the inequality of wealth or income or size in Economics and Ecology. The Lorenz curve was introduced by Lorenz (1905). Distributional inequality of a quantity is displayed by Lorenz Curve. Gini coefficient is numerical measure of information about distributional inequality of a quantity. The Lorenz curve is presentation of the cumulative income distribution. The Lorenz curve is straight line representing equality. Any departure from the straight line indicates inequality. Both Horizontal axis and Vertical axis are in percentages.

Lorenz curve  $L(G(x))$  for probability distribution having cumulative distribution function  $G(x)$  and probability density function  $g(x)$  using Partial Moments is defined as

$$L(G(x)) = \frac{1}{\mu} \int_{-\infty}^x y dG(y), \text{ where } \mu = \int_{-\infty}^{\infty} y g(y) dy. \quad (1)$$

Lorenz curve  $L(G(x))$  for probability distribution having cumulative distribution function  $G(x)$  and probability density function  $g(x)$  using quantile function (Gaswirth (1971)) is defined as

$$L(p) = \frac{\int_0^p q(t) dt}{\int_0^1 q(t) dt} = \frac{1}{\mu} \int_0^p q(t) dt, \text{ where } x = G^{-1}(p) \text{ and } \mu = \int_0^1 q(t) dt. \quad (2)$$

### 1.1 Properties of Lorenz Curve

The Starting and ending points of Lorenz curve are (0, 0) and (1, 1) respectively. Lorenz curve is continuous on  $[0, 1]$ . Only for finite Mean, Lorenz curve exists. Lorenz curve is an increasing convex function i.e.  $L'(0+) \geq 0$  and its second order derivative is positive (convex) i.e.  $L''(p) \geq 0$ . The Lorenz curve with positive scaling is invariant. The graph and value of Lorenz curve is always at most distribution function. The convex hull of the Lorenz Curve collapses to the equalitarian line, if there is perfect equality.

## 2. CHARACTERIZATION

In order to develop a stochastic function for a certain problem, it is necessary to know whether function fulfills the theory of specific underlying probability distribution, it is required to study characterizations of specific probability distribution. Different characterization techniques have developed.

The rest of paper is composed as follows. Characterization of certain univariate continuous distributions is studied through Lorenz curve.

### 2.1 Characterization of Univariate Continuous Distributions through Lorenz Curve

**Theorem 2.1**(Sarabia; 2008)

Suppose that Lorenz curve  $L(p)$  is increasing convex function with finite mean and  $L''(p) \geq 0$  exists in  $(x_1, x_2)$ , then finite

positive probability density function  $g(x) = \frac{1}{\mu L''(G(x))}$  in the interval  $(\mu L'(x_1^+), \mu L'(x_2^+))$  is obtained from the cumulative distribution function  $G(x)$ .

**Proof**

For probability distribution, Lorenz curve  $L(G(x))$  from (1) is  $L(G(x)) = \frac{1}{\mu} \int_{-\infty}^x y dG(y)$ ,

After twice differentiation of above equation and simplification we obtain as  $\mu L''(G(x)) g(x) = 1$ ,

Then probability density function  $g(x)$  is  $g(x) = \frac{1}{\mu L''(G(x))}$  in the interval  $(\mu L'(x_1^+), \mu L'(x_2^+))$ .

## 3. Univariate Probability Distribution

In this section, Gamma distribution, Beta distribution, Power distribution, Exponential distribution, Pareto distribution, Chi-square, Skew Normal distribution, Folded t-distribution are Characterized through Lorenz curve.

### 3.1 Gamma distribution

**Theorem 3.1:** For continuous random variable  $X$  having  $\text{Gamma}(n, \lambda)$ , Lorenz curve is  $L(p) = \frac{1}{\mu\lambda} [nG(t) - tg(t)]$  is,

where  $p = G(t)$  and  $t = G^{-1}(p)$  provided probability density function is  $g(t) = \frac{1}{\Gamma(n)} \lambda^n t^{n-1} e^{-\lambda t}$ ,  $\lambda > 0, t > 0$ .

### Proof

For continuous random variable  $X$  having  $\text{Gamma}(n, \lambda)$ , Lorenz curve for gamma distribution having pdf

$$g(x) = \frac{1}{\Gamma(n)} \lambda^n x^{n-1} e^{-\lambda x} \quad x > 0 \text{ is calculated as } L(p) = \frac{1}{\mu} \int_0^t xg(x)dx,$$

$$L(p) = \frac{1}{\mu} \int_0^t x \frac{1}{\Gamma(n)} \lambda^n x^{n-1} e^{-\lambda x} dx = \frac{1}{\mu\lambda} [nG(t) - tg(t)],$$

$$L(p) = \frac{1}{\mu\lambda} [nG(t) - tg(t)]. \quad (3)$$

Conversely

Differentiate equation (3), we have  $\mu L'(G(t))g(t) = \frac{1}{\lambda} [ng(t) - g(t) - tg'(t)],$

$$\mu L'(G(t))g(t) = \left[ -\left( \frac{1}{\lambda} \frac{1}{\Gamma(n)} \lambda^n t^{n-1} e^{-\lambda t} + \frac{t}{\lambda} \frac{1}{\Gamma(n)} \lambda^n t^{n-1} e^{-\lambda t} \left[ \frac{n-1}{t} - \lambda \right] \right) + \frac{n}{\lambda} \frac{1}{\Gamma(n)} \lambda^n t^{n-1} e^{-\lambda t} \right] = tg(t),$$

After simplification we obtain  $\mu L'(G(t)) = t.$

Again differentiating above equation, we have  $\mu L''(G(t))g(t) = 1.$

Then probability density function is  $g(t) = \frac{1}{\mu L''(G(t))} = \frac{1}{\Gamma(n)} \lambda^n t^{n-1} e^{-\lambda t}.$

$g(t) = \frac{1}{\Gamma(n)} \lambda^n t^{n-1} e^{-\lambda t}$ ,  $\lambda > 0, t > 0$  is probability density function of Gamma distribution.

### 3.2 Beta distribution

**Theorem 3.2:** For continuous random variable  $X \sim \text{Beta}(m, n)$ , Lorenz curve is  $L(p) = \frac{1}{\mu} \left[ \frac{t(t-1)}{m+n} g(t) + \frac{m}{n+m} G(t) \right]$  is,

where  $p = G(t)$  and  $t = G^{-1}(p)$  provided probability density function is  $g(t) = \frac{t^{m-1}(1-t)^{n-1}}{B(m, n)}$ ,  $0 < t < 1$ .

### Proof

For continuous random variable  $X \sim \text{Beta}(m, n)$ , Lorenz curve for beta distribution having pdf

$$g(x) = \frac{x^{m-1}(1-x)^{n-1}}{B(m, n)}, \quad 0 < x < 1 \text{ is calculated as } L(p) = \frac{1}{\mu} \int_0^t x g(x) dx,$$

$$L(p) = \frac{1}{\mu} \int_0^t x \frac{x^{m-1}(1-x)^{n-1}}{B(m, n)} dx = \frac{1}{\mu} \int_0^t \frac{x^m(1-x)^{n-1}}{B(m, n)} dx,$$

$$L(p) = \frac{1}{\mu} \left[ -\frac{t(1-t)}{n} \frac{t^{m-1}(1-t)^{n-1}}{B(m, n)} + \frac{m}{n} \left( \int_0^t \frac{x^{m-1}(1-x)^{n-1}}{B(m, n)} dx - \int_0^t x \frac{x^{m-1}(1-x)^{n-1}}{B(m, n)} dx \right) \right],$$

$$L(p) = \frac{1}{\mu} \left[ \frac{t(t-1)}{m+n} g(t) + \frac{m}{n+m} G(t) \right]. \quad (4)$$

Conversely

Differentiating both sides equation (4), we have  $\mu L'(p) g(t) = \left[ \frac{m}{n+m} g(t) - \left( \frac{t(1-t)}{n+m} g(t) \right)' \right],$

Using  $g'(t) = g(t) \left[ \frac{(m-1)}{t} - \frac{(n-1)}{1-t} \right]$ , we have

$$\mu L'(G(t)) g(t) = \left[ \frac{m}{n+m} g(t) - g(t) \left( \frac{(1-t)}{n+m} - \frac{t}{n+m} + \frac{t(1-t)(m-1)}{n+m} \frac{1}{t} - \frac{t(1-t)(n-1)}{n+m} \frac{1}{1-t} \right) \right] = t g(t).$$

After simplification we obtain  $\mu L'(G(t)) = t$ .

Again differentiating above equation, we have  $\mu L''(G(t)) g(t) = 1$ .

Then probability density function is  $g(t) = \frac{1}{\mu L''(p)} = \frac{t^{m-1}(1-t)^{n-1}}{B(m,n)}$ ,

$g(t) = \frac{t^{m-1}(1-t)^{n-1}}{B(m,n)}$ ,  $m > 0, n > 0$  is probability density function of Beta distribution.

### 3.3 Power distribution

**Theorem 3.3:** For continuous random variable  $X \sim \text{Power}(\alpha)$ , Lorenz curve is  $L(p) = \left(1 + \frac{1}{\alpha}\right)^{-1} \frac{t^{\alpha+1}}{\mu}$  is,

where  $p = G(t)$  and  $t = G^{-1}(p)$  provided probability density function is  $g(t) = \alpha t^{\alpha-1}$ ,  $0 < t < 1$ .

#### Proof

For continuous random variable  $X \sim \text{Power}(\alpha)$ , Lorenz curve for Power distribution having pdf

$$g(x) = \alpha x^{\alpha-1}, \quad 0 < x < 1 \text{ is calculated as } L(p) = \frac{1}{\mu} \int_0^t x g(x) dx,$$

$$L(p) = \frac{1}{\mu} \int_0^t x \alpha x^{\alpha-1} dx = \frac{1}{\mu} \left(1 + \frac{1}{\alpha}\right)^{-1} t^{\alpha+1},$$

$$L(p) = \left(1 + \frac{1}{\alpha}\right)^{-1} \frac{t^{\alpha+1}}{\mu}. \quad (5)$$

Conversely

Differentiate equation (5), we have  $\mu L'(G(t)) g(t) = \alpha t^\alpha = t g(t)$ ,

After simplification we obtain  $\mu L'(G(t)) = t$ ,

Again differentiating above equation, we have  $\mu L''(G(t)) g(t) = 1$ .

Then probability density function  $g(x)$  is  $g(t) = \frac{1}{\mu L''(p)} = \alpha t^{\alpha-1}$ ,

$g(t) = \alpha t^{\alpha-1}$   $0 < t < 1$  is probability density function of Power distribution.

### 3.4 Exponential distribution

**Theorem 3.4:** For continuous random  $X \sim \text{Exp}(\lambda)$ , Lorenz curve is  $L(p) = \frac{1}{\mu} \left[ \frac{1}{\lambda} (1 - e^{-\lambda t}) - t e^{-\lambda t} \right]$  is,

where  $p = G(t)$  and  $t = G^{-1}(p)$  provided probability density function is  $g(x) = \lambda e^{-\lambda x}$ ,  $t, \lambda > 0$ .

#### Proof

For continuous random variable  $X \sim \text{Exp}(\lambda)$ , Lorenz curve for Exponential distribution having pdf

$$g(x) = \lambda e^{-\lambda x}, \quad x, \lambda > 0 \text{ is calculated as } L(p) = \frac{1}{\mu} \int_0^t x g(x) dx = \frac{1}{\mu} \int_0^t x \lambda e^{-\lambda x} dx$$

$$L(p) = \frac{1}{\mu} \left[ \frac{1}{\lambda} (1 - e^{-\lambda x}) - t e^{-\lambda t} \right]. \quad (6)$$

Conversely

Differentiating both sides of equation (6), we have  $\mu L'(p) g(t) = [\lambda t e^{-\lambda t}] = t g(t)$ ,

After simplification we obtain  $\mu L'(p) = t$ ,

Again differentiating above equation, we have  $\mu L''(G(t)) g(t) = 1$ .

Then probability density function is  $g(t) = \frac{1}{\mu L''(p)} = \lambda e^{-\lambda t}$ ,

$g(x) = \lambda e^{-\lambda x}$ ,  $x, \lambda > 0$  is probability density function of Exponential distribution.

### 3.5 Pareto distribution

**Theorem 3.5:** For continuous random variable  $X \sim \text{Pareto}(\alpha)$ , Lorenz curve is  $L(p) = \frac{1}{\mu} \frac{\alpha}{\alpha-1} [1 - t^{1-\alpha}]$  is,

where  $p = G(t)$  and  $t = G^{-1}(p)$  provided probability density function is  $g(t) = \alpha t^{-\alpha-1}$ ,  $1 < t < \infty$ .

#### Proof

For continuous random variable  $X \sim \text{Pareto}(\alpha)$ , Lorenz curve for Pareto distribution having pdf

$g(t) = \alpha t^{-\alpha-1}$ ,  $1 < t < \infty$  is calculated as  $L(p) = \frac{1}{\mu} \int_0^t xg(x)dx$ ,

$$L(p) = \frac{1}{\mu} \int_1^t \alpha x^{-\alpha} dx,$$

$$L(p) = \frac{1}{\mu} \frac{\alpha}{\alpha-1} (1-t^{1-\alpha}). \quad (7)$$

Conversely

Differentiating both sides of equation (7), we have  $\mu L'(p)g(t) = \mu L'(G(t))g(t) = t(\alpha t^{-\alpha-1}) = tg(t)$ ,

After simplification we obtain  $\mu L'(G(t)) = t$ ,

Again differentiating above equation, we have  $\mu L''(G(t))g(t) = 1$ ,

Then probability density function is  $g(t) = \frac{1}{\mu L''(G(t))} = \alpha t^{-\alpha-1}$ ,

$g(t) = \alpha t^{-\alpha-1}$ ,  $1 < t < \infty$  is probability density function of Pareto distribution.

### 3.6 Chi-square distribution

**Theorem 3.6:** For continuous random  $X \sim \text{Chi}(k)$ , Lorenz curve is  $L(p) = \frac{1}{\mu} [kG(t) - 2tg(t)]$  is,

where  $p = G(t)$  and  $t = G^{-1}(p)$  provided probability density function is  $g(t) = \frac{2^{-k/2} e^{-t/2} t^{k/2-1}}{\Gamma(k/2)}$   $t > 0$ .

**Proof**

For continuous random variable  $X \sim \text{Chi}(k)$ , Lorenz curve for Chi-square distribution having pdf

$g(t) = \frac{2^{-k/2} e^{-t/2} t^{k/2-1}}{\Gamma(k/2)}$   $t > 0$  is calculated as  $L(p) = \frac{1}{\mu} \int_0^t xg(x)dx = \frac{1}{\mu} \int_0^t x \frac{2^{-k/2} e^{-x/2} x^{k/2-1}}{\Gamma(k/2)} dx$ ,

$$L(p) = \frac{1}{\mu} [kG(t) - 2tg(t)]. \quad (8)$$

Conversely

Differentiate equation (8), we have  $\mu L'(p)g(t) = \mu L'(G(t))g(t) = [- (2g(t) + 2tg'(t)) + kg(t)]$ ,

$$\mu L'(G(t))g(t) = \left[ - \left( 2 \frac{2^{-k/2} e^{-t/2} t^{k/2-1}}{\Gamma(k/2)} + 2 \frac{2^{-k/2} t \left[ -\frac{1}{2} e^{-t/2} t^{k/2-1} + (k/2 - 1) e^{-t/2} t^{k/2-2} \right]}{\Gamma(k/2)} \right) + k \frac{2^{-k/2} e^{-t/2} t^{k/2-1}}{\Gamma(k/2)} \right],$$

$$\mu L'(G(t))g(t) = g(t) \left[ -2 \left( 1 - \frac{1}{2} t + (k/2 - 1) \right) + k \right] = t g(t),$$

After simplification we obtain  $\mu L'(G(t)) = t$ ,

Again differentiating above equation, we have  $\mu L''(G(t))g(t) = 1$ ,

Then probability density function is  $g(t) = \frac{1}{\mu L''(G(t))} = \frac{2^{-k/2} e^{-t/2} t^{k/2-1}}{\Gamma(k/2)}$ ,

$g(t) = \frac{2^{-k/2} e^{-t/2} t^{k/2-1}}{\Gamma(k/2)}$   $t > 0$  is probability density function of Chi-square distribution.

### 3.7 Skew Normal distribution

**Theorem 3.7::** For continuous random  $X \sim \text{SkewNormal}(\lambda)$ , Lorenz curve is  $L(p) = \frac{1}{\mu} [t\Phi(t, \lambda) - H(t, \lambda)]$  is,

where  $p = G(t)$  and  $t = G^{-1}(p)$  provided probability density function is  $g(t) = 2\phi(t)\Phi(\lambda t)$ ,  $-\infty < t < \infty$ .

#### Proof

For continuous random variable  $X \sim \text{SkewNormal}(\lambda)$ , Lorenz curve for Skew Normal distribution having pdf

$g(x) = 2\phi(x)\Phi(\lambda x)$  and distribution function  $\Phi(x, \lambda) = [\Phi(x) - 2T(x, \lambda)]$  is calculated as

$$L(p) = \frac{1}{\mu} \int_0^t x g(x) dx = \frac{1}{\mu} \int_0^t x 2\phi(x) \Phi(\lambda x) dx = \frac{1}{\mu} [t\Phi(t, \lambda) - H(t, \lambda)],$$

$$L(p) = \frac{1}{\mu} [t\Phi(t, \lambda) - H(t, \lambda)]. \quad (9)$$

Conversely

Differentiating both sides of equation (9), we have

$$\mu L'(p)g(t) = \{\Phi(t, \lambda) + 2x\phi(t)\Phi(\lambda t) - \Phi(t, \lambda)\} = t(2\phi(t)\Phi(\lambda t)) = tg(t),$$

After simplification we obtain  $\mu L'(p) = t$ ,

Again differentiating above equation, we have  $\mu L''(p)g(t) = L''(G(t))g(t) = 1$ ,

Then probability density function is  $g(t) = \frac{1}{\mu L''(p)} = 2\phi(t)\Phi(\lambda t)$ ,

$g(t) = 2\phi(t)\Phi(\lambda t)$ ,  $-\infty < t < \infty$ . is probability density function of Skew Normal distribution.

### 3.8 The Folded t-distribution

**Theorem 3.8:** For continuous random  $X \square$  *Folded t – distribution with  $df = 2$* , Lorenz curve is

$$L(p) = \frac{1}{\mu\sqrt{2}} \left[ 1 - \left( 1 + \left( \frac{t}{\sqrt{2}} \right)^2 \right)^{-\frac{1}{2}} \right] \text{ is, where } p = G(t) \text{ and } t = G^{-1}(p) \text{ provided probability density function is}$$

$$g(t) = \frac{2}{(2+t^2)^{\frac{3}{2}}}, t > 0.$$

#### Proof

For continuous random variable  $X \square$  *Folded t – distribution with  $df = 2$* , Lorenz curve for Folded t-distribution distribution

having pdf  $g(x) = \frac{2}{(2+x^2)^{\frac{3}{2}}}$  is calculated as

$$L(p) = \frac{1}{\mu} \int_0^t xg(x)dx = \frac{1}{\mu} \int_0^t x \frac{2}{(2+x^2)^{\frac{3}{2}}} dx = \frac{2}{\mu} \left[ \frac{1}{\sqrt{2}} - \frac{1}{\sqrt{(2+t^2)}} \right],$$

$$L(p) = \frac{1}{\mu\sqrt{2}} \left[ 1 - \left( 1 + \left( \frac{t}{\sqrt{2}} \right)^2 \right)^{-\frac{1}{2}} \right]. \quad (10)$$

Conversely

Differentiating both sides of equation (10), we have  $\mu L'(p)g(t) = t(2+t^2)^{-\frac{3}{2}} = tg(t)$ ,

After simplification we obtain  $\mu L'(p) = \mu L'(G(t)) = t$ ,

Again differentiating above equation, we have  $\mu L''(G(t))g(t)=1$ ,

Then probability density function  $g(x)$  is  $g(t)=\frac{1}{\mu L''(G(t))}=\frac{2}{(2+t^2)^{\frac{3}{2}}}$ ,

$g(t)=\frac{2}{(2+t^2)^{\frac{3}{2}}}$ ,  $t > 0$ . is probability density function of Folded t- distribution.

#### 4. Concluding Remarks

In this research, we presented characterization of Gamma distribution, Beta distribution, Power distribution, Exponential distribution, Pareto distribution, Chi-square, Skew Normal distribution and Folded t-distribution through Lorenz curve.

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# Inbound Sequenced Fusion of Diverse Management theory like Lean, JIT, TPM, ERP to Eliminate Worthless Element for Superior Productivity in Exhaustive Plant

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**Abstract** - The paper covers the recent requirements of an industry, this work merging seven major value proofed methods of Industrial Management. This proposed philosophy advice to includes Ergonomics, Plant Layout, Work Place Design (WPD), Enterprise Resources Planning (ERP), and Just in Time (JIT), Lean Manufacturing and Total Productive Maintenance (TPM) for increasing the efficiency of plant. The topic unfolds the method of management which optimized all the work place, man power, material, machines. Evolution and the gradual development of all the five branches of Industrial Management (IM) will lead to increase the productivity and efficiency of the plant. This paper efforts to provide a Practical approach & systematic manner for solution in context of production and manufacturing Industry. The strategy includes some of phases to develop a new and improved productivity by implanting this methodology, with a wish of flow of knowledge and information will lead to surrounded environment and all the sectors for the wellness of humanity.

**Keywords** - Plant Layout, Work Place Design, Ergonomics, Enterprise Resources Planning, Lean Manufacturing, Just in Time and Total Productive Maintenance.

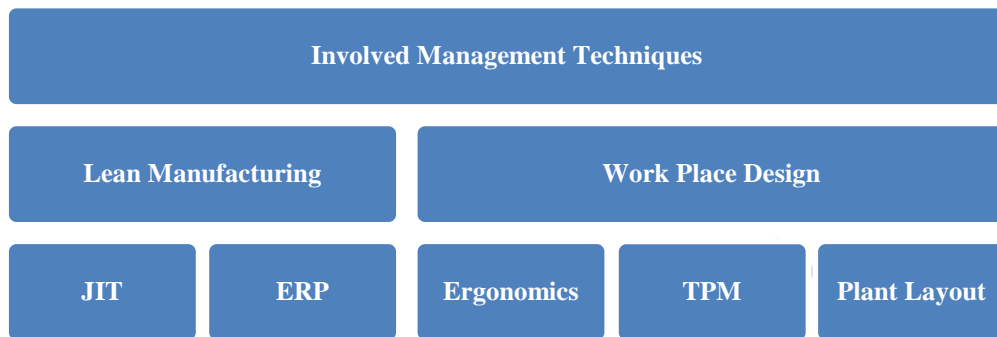
## INTRODUCTION

It is tending to develop a systematic procedure for improving productivity and increasing the efficiency of plant with the help of predefined methods as like Plant Layout, Work Place Design (WPD), Ergonomics, Enterprise Resources Planning (ERP), Lean Manufacturing, Just in Time (JIT) and Total Productive Maintenance (TPM). There is number of research's available for each of techniques but no one involving such a relation among the various concepts and very few of researches are presenting detail activities at deferent phases of industrial work, also there is space for the practical concept and simultaneously implementation. Hence, it is a strategic method between all this relative approaches and describes supporting method of the new and improved concept. Further, an implementation procedure of the concept is being provided. We can easily find In previous research a lot work for improvement to reduce or recycle primary wastage which are generated from the industries like as solid waste (Scrapes, paper mills solid waste, cement n fabric mills bio mass) liquid waste (Polluted water, chemical) and also these wastages are suggested to convert in useful means like as electrical energy, heat energy, bio-mass fuel etc, these all effort done to minimization of primary wastages. But there are some another type of wastages involved in production process of any industry, in this paper these wastages are being termed as secondary wastages. In fact, these secondary wastages are more responsible for plant losses and are the more causable barriers for plant profitability and optimization, compared to primary wastages. This paper investigates systematically on secondary wastages & logically discuss for solution. It has been observed that the solution is possible by using pre-existing techniques Plant Layout, Workplace de-sign, Ergonomics, Lean, Just in Time (JIT) & Total Productive Maintenance (TPM) being explained systematically. IJERGS staff will revise and reformat if required.

## TECHNOLOGIES INVOLVED

This methodology analyze and increase different physical values for manufacturing and production plant efficiency. It is also known as Planning and Layout designing. The ability to design and operate manufacturing facilities that can instantly adapt to changing technological development and market requirements is becoming increasingly important to the success of any running organization. Objectives of plant layout are to provide better quality products at lesser costs/optimized production to the consumers. To be most effective and optimum utilization of available floor space. To minimize waste and obstacles in different production processes thereby avoiding the accumulation of work at preferable point. To achieve economies in handling of raw materials, work in- progress and finished goods. The workplace today is the result of historical innovations that were designed to make the workplace a productive environment. However the world of work constantly change designing that once were helpful are adding less value than they once did. Ergonomics (or human factors) is the scientific stream concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Enterprise resource planning (ERP) is business process management technique that follows an organization to use a system of integrated applications to manage the business and automate many back office functions related to

technology, services and human resources. Lean manufacturing is a business model and collection of tactical manufacturing and strategically that emphasize eliminating non-value added activities (waste) while delivering quality products on time at least cost with



**FIGURE – 1: INVOLVED MANAGEMENT TECHNIQUES**

better efficiency. Just in time is a type of operations management approach which originated in Japan in the 1950s. It was adopted by Toyota and other Japanese production units, with excellent results: Toyota and other companies that adopted the approach ended up raising productivity (through the elimination of waste) significantly.

Total productive maintenance (TPM) is a system of maintaining and improving the integrity of production and quality systems through the machines, equipment, processes, and employees that add business value to the organization.

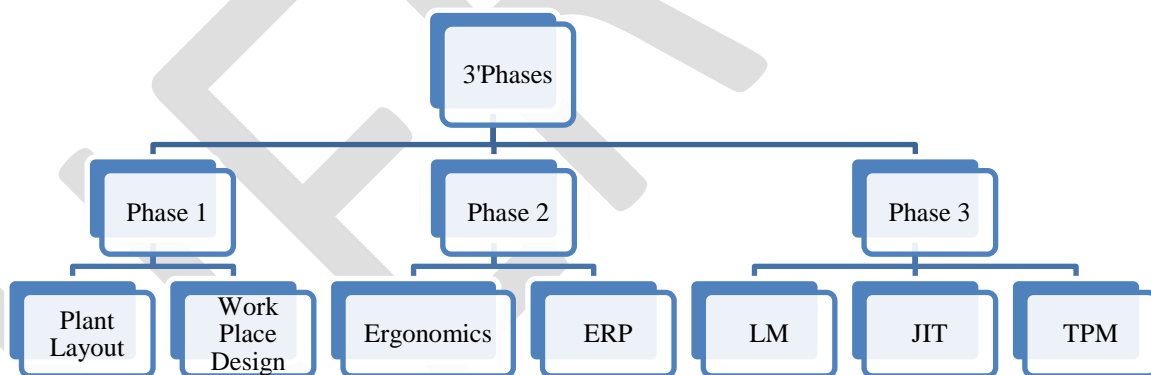
## PHASES OF TECHNOLOGIES

This method having three Phases:

Phase 1 - Plant Layout, Work Place Design

Phase 2 - Ergonomics, Enterprise Resources Planning

Phase 3 - Lean Manufacturing, Just in Time and Total Productive Maintenance

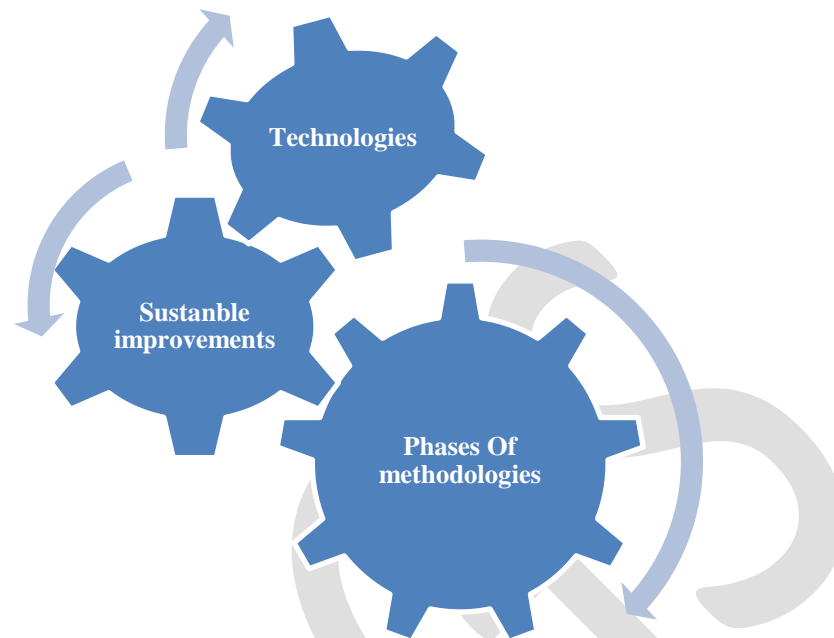


**FIGURE – 2: REPRESENTING THE PHASES OF TECHNOLOGIES**

## METHODOLOGY

In spite of the fact that a lot of improvements has been achieved by use of computer & automation efforts with modern industrial management techniques like as Just in Time & Total Productive Maintenance Lean but still a large amount of wastage is involved in manufacturing and production process. In this paper we recognized this fact & develop the methodology nearly focused on Indian Industry. The Paper is completed in three main phase that lead reduction of wastages during mass manufacturing operation by excellence interrelation of Plant Layout & work place design With Ergonomics and simultaneously use of Just in Time & Total Productive Maintenance. Flow of method will go through three major phases and these three major phases are having their own sub-phases for the ease implementation of this method. This method run from the very starting point from the start to three phases. The first phase will belong to highly accurate and efficient implementation of the Plant Layout and Work Place Design according to the capital. The second phase will be applicable after the first implementation this includes Ergonomics and the Enterprise Resources Planning for the overall plant that covers all the sectors of the plant. The third and last phase will belongs to another and most

important implementation of Lean Manufacturing for the efficient production and the Total Productive Maintenance to avoid breakdown of machines.



**FIGURE - 3: PHASES OF TECHNOLOGIES AND THEIR INVOLVEMENT**

As we have a strong belief, if in an industry we reduce or finished kinds of wastages then ultimately it will increase plant efficiency, productivity and profitability. There is three broad (main) phases are described for elimination of wastages by adequate review and interrelation of pre-existing techniques. Like Plant Layout, Work Place Design, Enterprise Resources Planning, and Just in Time, Lean Manufacturing and Total Productive Maintenance. The methodology supporting to overall organization activity from employees attitude to approximate all process of production, At the same time special attention to sub activity of process and development of a business strategy that harness all of company resources to achieve world class Quality at reasonable costs & easy reach to Customers.

In very first phase first sub-phase and second sub-phase will take place respectively of Plant Layout and Work Place Design for the wastages relating to material handling and transportation are reduced by efficient plant layout. It will help to reduce unnecessary effort by the help of Work Place Design.

In Second phase first sub-phase will take place for wastages regarding man power (operator and helping hands) Physical load, mental load, and perceptual load minimization and establish a comfort relation among man, material and machine by work place design according to ergonomics rules.

In Second phase second sub-phase will take place Enterprise Resources Planning for the plant can use to collect, store, manage and interpret data from many business activities, including: Product planning, cost. Manufacturing or service delivery. Marketing and sales.

In Phase 3 wastages involve in production process activity are eliminated by an adequate review and interrelated combination of lean production, Just in Time and Total Productive Maintenance.

The first sub-phase in Phase 3 will work as Lean production is applied to improve value adding activities n to eliminate non value adding activities.

The Second sub-phase in Phase 3. Then Just in Time is implemented for reduction in 7 Types of involve in production.

1. Waiting time.
2. Transportation relating waste
3. Inventory wastages.
4. Waste of motion.
5. Error n defects in product.
6. Extra over production
7. Process waste by DFT (Design for Manufacturing)

The Third sub-phase in Phase 3 At last strongly build up Total Productive Maintenance system for reducing equipment machinery stoppage chance or break down time. Total Productive Maintenance reduces wastes related to accident, disasters, health, safety, environment hazardous. Total Productive Maintenance support plant better quality more quantity and customer satisfaction.

There is three broad (main) phases are described for elimination of wastes.

In the first phase-Subparts will take place respectively of Plant Layout and Work Place Design (WPD).

In second phase-Ergonomics and Enterprise Resources Planning (ERP) will take place.

In Third Phase: Lean production, Just in Time and Total Productive Maintenance used.

First sub-part of Phase third will work as Lean production is applied to improve value adding activities and eliminate non-value adding activities.

Second sub-part of Phase third. JIT to reduce seven types of wastages involved in production.

Third sub-part in Phase third. At last strongly build up Total Productive Maintenance (TPM) system for reducing equipment machinery stoppage chance or break down time.

## IMPLEMENTATION OF PHASES

Barriers in implementation of suggested methodology & techniques and respectively encountering points are given below.

**Barriers – 1** Lack of awareness in workers and as well in some management members about LM production system and practice.

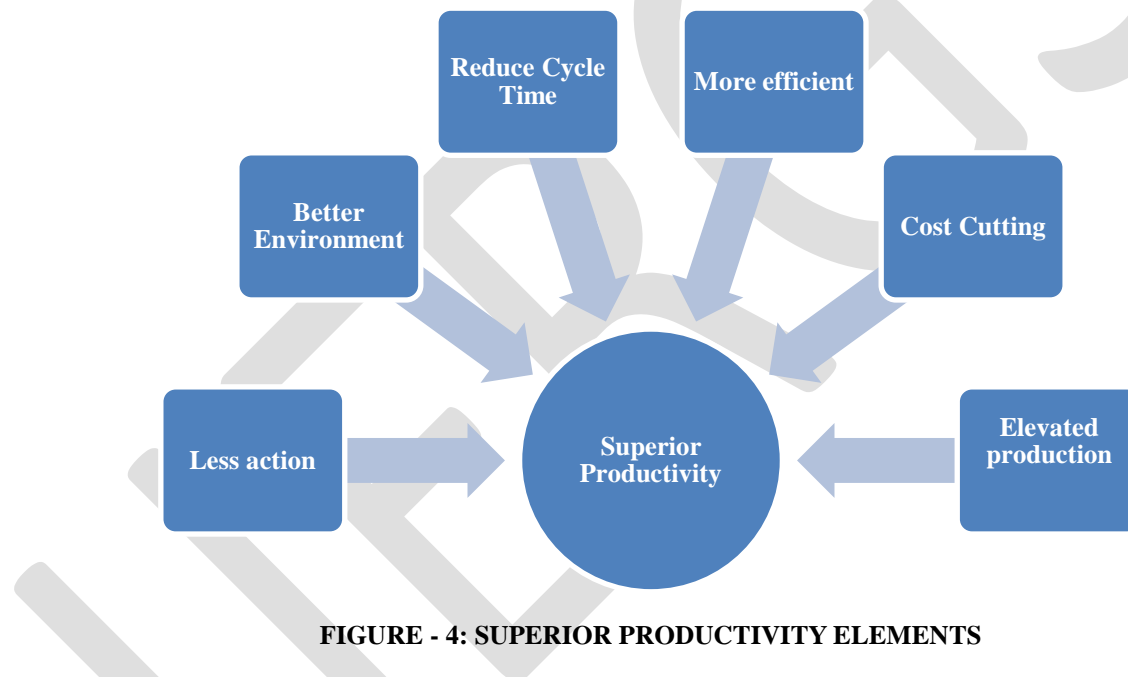
**Solution:** Awareness towards lean methodology and practicing system in shop floor.

**Barriers – 2** Production team has not union vision to reduce delay and miss arrangement of working process.

**Solution:** Train the team to work together as a team and develop a support system which provide mental & moral status improvement to the team.

**Barriers – 3** Dependence on traditional system of work management and lack of dare for new experiment s and local level research.

**Solution:** providing stage for new thoughts coming from different level of organization and appropriate motivation to encourage the successful experiments & research.



**FIGURE - 4: SUPERIOR PRODUCTIVITY ELEMENTS**

**Barriers – 4** Lack of trend systematic supervision.

**Solution:** periodically seminar to clear vision and avoid miss concepts.

**Barriers – 5** Lack of cooperation among the departments and personal conflicts.

**Solution:** Top management should make effort for a healthy working environment make believe in subordinates they can get benefits only in case of overall profit of organization.

**Barriers – 6** Lack of proper communication among top management, staff and workers.

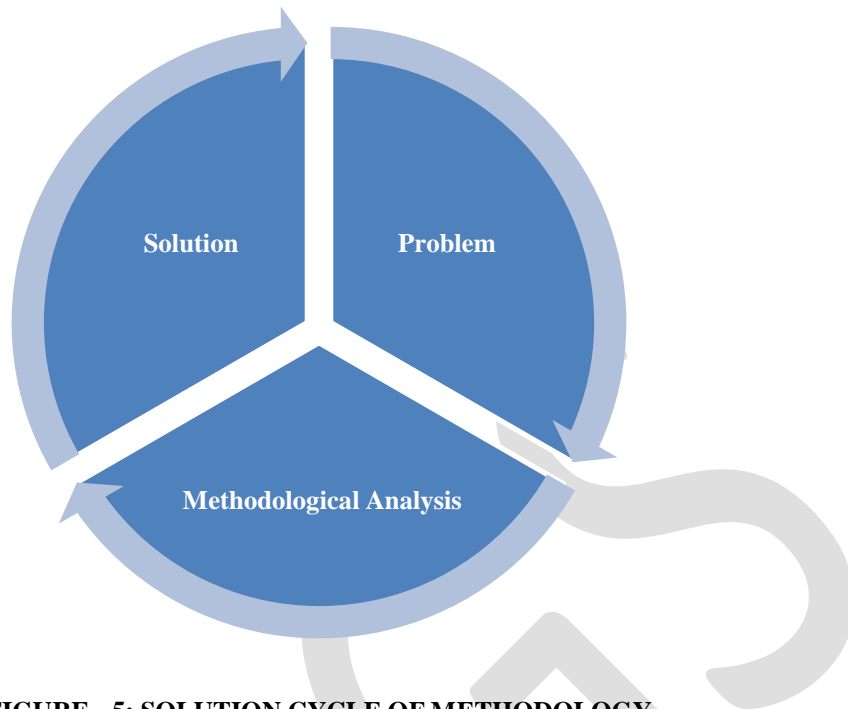
**Solution:** faith generation among all levels of employees and make them understand at the last we all have same target to achieve.

**Barriers – 7** Different departments have different response level for utility of LMP as for example generally it has been seen that Q.C., Planning, Sales & R&D better in application of LM compare to HR, Production, Maintenance and purchase.

**Solution:** Initiative member searching and giving them responsibility for same in different departments.

**Barriers – 8** Bottle neck in some assembly lines of manufacturing or testing create problem for TPM.

**Solution:** By OEE (Over all Equipment Effectiveness) and OPE (Over all Plant Effectiveness) analysis bottleneck is encountered which support to a strong TPM.



**FIGURE - 5: SOLUTION CYCLE OF METHODOLOGY**

Ergonomics is not the subject which importance and profits are generally known to employer so some time they don't permit management to wear the expenses for required change in infrastructure and facilities of company according to ergonomics consideration.

**Solution:** The owner and top management must study and step wise experiment conduct to get positive results and improvement in plant efficiency, it can start with little capital and simultaneously profit can be observed.

In Indian micro and small scale industry actual benefits from JIT is not being achieved because the vendors and small parties related to the company performance like as transportation service, supplier, labor contractor etc. are not familiar and habitual with profits and working system of JIT so the particular company doesn't get the required cooperation and not able to perform as expectation of world level customer.

**Solution:** Following steps should be follow:

- A. One by one each related party should be noticed to work according to required JIT system including provide them a format of working system and then Regular feedback should be collected
- B. If any disturbance or problem found then discuss with relevant party
- C. Identify & define the problem
- D. Analyses for route cause of problem
- E. Collect views for solution from different level of participant involve in particular related activity.
- F. Select the best solution and modified if required.
- G. Implement suitably as well possible in practical manner.
- H. Take the observation of changes decide implement procedure practice is proper or not.
- I. If results are satisfactory then continue it, otherwise start again from step (D) and follow up to (H)

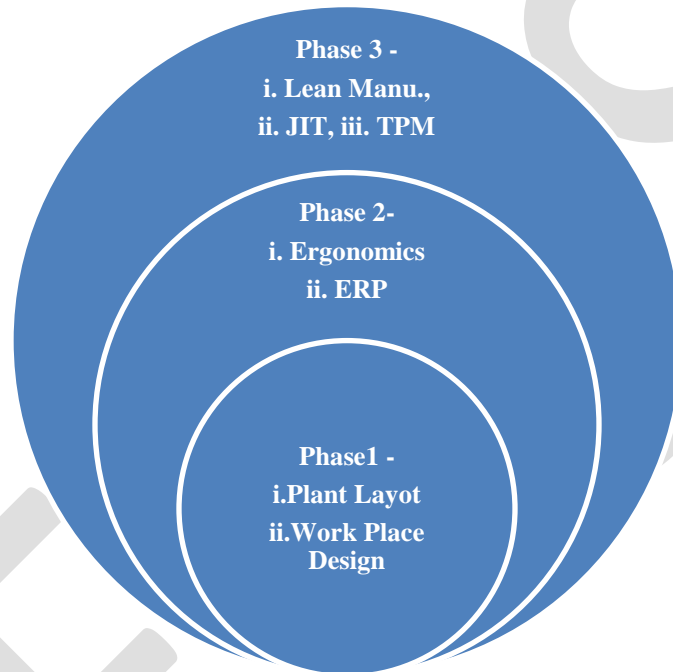
Process layouts provide cost cutting in human resources, as employees can more easily work with their profiles and designed to increase economies and allowing particular processes to work more efficiently. It Lowers total material handling cost, Less work in processes, Better utilization of men-machines systems, Less floor area is used for storage, Better production control, Production cycle time can be reduced.

Ergonomics reduces costs with the help of ergonomic it can reduce risk factors, Ergonomics improves productivity, The best ergonomically designed job will perform in less effort, fewer actions and better elevation and environment will be more efficient, Ergonomics improves quality, Poor ergonomics leads to reach fatigue point of workers that don't do their work, Ergonomics improves better employee management in work, Ergonomics provides a clean and safe environment to work.

Total Productive Maintenance lead to Productivity Improvement in this Productivity is improved by less losses, Total Productive Maintenance also provide Increased Plant Reliability and Customer Satisfaction it leads to quick delivery to customers, Total Productive Maintenance also works on Cost Reduction in this the cost is reduced because the losses will reduce. Total Productive Maintenance provides Improved working environment in this Clean working conditions provides a good health and good health lead

to increase productivity, Total Productive Maintenance allows to Quality Improvement in this Quality is improved as an outcome, that leads lesser breakdown and defects in production.

Just in Time improves quality and Inventory Control eliminates waste and in the process, improves Exhaustive Plant efficiency. Just in Time improves flow of goods and reduces cycle time, in overall manufacturing process there is a better flow of goods, because there is no over-production of any one item. Labor Costs Are Reduced Through production of goods only when required staff are not paid for non-production, thus saving the company costs. Usually staff will be deployed into other areas of work, so that they will still earn money, but the company saves because it is not paying workers to produce items that have no immediate use. Lean invokes a culture that is very much focused on quality and this culture can become a real driving force within the personnel of any company, which also spins off into JIT being viewed as a positive way of keeping the company financially viable and ahead of its competitors.



**FIGURE – 6: RELATIONS INVOLVED IN METHODOLOGY**

ERP streamlining processes and workflows will work in one subsystem, reduce needless data entry and it shares information over the area, establish method that are based on appreciate best business practices, improved workflow and performance, improved customer satisfaction based on improved on-time delivery, Track actual costs of activities and perform action based costing, Provide a consolidated picture of sales, inventory and receivables, increased quality, reduce delivery times, Reduced inventory costs resulting from great planning, tracking and forecasting of requirements, Turn collections faster based on better clarity into accounts and fewer billing and/or delivery errors, Decrease in vendor pricing by select better advantage of quantity breaks and tracking vendor performance.

A lot of the activity in lean conditions is geared towards improving quality. As quality issues occur, problem-solving techniques are used to root cause the query. From there, error proofing is put in place to stimulate the process and prevent recurrence. As a result, the quality of your product will be improved. Easier to manage the work instructions and standardized work let people know what they have to do and when. This makes managing an area much easier. And problems will still arise. Improved Visual Management another benefit of lean manufacturing is supervision by eyesight. If done correctly, your plant will be set up so you can judge an entire area with a visual investigate. Any irregularity will stand out and be easy to identify as a query. Total Company Involvement lean is meant to involve the whole company. It is not intended to be put into action in only one area. It is a management theory which should include every part of your organization. This helps promote the concept that everyone in the company is part of the team. Increased efficiency Line balancing will guarantee each person in the process is working in the most efficient way. Standardized work will assure they are doing it perfectly following the same process every time. This drives to repeatability and enhanced efficiencies. Manpower reductions one of the major advantage of lean is getting more done with limited people. With standardized work and increased efficiencies, the ability to do the job with limited people becomes a very extremely possibility. This does not mean you have to transfer these people to

the unemployment queue. The concept of lean would have these freed-up people utilized to perform further kaizen activity, training to improve skill level, or maintenance of the system once it is executed. Problem Elimination lean manufacturing drive you to tackle an issue and continue to investigate it until it has been eliminated. Root cause analysis and cross-functional teams are utilized to ensure a query receives the level of attention it deserves to correct it. Reduced Space as part of the waste reduction process, space will be created. Modification of finished and raw inventory will save space vertically in your racking as well as horizontally across your workplace. Improved employee morale this is a benefit that may not be realized during the initial stages of your implementation. The reduction of uncertainty in the workplace, as a result of lean, will reduce pressure in your organization members and lead to improved employee morale. Safer Work Environment visual management and helps identify when things are out of position. When unnecessary elements are removed from the operation, the workplace grows much more organized and an organized work environment is a safe work environment.

## RESULT AND DISCUSSIONS

For Indian industries especially for mini and micro scale industries are not explored as per requirements of world level competition. These industries are not reaping out the actual profit by Lean practice due lack Advance Education, proper training and guidance. In this paper a frequency approach is delivered to direct justification of origin point of real problem and respectively the proper problem-solving technique is suggested. This pattern will help to industry system to solve problem in less time by less effort. We realize that if an organization use such concept and regular observations are taken for implementation then progress in overall growth of organization is possible.

## CONCLUSION

This paper presents an integrating techniques Plant Layout, Work Place Design (WPD), Ergonomics, Enterprise Resources Planning (ERP), Lean Manufacturing, Just in Time (JIT) and Total Productive Maintenance (JIT). This method is a set of techniques that are unique to each of the three phases. This study is joint implementation of different techniques. Each phase of our integrating method represents a different aspect of improvement initiatives aimed towards product, process, plant development and plant management. While this study provides a basic for examining - Plant Layout, Work Place Design(WPD), Ergonomics, Enterprise Resources Planning(ERP), Lean Manufacturing, Just in Time(JIT) and Total Productive Maintenance(TPM) within a single technique and our results suggest that implementation of this method practices can reach to maximum productivity and efficiency of the overall plant.

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# Study to Proposed Methodology on Improving growth in Industrial Performance Rating by Integrating Management Information System and Safety Management

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**Abstract**— The Industrial performance varies according to time by time a tactical process of implementing of upgrading methodologies can produce more and more performance of any industries. Now a day for better performance rating industries are using some technologies such as Six Sigma, Kaizen, TQM and they are all about taking about Production and the Quality but no equally thinking level is available for the safety Management of the company.

Safety is the prior and one of the most necessary factors for the industrial performance it is one of most helping factor to increase Productivity, Quality, Maintenance and Rating of the company. Flow of information in a systematic manner can play a very important role in industrial performance and in performance rating. This paper work is prepared to design a Management Information System along with Periodic Upgraded Safety Management. In previous research, there is approx negligible work found in combination of safety management and management information system, which approach to industrial growth and performance rating. This research work has done to focusing on some initial and important points like how safety management and management information system can be used simultaneously.

**Keywords** — Safety Management, Management of Information, Industrial Performance, Industrial rating, Evolution of MIS, Functioning of MIS, Role of planning, Work System.

## INTRODUCTION

A well-designed information flow process from its origin to destination will lead to increase the accuracy of the production and quality including growth and performance of industry. The combination of Safety Management inbuilt in Management Information System can give a specious result to increasing the Industrial Performance Rating and overall growth. This paper contains the systematic study of safety management and management information system and approach improvement in industrial growth and industrial performance rating. The work explains, what the changes and care may be done to get the better result, how the related activity can be controlled, and how these activities may conducted with cooperation in all over organization, what the advantages over traditional method can be observed after applying this new methodology. The paper work also contain the expected barriers and problems which may occur in the implementation of this suggested methodology, and also the list of limitation is provided which are bounded with existing or previous methodology, after implementing this new methodology numbers of dimension will be effective which will produce desirable results in field of Industrial performance and rating.

## PROBLEM FORMULATION

### Problem in developing an effective MIS:

Following points are major barriers in growth of MIS

1. Indifferent behavior and response of higher management for new implementation of any kind of new system.
2. There is no direct production benefits in the production of any product.
3. There is no profit from the first day of implementation starting.
4. Lack of freedom for new experiments and constraint space for the new development expensive.
5. No guaranty for 100 % efficient or desire result system at first attempt may take place number of changes for desire result.

### Deficiency of Management Information System:

In Indian small and micro scale industries major percentage despite the availability of technology there is missing of a well MIS (Management Information System). The MIS system which have the capability to integrate over all organization functioning for a

smooth flow working and full proof planning of the organization to utilize the maximum efficiency of the system. A well developed MIS system is required for regular growth strategy preparation.

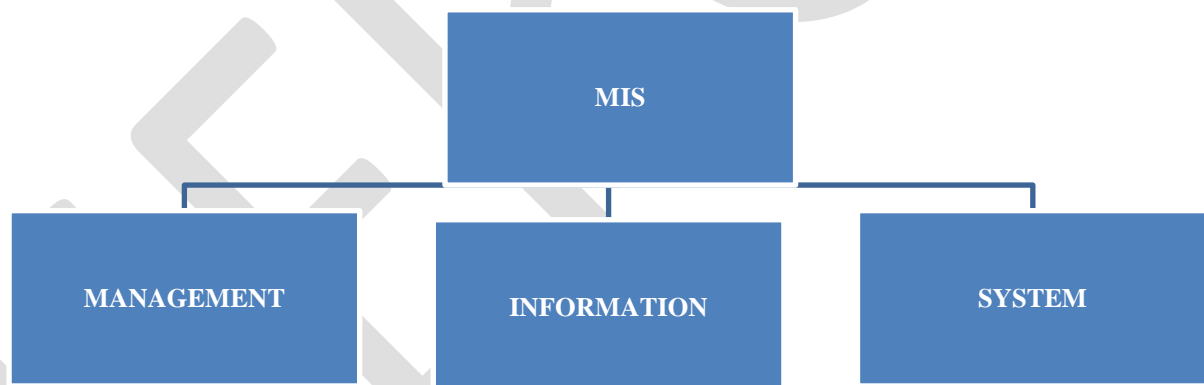
But in fact most of micro industries are not aware for the MIS and some them are aware but do not have the equipment and system and well designed coerce pattern to follow for the development or maintaining of error free MIS system.

#### **Issues Related to safety management:**

1. Lack of awareness in small scale industry: as the management does not recognized the direct and instant benefit of safety management so generally they do not pay as required attention to implement and research in the field of safety management.
2. No educational literature is available at industrial level to aware the people about human fatigue and relation of human fatigue to accident.
3. No industrial level research is available in most of small-scale industry to analyzing the accidents, frequency of accidents, causes of accidents, cost finish accidents versus cost of loss after occurring accidents.
4. Absence of the team which should search for the probable causes of any accident may occur in the industry.
5. Apathy of safety activities, Educating employee, safety programs, safety instruction and training. in small scale industries.
6. Regular development of for safety consciousness is not found in general.

#### **PROPOSED METHODOLOGY**

To improve the performance rating of any industry, safety performance rating play a very important role, but in most of the cases it has been observed that the companies management doesn't concern the safety performance in their prime concerns. the process industries must ensure Safety Information Management (SIM) is implemented satisfactorily.



**FIGURE 1: SHOWING THE COMPONENTS OF MIS**

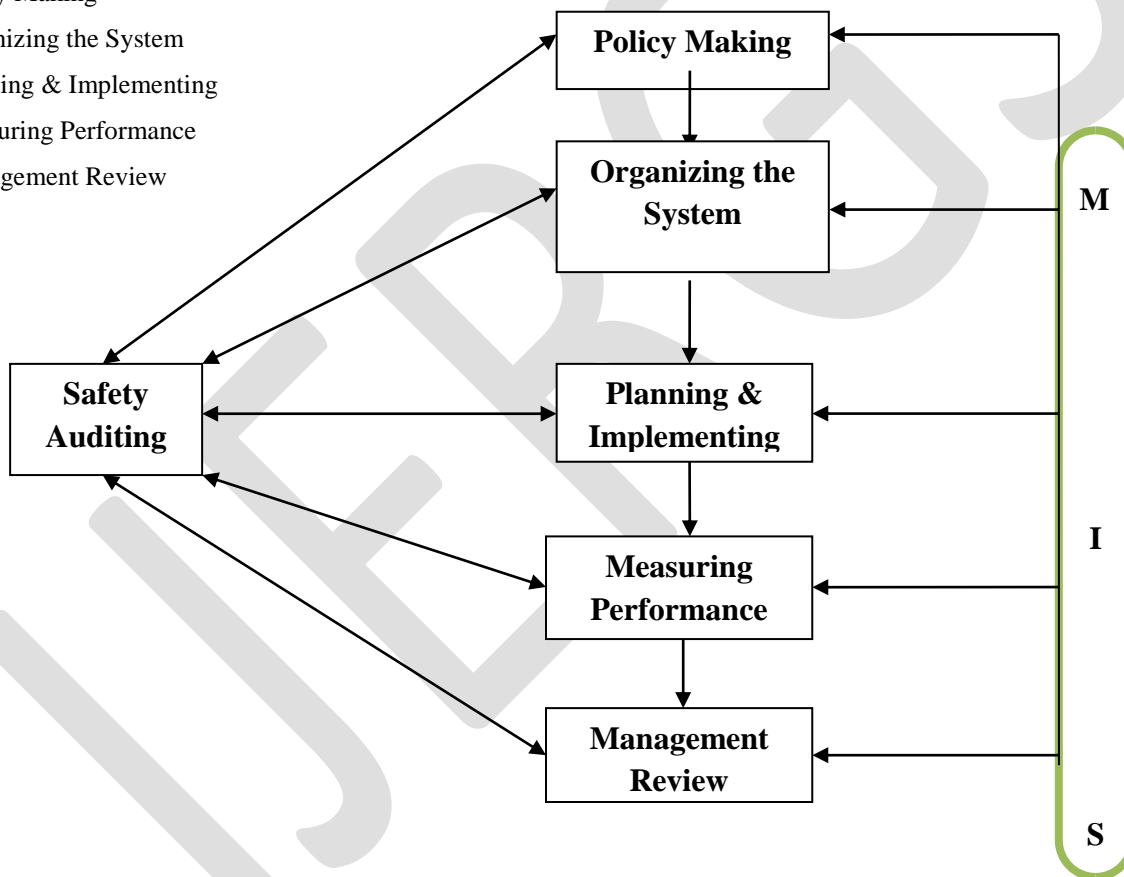
The solution for many of the current problems in an industry is actually quite simple and logical, When MIS (Management Information System) is applied in an appropriate format. In addition a company having efficient safety management system also has ability to bypass many of the problems before occurring in form of any difficult situation. This methodology suggests combining both MIS and safety management. The basic concept is that an industry having healthy working environment and control on accidents and undesirable situation can produce more effective work and can increase the productivity of the plant in different departments of an industry, and all these will lead the Improving Industrial Performance and performance rating of the industry. As reduced or zero frequency of accidents leads the continue production, work satisfaction in employee, generate the feeling of safety and motivate the employees to give them maximum focus on the work so in this methodology, it is suggested to develop a stronger safety management system based on MIS. A effective MIS can make safety management system more effective and quick responsible.

Such a combined MIS and safety management system must be user-friendly, users (staff concern with safety issues) current and historical data must be instantly available. There must be support from all over the industry as one unit and also from different departments as a sub unit of industry. It will also suggest for some of Job-redesign, because the implementation of MIS will change the tasks of employees.

The adequate combination of the MIS and safety system will make the problem solution simple, but it does require certain changes in working culture and considerable time and support from the top management to shoe the favorable difference in various factors. The use of MIS can ensure much easier solution and activate the predictive alert. The use of MIS based databases will results in required data being instantly available. Simple user interfaces should be created, and queries and suggestion providing approach should be available to the various users without too much complexity. The effectiveness and adequacy of the safety management system should be upgraded at regular basis. Different evaluation methods should be used including the MIS feature for assessing the different aspects of the safety management system. It is also important to build up a good team of members with the appropriate skills in the project team. In the MIS team, there should be different expert employees in field of different tasks.

**The MIS should be used to accomplish the following steps in safety system:**

- (A) Policy Making
- (B) Organizing the System
- (C) Planning & Implementing
- (D) Measuring Performance
- (E) Management Review



**FIGURE - 2: REPRESENTING THE COMBINE STRUCTURE OF SAFETY COMPONENTS WITH MIS**

In any industry there must be safety manager, who should be responsible with his or her team to arranging the meetings with the actively participating members. The safety management team should firstly prepare a safety policy.

In this phase the safety department requires the commitment and endorsement of the employer and employees to present a successful safety policy.

**(A) Following steps should be taken in a safety policy:**

1. Policy Statement - Commitment for managing health and safety and the goal of the policy

2. Responsibility – Pre-deciding responsible person for specific action.
3. Establish the procedures - Outlines the details of procedures.
4. Employee training
5. Use of administrative controls, hazard isolation, locking, warnings, signs and symbols marking hazards, etc.
6. Use of personal protective equipment (PPE)
7. Removing hazardous materials or replacing such materials with less harmful alternatives
8. Improved lighting and working environment
9. Prevention of slip-trip-fall

**(B) Organizing the System:** A systematic organized working system should be developed After making the safety policy, for setting the responsibility of all the action being taking place in an industry and may become helpful for industry or employees, training of employees should be at regular basis and in a preplanned schedule which ensure all the related and required advance training for employees. Establishment of the procedures, administrative controls should be there to observe and maintain the safety regularity like hazard isolation, signs and symbols marking hazards and harmful chemicals, warnings, locking etc. All the industrial employees and outside contractual basis labor should be trained and motivated to use the personal protective equipment (PPE). Limiting and finishing the use of hazardous materials or replacing such materials with less harmful alternatives. Maintain comfortable lighting and working environment. Search and finished out the all possible causes of slip-trip-fall.

**(C) Planning & Implementing:** For executing and managing the safety policy, the safety department firstly needs to prepare a plan which have the ability to detect the steps and procedure in enough detail for executing the efficient safety policy and implementing the policy in different departments of the industry. The safety plan should also be present in all occasions of the industry and after a fix interval of weeks or months.

**(D) Measuring Performance:** It is also very important to check the established system of safety is working properly or not. The observation and feedback should be collected to judge the efficiency of the system, Moreover, this process also is like an evaluation process. Implementation process is required to monitor and check the feedback in order to control the quality of the system's outcome.

**(E) Management Review:** Organizational working can smoothly flow only if the management system of the organization is working efficiently, taking right decisions and control the factors relating to the organization interests. So in the case of safety management it is also important act of top management to o the managerial review of the safety system and its alignment with the overall organization to ensure the required level of performance of the safety department.

**(E) Safety Auditing:** The safety audit is the checkup of all above detected points and examinee the correlation among various departments of the industry and check out the ground level activity with documental presentation of the safety plan and safety manual. Following important steps should be follow for safety audit of an Indus\try.

1. Initial research prior to arriving on site, the auditor must decide whether to run a formal or informal audit. In a walkthrough inspection, a very experienced auditor requires an informal approach this is where the auditor identifies deficiencies. Initial research also includes sending a pre-audit questionnaire. This can be a summary of the items to be reviewed or it may include sending the audit in its entirety.
2. Opening meeting and walkthrough - "This is a very important process because one of the things that you need to take into any opening meeting is that most companies aren't happy to have an audit performed at their facility," During the opening meeting, it is important for the auditor to stress that he or she is there to help and not to point fingers. It take only notes to get an idea of problem areas, and not a full-fledged walkthrough.
3. Review of programs and records - it contains information on serious accidents and injuries that have occurred It is most vital steps. As for example review of the last five years of injuries and accidents, it contains - Looking for excess injuries like Fire accidents, Chemicals effects on human health, serious cuts etc. Review insurance claims, first-aid logs and accident investigation forms if available. Then see what written programs or plans are in place and which ones must be added. Almost every employer needs an emergency action plan and a hazard communication plan with proper training.
4. Walkthrough in detailed – This step contains the audit of housekeeping, electrical wires, exits, stairs, fall protection and ladders. These are numbers of such areas that need to be checked for unsafe conditions. Exits, Walkways and work place should be cleaned, dry and cleared so that employees can work their job safely. All electrical equipment must be protected by a fence or wall with visible warning signs present. Electrical wiring should not have extension cords and exposed should be intact to the ground. In addition

splice-free probability should be finished, platforms and floor openings must be guarded by railings. Stairs must be stable with handrails and kept clean and dry. An emergency escape stairwell should not be used for storage. Ladders should be permanently attached with clean, sturdy rungs. At the workplace the auditor may have to question employees about the handling, cleaning and storage of this equipment. However, employee involvement in safety at the facility is usually apparent through other avenues.

5. Review findings - In the closing conference, the auditor should view the significant findings. "This doesn't mean that each individual item need to be gone over line by line but items that are going to result in significant time or costs or could be seen as systemic must be reviewed. A corporate attorney can review the report from a legal standpoint but the auditor should not allow anyone to significantly change or hide any findings.

6. Follow-up – Once the written report has been issued there are many ways to monitor audit follow-up procedures. These columns might include who has been assigned the responsibility for correcting the item, the date that the item is expected to be corrected by and verification by another person that the items have indeed been corrected. Some of the auditing software available has the ability to do this type of tracking. More often than not, workplace injuries and citations come from minor issues that would have been picked up during a normal audit. Effective auditing protects both the employees and the organization by reducing citations and injuries, and result in reducing operating costs.

## RESULT

The suggested methodology will make organization more aware for the importance of health and safety at work compare than before. Clear development stages can be found in the process of improving the management of safety. In this proposed methodology origins of the problems are analyzed. A systematic method is developed for identifying and controlling hazards. Safety tasks and responsibilities are defined and communicated. Continuous improvement addition to previously available system, improvement is encouraged through management review.

Following results become:

### **(A) Following results obtained and forecast to be happened in future by suggested safety policy:**

1. Commitment of management for health and safety is developing more stronger and the goal of the policy is more determined.
2. Responsibility – Pre-decided responsibility for each job fix the related employee responsibility and sincerity about the job due to this the hazards and undesirable situation will reduced.
3. Established procedures and Outlines of the details of procedures will also supports the new joining and the staff with some missing of knowledge; result will be more confident working environment and believe system will be developed.
4. A repetitive and after a fix interval Employee training system will leads the skilled employee and all of staff will continually trend about the advance safety system it will reduced the probability of the accidents in industry and even employees personal life.
5. Use of administrative controls, hazard isolation, locking, warnings, signs and symbols marking hazards, will be continuously managed and improved through MIS system.
6. Use of personal protective equipment (PPE) and observation the employees are using correctly or not will be easy to Surveillance and mistake will be caught by in minimum time by the use of MIS.
7. MIS will help to all the levels of management and workers concern to the matters like removing hazardous materials or replacing such materials with less harmful alternatives simultaneously and regularly it will upgrade the safety system continuously no one person mistake or missing of data will cause the major accident.
8. Improved lighting and working environment is developed full Prevention against slip-trip-fall is becoming possible.

**(B) Organizing the System is becoming less complex through MIS involvement:** A systematic organized working system will be developed, by setting the responsibility of all the action being taking place in an industry is helpful for employees. Training of employees will be held at regular basis with a preplanned schedule. All the industrial employees and outside contractual basis labor will be trained and motivated to use the personal protective equipment (PPE). Limiting and finishing the use of hazardous materials or replacing such materials with less harmful alternatives will ensure for safety. Maintaining lighting and Prevention against slip-trip-fall will finish the all possible causes of slip-trip-fall.

**(C) An adequate Planning & Implementing system is delivered:** Suggested methodology can sustainably execute and manage the safety policy. The safety plan will be presented in all occasions of the industry and after a fix interval of weeks or months.

**(D) Measuring Performance:** The observation and feedback of planning and implementing steps will be collected at regular basis to judge the efficiency of the system it is an evaluation process. Implementation process monitoring and will control the quality of the safety system's outcome.

**(E) Improved Management Review:** Organizational working will be smoother and organization is working will be more efficient, decisions making and controlling the factors relating organization safety will be easy and faster.

**(E) Safety Auditing:**

1. Initial research will able to detect all about the ground level condition as MIS system is implemented so it will show even the latest changes and actual situations.
2. Opening meeting and walkthrough – A MIS based safety system will reduce the complexity of the meeting and it will become easy to detect the condition and preparation of the safety department.
3. Review of programs and records - Written programs, plans data will be available online which is easy to handle and show, also easy to understand. Such system will also assist an emergency action plan and a hazard communication plan with proper training.
4. Review findings - In the closing conference, the auditor should view the significant findings. "This doesn't mean that each individual item need to be gone over line by line but items that are going to result in significant time or costs or could be seen as systemic must be reviewed. A corporate attorney can review the report from a legal standpoint but the auditor should not allow anyone to significantly change or hide any findings.
5. Follow-up – by the online MIS safety system it will easy and faster and convenient to take and judge the follow-up of the improvements being running for safety management efficiency.

## CONCLUSION

The current MIS consist of people who manually transform raw data into management reports and the proposed work support the electronic revolution in MIS. There is too much manual involvement required in the process of management reporting. The way they currently make management reports is extremely outdated, and you would not expect this from an organization. The current situation is mainly a description of what they do not have and actual solutions require perhaps more technical knowledge than I have. The proposed methodology suggest to make the information system in any industry more advance and efficient it will be more rapid responsive in any emergency situation. The flow of information will take place at the moment and employees will be always aware for the real time situation and updates. A well developed and setup MIS have only the ability to serve real time information, and exact information regarding any situation and problem help to take the correct and efficient decision.

In industries where nonstop works are going on in regular format the possibility of accidents also enhanced, but in industries accidents are controlled or finished through an affective work system and by the awareness of employees for nature of work and probable dangers. So in condition of any emergency or accident or controlling the occurrence of a major accident the well developed Management information system can play a very important role. It can make the situation easy to handle, provide real time data and ability to handle the situation efficiently.

In this research such a system is advice to develop in an industry, where every develops and maintains its own information and have access to real time information also capability to explore the information within seconds to all concerns of the matters, as and when required

The largest problems of current MIS, producing the reports and the fact that reports are static which limits management in in-depth and historical analysis should be automatic and easy to maintain, control and distribute. The main reason of any safety related loss is the gap in availability of management information in reference of time, which is mostly caused by the lack of automation.

It could be beneficial to identify success keys of safety system MIS system due to the fact that these success factors can play a role as the criterion to guide the successful safety policy implementation process.

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# LOW POWER SQUARE AND CUBE ARCHITECTURES USING VEDIC SUTRAS

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**Abstract**— In this paper low power square and cube architectures are proposed using Vedic sutras. Low power and less area square and cube architectures uses Dwandwa yoga Duplex combination properties of Urdhva Tiryagbhyam sutra and Anurupyena sutra of Vedic mathematics. Implementation results show a significant improvement in terms of area, power and delay. Proposed square and cube architectures can be used for high speed and low power applications. Synthesis and simulation is done using Cadence RTL simulator(180nm) Technology. Hardware implementation is done using Spartan6 Xilinx FPGA .Propagation delay of the proposed 8-bitsquare is 1.822ns and area consumed in terms of slices is 22 and for 8-bit cube propagation delay is 1.405ns.Total power estimation for square and cube are 0.0297mW and 0.194mW respectively.

**Keywords**— Vedic mathematics, Dwandwayoga, Anurupyena , Square, Cube, low power, less area.

## INTRODUCTION

Vedic mathematics is the name given to ancient mathematical system which was rediscovered from the Vedas by Sri Bharati Krishna Tirthaji between 1911 and 1918. The most important feature of the Vedic mathematics system is its coherence. Instead of lengthy unrelated techniques the entire system is beautifully interrelated and unified. The general multiplication method can be easily reversed to allow one-line division also the simple squaring method can be reversed to get one-line square root. All these methods can be easily understood. The unifying quality of this system is its highlight, this makes mathematics easy and it will encourage innovation. In the past, conventional methods have been used for multiplication. Conventional methods have been highly time consuming.

Square and cube are frequently performed functions in most of the DSP systems. Square and cube are special cases of multiplication. Square and cube architectures forms the heart of the different DSP operations like Image Compression, Decoding, Demodulation, Adaptive Filtering, Least Mean Squaring etc., and also have numerous applications as mentioned in such as cryptography, computation of Euclidean distance among pixels for a graphics processor or in rectangular to polar conversions in several signal processing circuits where full precision results are not required. Traditionally, square and cube were performed using multiplier itself. As the applications evolved demand for the high speed processing increased, special attention was given for square and cube function.

In this paper algorithms and architectures used to design square and cube of a binary number is explored and to create a circuit using the Vedic Sutras. Often times square and cube are the most time-consuming operations in many of digital signal processing applications and computation can be reduced using the vedic sutras and the overall processor performance can be improved for many applications. Therefore, the goal is to create a square and cube architectures that is comparable in speed, power and area than a design using an standard multiplier. The motivation behind this work is to explore the design and implementation of Square and Cube architectures for low power.

This paper is organized as follows. Section 1 gives the overview of Vedic mathematics and Vedic mathematics sutras and sub-sutras. Section 2 briefs about square architecture. Section 3 details about cube architecture. Section 4 discusses about results and discussion and section 5 about the conclusion.

## 1. Overview of Vedic Mathematics

Vedic mathematics is the name given to the ancient system of mathematics. It was rediscovered by Jagadguru Swami Sri Bharati Krishna Tirthaji (1884-1960) between 1911 and 1918. He is a scholar of Sanskrit, mathematics, history and philosophy. The whole of Vedic mathematics is based on 16 Vedic sutras. These sutras are used in various mathematical fields. But only two out of these 16 sutras are popular for multiplication. It solves many mathematical problems that are related to geometry, arithmetic, quadratic equations, trigonometry, calculus and even factorization.

Vedic mathematics is not just a magic in the field of mathematics it is also very logical in obtaining the solutions to the mathematical problems. That's the reason it has been approved globally. The eminent characteristics of Vedic mathematics has led it to across the Indian boundaries and become a very interesting topic of research in foreign countries. It solves many simple and complex mathematical problems especially arithmetic methods are very powerful yet very simple to use. This is very attractive method and provides us with algorithms that are very effective and can be used in many engineering branches such as signal processing and computing.

The wonder of Vedic mathematics is that it lowers the normal calculations in traditional mathematics to easy one because the Vedic formula depends on common principles in which our mind works. It consists of arithmetic rules which increases the speed. Vedic mathematics also gives some effectual algorithms which can be applied to different branches of engineering.

### A. Vedic Mathematics Sutras

This list of sutra is taken from the book Vedic Mathematics which includes a full list of the 16 main sutras. The following are the 16 main sutras or formulae of Vedic math and their meaning in English.

1. Ekadhikena Purvena: One more than the previous
2. Nikhilam Navatascharamam Dastah: All from nine and last from ten
3. Urdhwa-tiryagbhyam: Criss-cross
4. Paravartya Yojayet: Transpose and adjust
5. Sunyam Samyasamuchchaye: When the samuchchaya is the same, the samuchchaya is zero, and i.e. it should be equated to zero.
6. (Anurupye) Sunyamanyat: If one is in ratio, the other one is zero.
7. Sankalana-vyavakalanabhyam: By addition and by subtraction
8. Puranpuranabhyam: By completion or non-completion
9. Chalana-Kalanabhyam: Differential
10. Yavdunam: Double
11. Vyastisamastih: Use the average
12. Sesanyakena Charmena: The remainders by the last digit Sopantyadyaymantyam: The ultimate & twice the penultimate
13. Ekanyunena Purven: One less than the previous Gunitasamuchchayah: The product of the sum of coefficients in the factors
14. Gunaksamuchchayah: When a quadratic expression is product of the binomials then its first differential is sum of the two factors

### B. Vedic Mathematics Sub-Sutras

1. Anurupyena: Proportionately
2. Sisyate Sesamajnah: Remainder remains constant
3. Adyamadyenantyamantyena: First by first and last by last
4. Kevalaih Saptakam Gunyat: In case of seven our multiplicand should be 143
5. Vestanam: Osculation
6. Yavdunam Yavdunam: Whatever the extent of its deficiency, lessen it still further to that very extent
7. Yavdunam Tavadunam Varganchya Yojayet: Whatever the extents of its deficiency lessen it still further to that very extent; and also set up the square of that deficiency.
8. Antyayordasakepi: Whose last digits together total 10 and whose previous part is exactly the same
9. Antyayoreva: Only the last terms
10. Samuchchayagunitah: The sum of the coefficients in the product
11. Lopanasthapanabhyam: By alternate elimination and retention
12. Vilokanam: By observation

13. Gunitsamuchchayah Samuchchayagunitah: The product of sum of the coefficients in the factors is equal to the sum of the coefficients in the product

## 2. Square Architecture

Square Architecture using dwandwa yoga property of urdhwa tiryagbhyam sutra . Yavadunam Sutra is used for Squaring , is limited to the number which are near the base 10,100 etc.,The “Ekadhikena Purvena Sutra” is used for Squaring, is limited to number which ends with digit 5 only. The other method “Dwandwa Yoga” or Duplex is used in two different senses. The first one is by squaring and the second one is by cross multiplication. It is used in both the senses ( $a^2$  ,  $b^2$  and  $2ab$ ).

In order to calculate the square of a number “Duplex” D property of Urdhva Tiryagbhyam is used. In the Duplex, take twice the product of the outermost pair, and then add twice the product of the next outermost pair, and so on till no pairs are left. When there are odd number of bits in the original sequence there is one bit left by itself in the middle, and this enters as its square. Thus for 987654321

$$D = 2 * (9 * 1) + 2 * (8 * 2) + 2 * (7 * 3) + 2 * (6 * 4) + 5 * 5 = 165.$$

Further, the Duplex can be explained as follows

1. For a 1 bit number D is its square.
2. For a 2 bit number D is twice their product
3. For a 3 bit number D is twice the product of the outer pair + the square of the middle bit.
4. For a 4 bit number D is twice the product of the outer pair + twice the product of the inner pair.

Thus

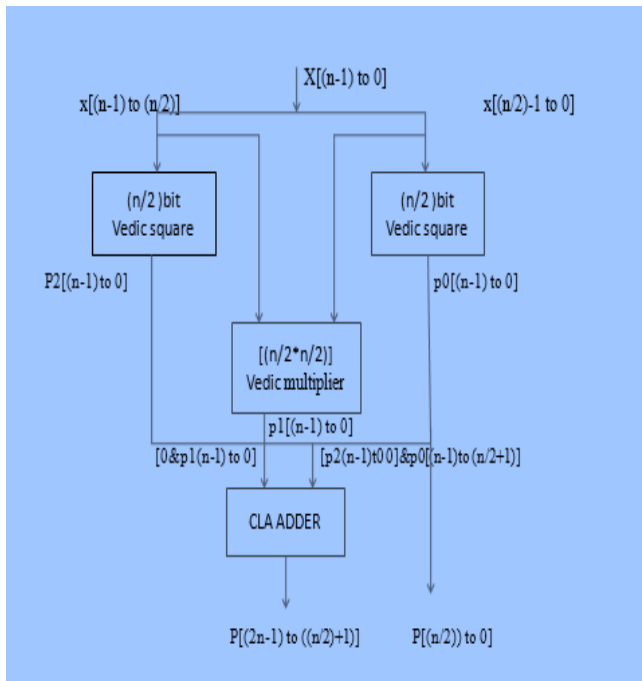
$$D(1) = 1 * 1;$$

$$D(11) = 2 * 1 * 1;$$

$$D(101) = 2 * 1 * 1 + 0 * 0;$$

$$D(1011) = 2 * 1 * 1 + 2 * 1 * 0;$$

The vedic square has many advantages over the vedic multiplier. The block diagram of vedic square is as shown below:



As shown in the block diagram first  $[(n/2)-1 \text{ to } 0]$ -bit of final product is obtained by directly taking the  $[(n/2)-1 \text{ to } 0]$ -bit result of first squarer module (Least Significant Bit (LSB)-bits squarer). The result of the second squarer (Most Significant Bit (MSB)- bits squarer) is concatenated with remaining bits of first squarer and it is added with multiplier module results by concatenating  $(n/2)-1$  zeros at the MSB side and one zero at the LSB side. The sum produced by CLA adder gives the remaining  $[(2n-1) \text{ to } (n/2)]$ -bit product. In optimization two due to reduced PPs and using  $(n+(n/2)-1)$ -bit adder there is considerable amount of reduction in power consumption and propagation delay.

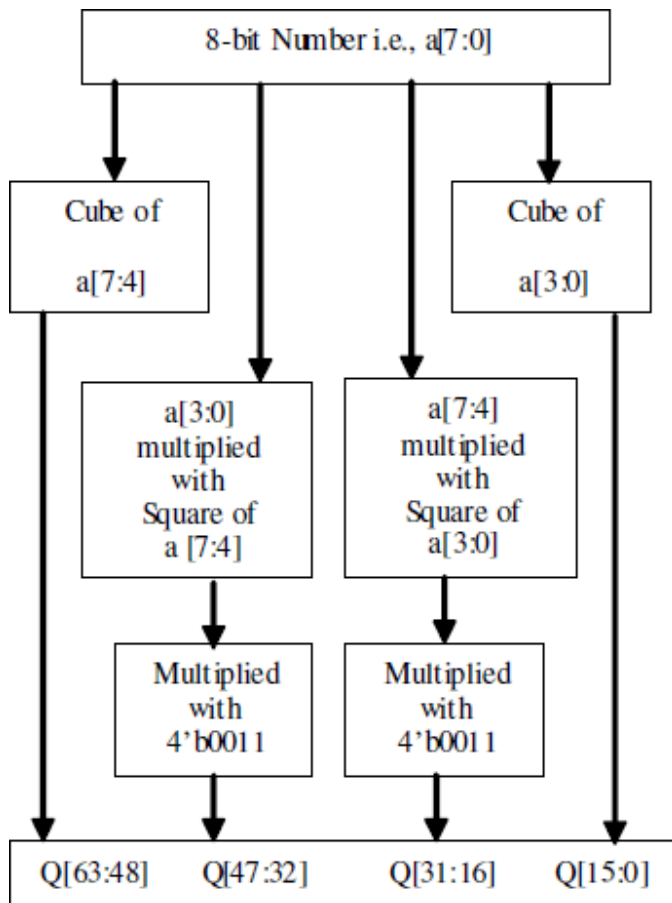
### 3. Cube Architecture

Cubing plays a vital role in secure communication systems, Signal Processing Applications, Finite Field Arithmetic etc. As the radix of the number used for cubing increases the process gets complicated which in turn increases the delay and power consumption.

In this paper the Anurupya Vedic sutra is used for cubing operations. The cubing operation is one of the most important operations in arithmetic process and it is found to be complicated, as we go for higher radix numbers. Cubing operation can be performed using ordinary multipliers, which are scalable but they have a larger delay. Structure based array implementations are faster but scalability increases design complexity as well as expense.

Moreover, multipliers occupy large area, have long latency and consume considerable power. Therefore, multipliers which offer either of the following design targets-scalability, reconfigurability, high speed, low power consumption, regularity of layout and less area or even a combination of some of these features are welcomed. The Anurupya sutra of Vedic mathematics provides an efficient way of constructing a straight cubing system without using conventional multiplication methods.

The proposed cube is based on the Anurupya Sutra of Vedic Mathematics which states "If you start with the cube of the first digit and take the next three numbers (in the top row) in a Geometrical Proportion (in the ratio of the original digits themselves) you will find that the 4th figure (on the right end) is just the cube of the second digit". The algebraic explanation is as follows: If  $a$  and  $b$  are two digits, then according to Anurupya Sutra., which is exactly equal to  $(a+b)^3$ . This sutra has been utilized in this work to find the cube of a number. The number  $M$  of  $N$  bits having its cube to be calculated is divided in two partitions of  $N/2$  bits, say  $a$  and  $b$ , and then the Anurupya Sutra is applied to find the cube of the number.  $a^3$  and  $b^3$  are to be calculated in the final computation of  $(a+b)^3$ . The intermediate  $a^3$  and  $b^3$  can be calculated by recursively applying Anurupya sutra. The below is the block diagram of cube architecture.



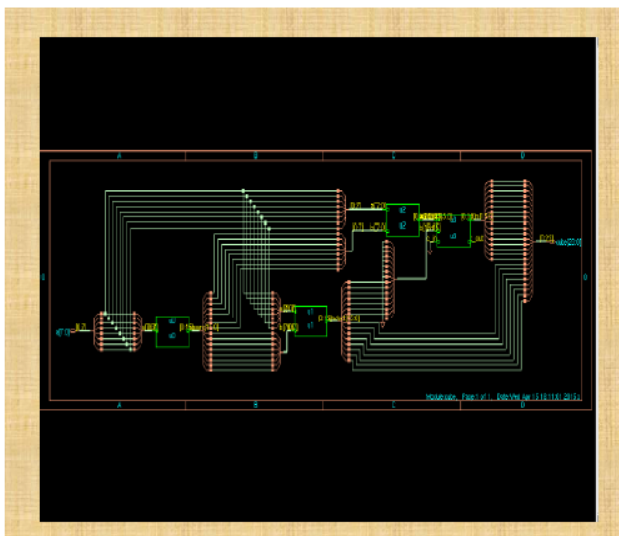
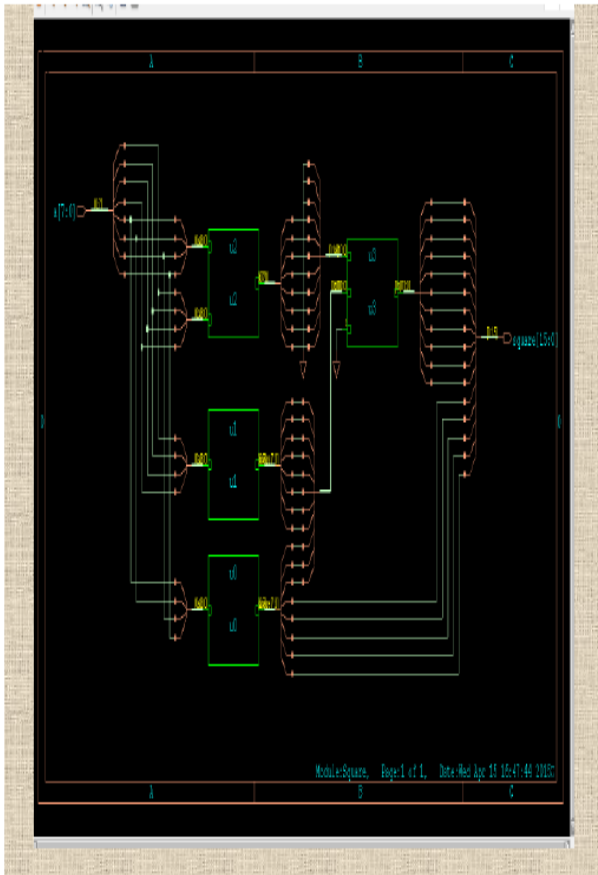
The first row can also be expressed as writing the numbers from the cube of the first digit to the cube of the second digit such that the numbers in between form the same ratio with respect to each other. In other words, the numbers in the first row are in geometric progression from the cube of the first digit to the cube of the second digit. In fact the constant ratio of the geometric progression is the same as the ratio between the first and second digits of the number to be cubed.

#### 4. RESULTS AND DISCUSSIONS

In this work, 8-bit squaring and cube architectures are implemented in Verilog HDL . Logic synthesis and simulation are done in cadence RTL simulator tool 180nm technology . Hardware implementation is done using spartan 6 xilinx FPGA device. The results are displayed in Table for square and cube architecture of 8-bit size. These Table show the difference in delay, area utilization and low power estimation.

## SYNTHESIS RESULTS:

### 8-BIT VEDIC SQUARE



8 bit vedic cube

**Table:**

<b>Parameter</b>	<b>Delay (ns)</b>	<b>Area (slices)</b>	<b>Power (mW)</b>
<b>Square</b>	<b>1.82</b>	<b>22</b>	<b>0.02</b>
<b>Cube</b>	<b>4.20</b>	<b>58</b>	<b>0.19</b>

## 5. CONCLUSION

Due to its regular and parallel structure it can be concluded that Vedic Square and cube are faster than conventional square and cube. Due to factors of timing efficiency, speed, low power and less area the proposed Vedic square and cube can be implemented in Arithmetic and Logical Units replacing the traditional square and cube circuits. It is demonstrated that this design is quite efficient in terms of area, speed & low power. Squaring of binary numbers of bit size other than powers of 2 can also be realized easily. For example, squaring of a 24-bit binary number can be found by using 32-bit squaring circuit with 8 MSBs (of inputs) as zero. The idea proposed here may set path for future research in this direction. Future scope of research is to reduce area requirements.

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# Application of Chitosan powder to enhance the properties of distillery spent wash

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**ABSTRACT-** Sugarcane molasses-based distillery effluent dumping into the environment is risky and has high pollution potential. Very high COD, BOD, total nitrogen and total phosphate content of the wastewater may consequence in eutrophication of natural water bodies. The highly colored components of the molasses wastewater reduce sunlight penetration in rivers, lakes or lagoons which in turn decrease equally photosynthetic activity and dissolved oxygen (D. O) concentration affecting aquatic life. Onsite anaerobic treatment technology has been implemented but still 100% chemical oxygen demand (COD), and biochemical oxygen demand (BOD) are not removed, so further post treatment is must to safely dispose the effluent. Application of chitosan powder as an adsorbent plays active role to remove the impurities and ingredient present in distillery effluent. Different parameters are enhanced by the application of chitosan powder. 93.33% COD degradation has been achieved by application of 10 gm of chitosan powder.

**Keywords:** - Chitosan Powder, distillery spent wash, chemical oxygen demand, Melanoidin.

## 1. INTRODUCTION

Sugarcane molasses is the consequence of sugar industry which generated throughout sugar manufacturing sugarcane molasses comprises 50 % fermentable sugar and about 4 to 10 kg of molasses which is required for 1 l of alcohol production [1, 2]. Sugar molasses is the dark brown, rotten, viscous liquid. Sugar molasses is the most common feed stock for industrial fermentation processes, molasses are diluted 1- 3 fold for successful fermentation process and manufacturing of spirit, alcohol and ethanol [3, 4]. Distillery Spent wash is highly acidic, having strong odour, variety of recalcitrant colouring pigment as melanoidins, metal sulfides and phenolics are responsible for dark brown colour of spent wash [2, 4, 5]. During manufacturing the ethanol, rectified spirit and alcohol spent wash is generated with huge quantity, during the ethanol production around 8 – 15 l of spent wash generated [2, 6]. Melanoidin is the color pigment formed during the Maillard reaction between the amino acid and sugar, which having high molecular weight [2, 6, 7]. Intense dark brown colour present in melanoidin is interfering the photosynthesis process by blocking sunlight rays, aquatic plant and animals are highly affected. To disposal the cumbersome, toxic distillery effluent anaerobic method has been implemented since 1980 and proved to be primary treatment to handle the distillery effluent. As effluent is complex cumbersome

single primary treatment is not sufficient to dispose the effluent safely on ground. As day by day rules and legislation are mandatory for disposal of distillery effluent secondary treatment is must to dispose the effluent safely. In this paper chitosan powder is used as adsorbent to dispose the effluent effectively. Chitosan is a semi crystalline polymer in the solid state. Chitosan has been shown to be biologically renewable, biodegradable, biocompatible, non-antigenic, non-toxic and biofunctional. Chitin, the second-most abundant biopolymer, and its deacetylated product, chitosan, are high molecular-weight biopolymers and are recognized as versatile, environmentally friendly raw materials [8]. This paper illustrates application of chitosan powder to distillery industry.

## 2. MATERIAL

Chitosan powder has been procured from commercial seed supplier Meck Pharmaceuticals and Chemical limited Ahmedabad, having properties such as low density, off white to brown colour, sparingly soluble to 1% acetic acid. Distillery spent wash has been collected from Pravara Loni distillery plant and has been stored in refrigerator to maintain the temperature of the sample. Effluent were analysed for different test such as pH, chemical oxygen demand, total dissolved solids, as per the standard method of analysis [9]. The COD was measured by closed reflux method using potassium dichromate.  $H_2SO_4$  and NaOH are use to adjust the pH of sample, distilled water were used to prepare the entire solution.

## 3. METHODS

Experimental work has been carried out which consist of application of chitosan dosages and contact time with the three different dilutions of sample as shown in Table 1 Chitosan dosage of 2g, 5g, and 10g with the corresponding contact time of 6hr, 12hr and 24hr for every sample was used with every dilution. Each diluted sample of 600ml quantity is separated into three parts of 200ml quantity all. There are overall nine samples three from each diluted sample of 200ml quantity each. All concentration sample is taken in a volumetric flask of 250ml and added with a desired chitosan dose. Each flask was shaken for one hour and the samples was filtered and collected for analysis after desired contact time. Whole adsorption test was performed at room temperature. The chemical oxygen demand (COD) determines the amount of oxygen required for chemical oxidation of organic matter using a strong chemical oxidant, such as potassium dichromate under reflux conditions. Most of the organic matters are destroyed when boiled with a mixture of potassium dichromate and sulphuric acid producing carbon dioxide and water. A sample is refluxed with a known amount of potassium dichromate in sulphuric acid medium and the excess of dichromate titrated against ferrous ammonium sulphate. The amount of dichromate consumed is proportional to the oxygen required to oxidize the oxidizable organic matter.

Table 1 Showing varying chitosan dose with contact time at different dilutions

Sample no.	25% dilution		Sample no.	50% dilution		Sample no.	100 % dilution	
	Chitosan (gm)	Duration (Hr)		Chitosan (gm)	Duration (Hr)		Chitosan (gm)	Duration (Hr)
1	2	6	1	2	6	1	2	6
2	5	12	2	5	12	2	5	12
3	10	24	3	10	24	3	10	24

Formula for COD Calculations

$$\text{COD} = \frac{(a - b) \times N \times 8 \times 1000}{\text{ml of sample}} \times D.F$$

Where,

a = ml of titrant used for blank correction

b = ml of titrant used for sample

N = normality of FAS =  $\frac{2.5}{\text{Blank reading}}$

$$\text{COD Removal (\%)} = \frac{\text{COD Of Blank Sample} - \text{COD Of Next Sample}}{\text{COD Of Blank Sample}} \times 100$$

Following are the parameters which were analyzed initially, before adsorption for the three dilutions of 25%, 50% and 100% pure sample and with different chitosan dose and contact time. Table 2 Shows parameter analyzed before adsorption

Table 2 Parameter to be tested for different dilution

Parameters	For 25% sample dilution	For 50% sample dilution	For 100% pure sample
pH	5.4	5.99	4.29
COD(mg/l)	1200	2560	3200
TDS(mg/l)	361	491	675
DO(mg/l)	3.0	1.7	1.2

### Graphs after Adsorption

The following graphs illustrate the results obtained during the analysis of spent wash. In Figure 1 COD decreases with increase in chitosan dose up to 10gm and contact time of 24hr and then attains a constant value with increase in chitosan dose and contact time. The optimum percent removal 93.33% has been observed at an chitosan dose of 10gm, contact time of 24hr with 25% diluted sample.

### For 25% Effluent Dilution

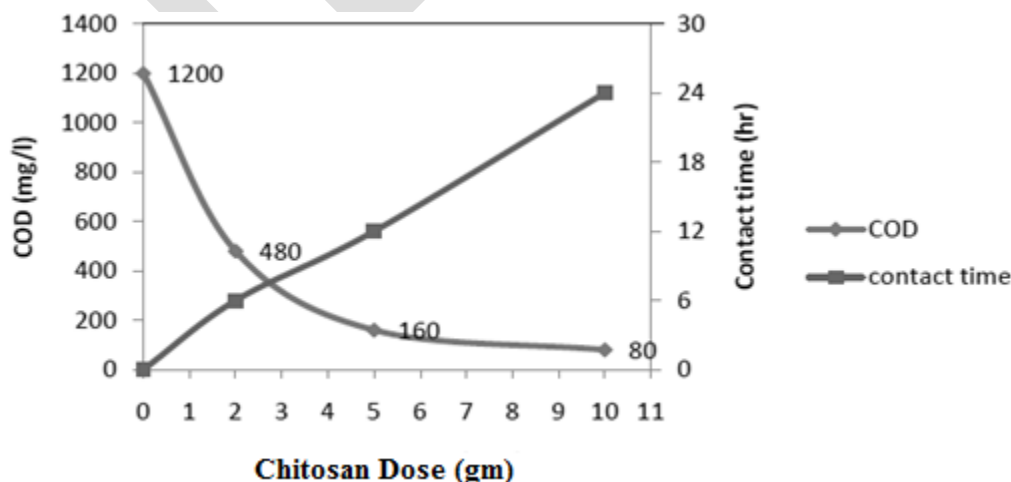


Fig 1 variation of COD with chitosan dose and contact time

In Figure 2 TDS decreases with increase in chitosan dose up to 10gm and contact time of 24hr. The maximum percent removal 70.6% has been observed at chitosan dose of 10gm, contact time of 24hr with 25% diluted sample

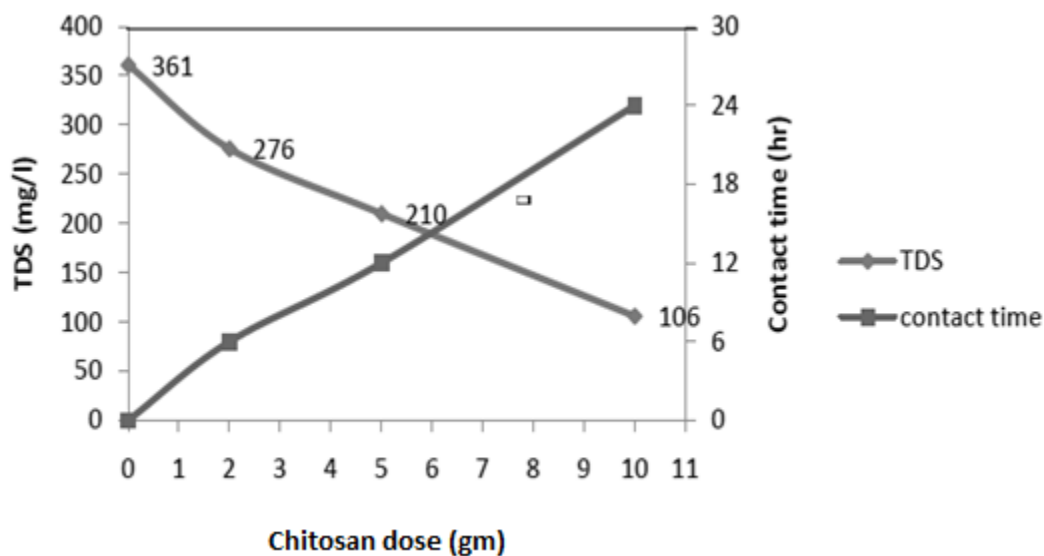


Fig 2 Variation of TDS with chitosan dose and contact time

In Figure 3 pH increases with increase in adsorbent dose up to 2gm and contact time of 6hr and then decreases with increase in chitosan dose and contact time. The maximum percent removal 25.31% has been observed at an chitosan dose of 2gm and contact time of 6hr with 25% diluted sample

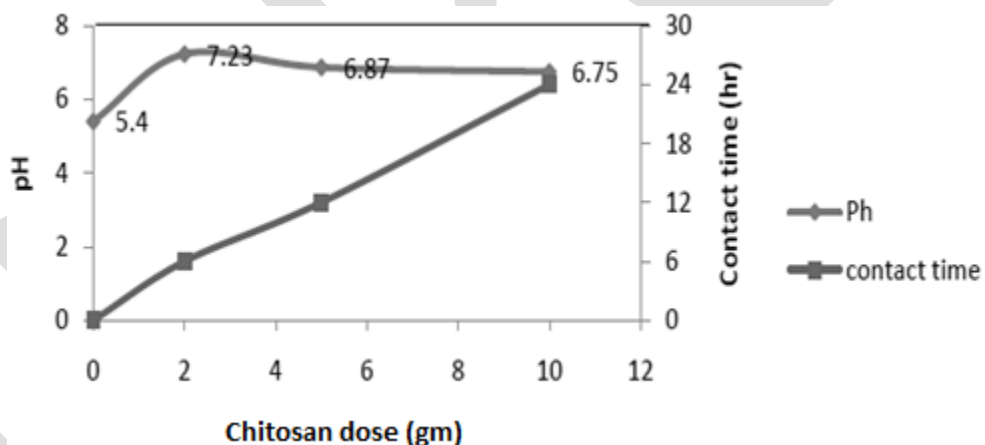


Fig 3 Variation of pH with chitosan dose and contact time

In Figure 4 DO increases up to a maximum value of 9.2 with increase in chitosan dose up to 10gm and contact time of 24hr. The maximum percent removal 67.39% has been observed at chitosan dose of 10gm, contact time of 24hr with 25% diluted sample.

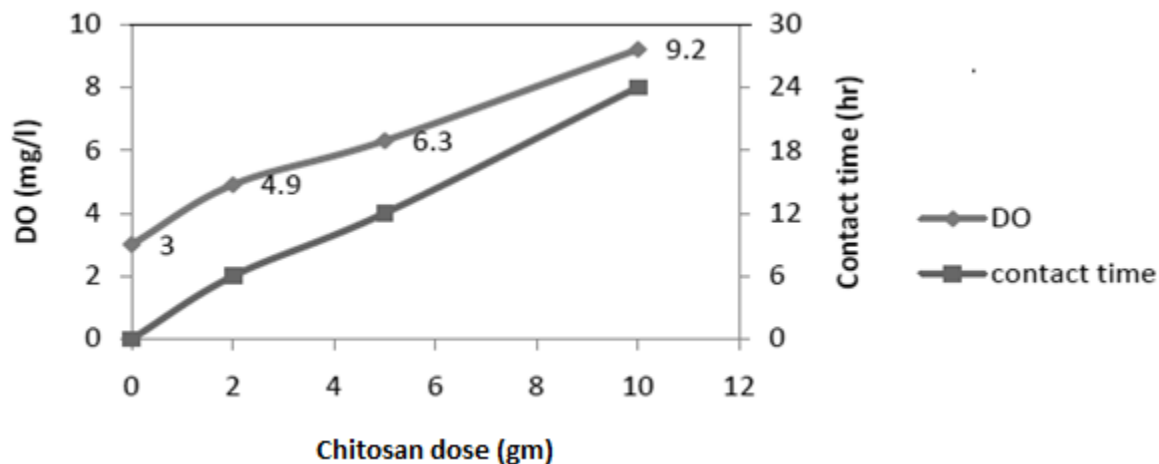


Fig 4 Variation of DO with chitosan dose and contact time

#### For 50% Effluent Dilution

In Figure 5 DO increases up to a maximum value of 8.5 with increase in chitosan dose up to 10gm and contact time of 24hr. The maximum percent removal 80% has been observed at chitosan dose of 10gm, contact time of 24hr with 50% diluted sample.

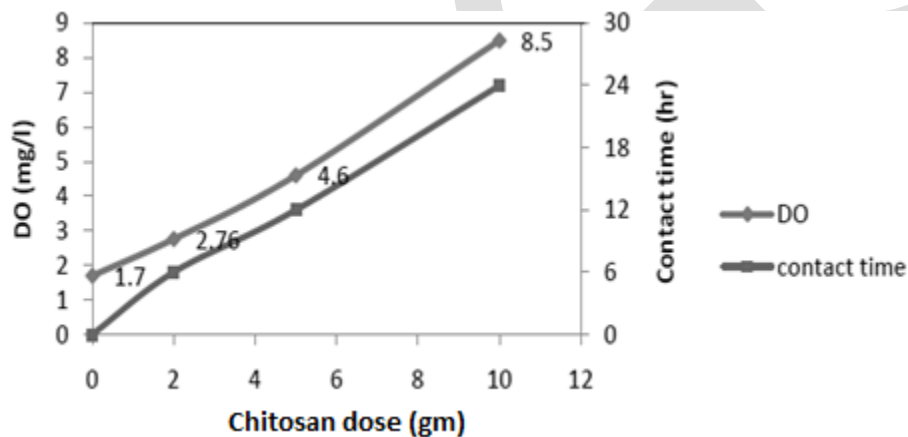


Fig 5 Variation of DO with chitosan dose and contact time

In figure 6 pH increases with increase in chitosan dose up to 5gm and contact time of 12hr and then decreases with increase in chitosan dose and contact time. The maximum percent removal 20.13% has been observed at an chitosan dose of 5gm, contact time of 12hr with 50% diluted sample

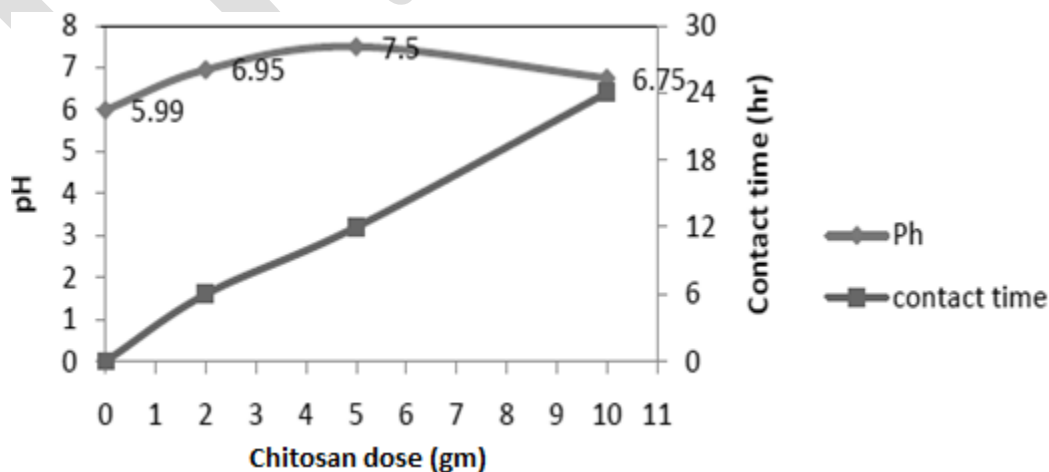


Fig 6 Variation of pH with chitosan dose and contact time

In Figure 7 COD decreases with increase in chitosan dose up to 10gm and contact time of 24hr and then attains a constant value with increase in chitosan dose and contact time. The maximum percent removal 75% has been observed at chitosan dose of 10gm, contact time of 24hr with 50% diluted sample.

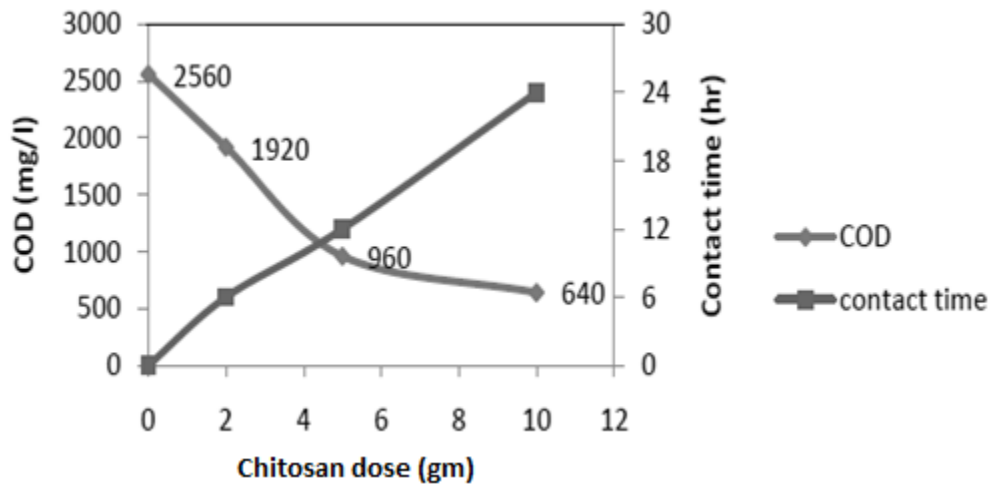


Fig 7 Variation of COD with chitosan dose and contact time

In Figure 8 TDS increases with increase in chitosan dose up to 2gm and contact time of 6hr and then decreases with increase in chitosan dose and contact time. The maximum percent removal 45.21% has been observed at an chitosan dose of 10gm, contact time of 24hr with 50% diluted sample.

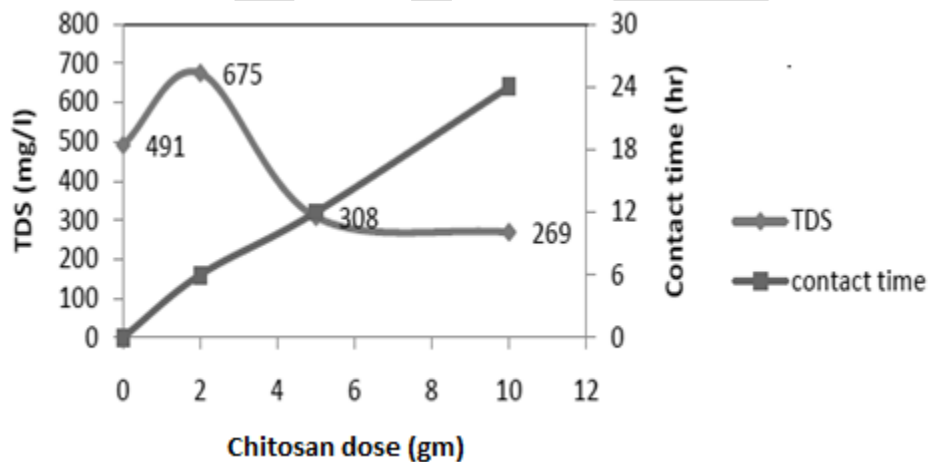


Fig 8 Variation of TDS with chitosan dose and contact time

#### For 100% Effluent Dilution

In Figure 9 pH increases with increase in adsorbent dose up to 5gm and contact time of 12hr and then there is not much effect with increase in chitosan dose and contact time. The maximum percent removal 42.95% has been observed at chitosan dose of 10gm, contact time of 24hr with 100% pure sample.

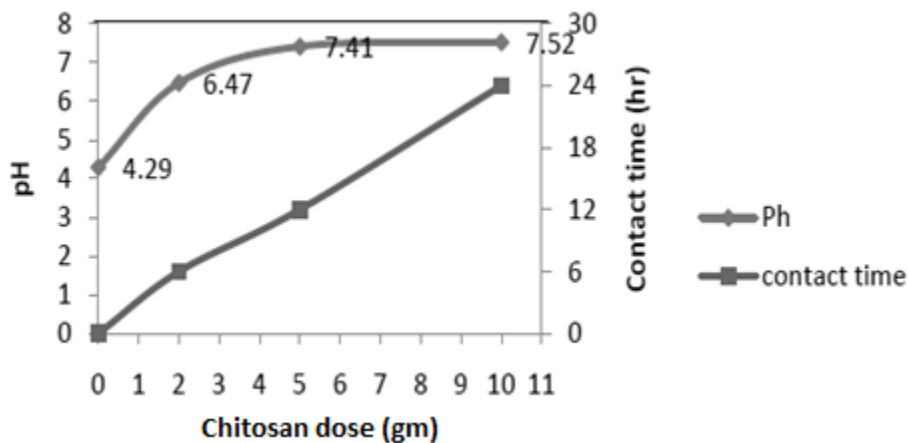


Fig 9 Variation of pH with chitosan dose and contact time

In Figure 10 COD decreases with increase in chitosan dose up to 10gm and contact time of 24hr and then attains a constant value with increase in chitosan dose and contact time. The maximum percent removal 40% has been observed at chitosan dose of 10gm, contact time of 24hr with 100% diluted sample.

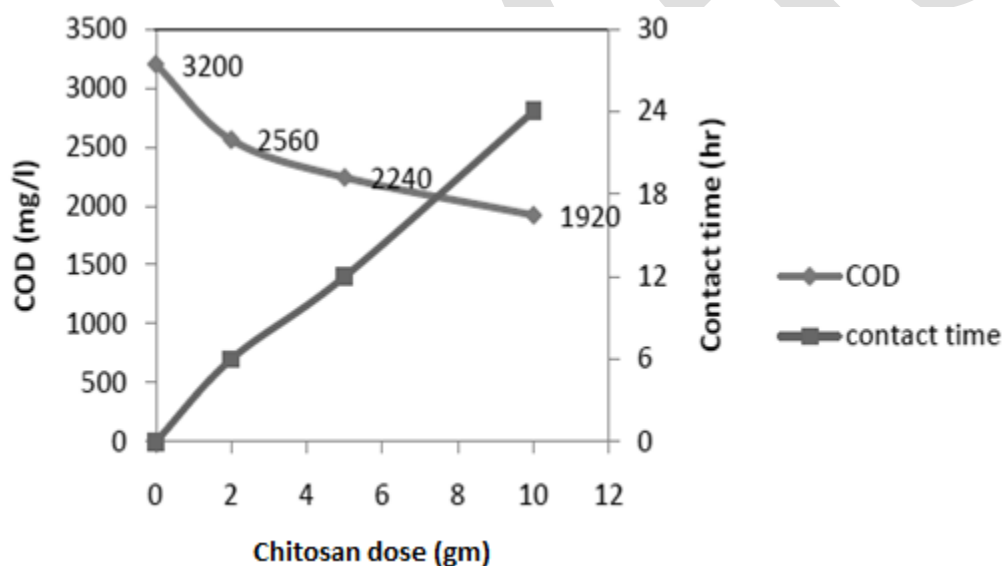


Fig 10 Variation of COD with chitosan dose and contact time

In Figure 11 TDS decreases with increase in chitosan dose up to 10gm and contact time of 24hr and then attains a constant value with increase in chitosan dose and contact time. The maximum percent removal 39.85% has been observed at chitosan dose of 10gm, contact time of 24hr with 100% diluted sample.

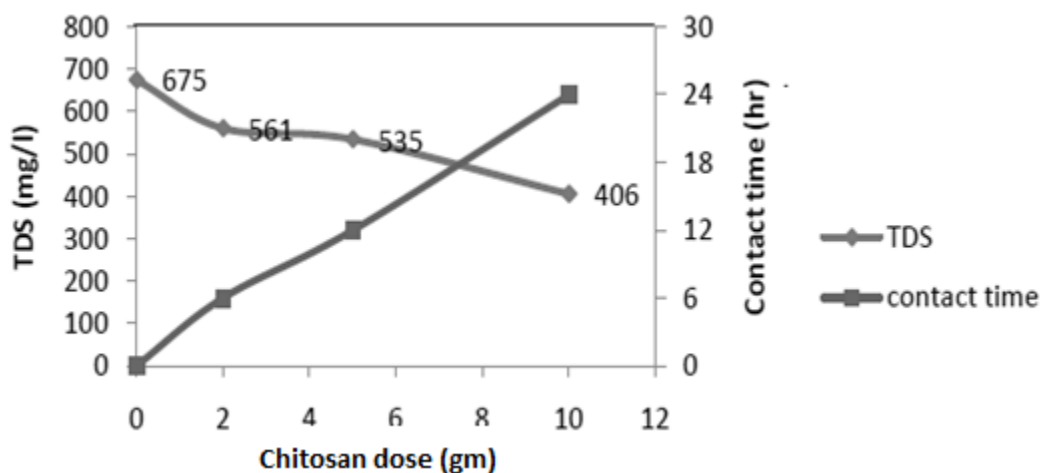


Fig 11 Variation of TDS with chitosan dose and contact time

In Figure 12 DO increases up to a maximum value of 7.9 with increase in chitosan dose up to 10gm and contact time of 24hr. The maximum percent removal 84.8% has been observed at chitosan dose of 10gm, contact time of 24hr with 100% diluted sample.

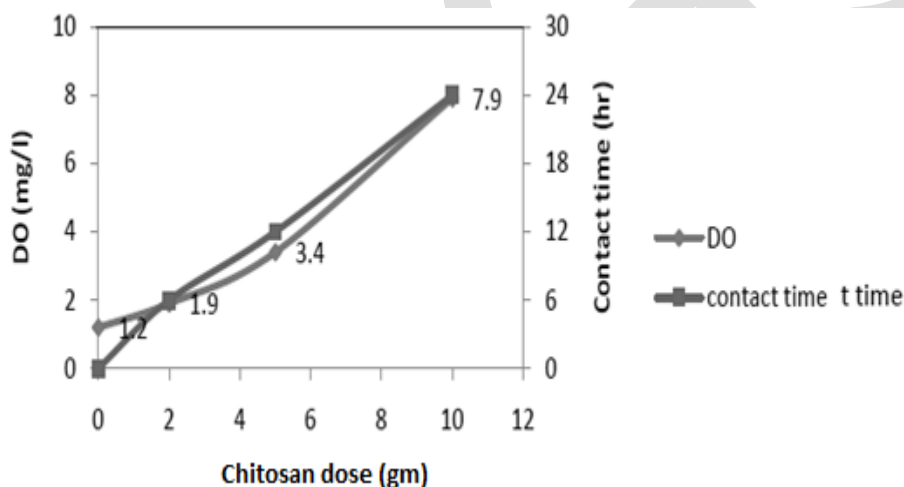


Fig 12 Variation of DO with chitosan dose and contact time

Table 3 Combine results of different dilution in a tabular form

Pollutants	Sample Dilution%	Chitosan dose (gram)	Contact time (hr)	% Removal
pH	100%	10	24	42.95
COD	25%	10	24	93.33
TDS	25%	10	24	70.6
DO	100%	10	24	84.8

#### 4. CONCLUSIONS

- It revolved that chitosan dose of 10 gram and contact time of 24 hr for 200ml of sample is originate to be most successful for different dilutions for removal of most pollutants.
- For removal of heavy metals, chitosan dose of 5 gram and contact time of 12 hr create to be most helpful. Ever-increasing the chitosan dose and contact time after this limit there is not much consequence on the elimination of pollutants and heavy metals. This is may be due to the adsorptive capacity of the chitosan is reached to optimum.

- The chitosan dosage, pH, contact time and initial concentration of organic matter have significant effect on the COD removal and dissolved oxygen. The optimum removal 42.95% of pH has been observed at 10gm of chitosan dose and a contact time of 24hr for without dilution of sample.
- The optimum degradation of COD has been observed 93.33% at 10gm of chitosan dose and a contact time of 24hr for 25% diluted sample. The maximum removal 70.6% of TDS has been observed at 10gm of chitosan dose and a contact time of 24hr for 25% dilution. The optimum removal of 84.8% DO has been observed at dose of 10gm of chitosant and a contact time of 24hr for without dilution of sample.

## ACKNOWLEDGEMENT

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# A KEY PERFORMANCE INDEX APPROACH FOR ASSESSMENT OF GLOBAL SOLAR RADIATION IN NIGERIA

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**Abstract-** Global solar radiation is the sum of direct, diffuse and reflected solar radiation. Direct solar radiation passes directly through the atmosphere to the earth surface. Diffuse solar radiation is scattered in the atmosphere and deflected solar radiation reaches a surface and is reflected to adjacent surface. This paper presents a key performance approach for assessment of global solar radiation in Nigeria. The mathematical modeling of the system Cost Of Energy (COE) in  $\text{\$/kWh}$  was formulated subject to the reliability condition for the computation of the energy contributions of the PV source, wind source and the grid source. The performance characteristics of the system are characterized in terms of its reliability in providing a cost- effective energy solution for satisfying the energy demand within the entire period. The results of the work shows that the percentage PV contributions of Abuja, Benin City, Katsina, Lagos, Nsukka and Yola are 32.63%, 34.58%, 55.84%, 55.32%, 39.12% and 42.02% respectively, thus ranking Katsina as the highest and Abuja as the least due to the thick population of Katsina and the percentage variation of the renewable energy contribution in the Northern part of the country. The percentage energy contribution of wind for Abuja, Benin city, Katsina, Lagos, Nsukka and Yola are 70.69%, 66.71%, 38.84%, 22.08%, 34.92% and 22.83% respectively while that of grid are 8.88%, 10.71%, 17.32%, 34.68%, 37.96% and 48.175 respectively thus ranking Abuja as the city with the highest percentage wind energy contribution of 70.69% and Lagos as the city with the least percentage wind energy contribution of 22.01%. In the same vein, Yola emerged as the city with the highest percentage grid energy contribution of 48.178% with Abuja having the least percentage grid energy contribution of 8.88%. This is because the contribution of wind energy is largely limited by the sharp decrease in the annual average wind speed in the Southern part of the country. The percentage of the wind energy conversion system varies from about 22.18% in Yola to 70.69% in Abuja because a large fraction of solar energy is required to compensate for the available grid electricity supplied. Abuja and Yola recorded the highest and least energy throughput of 8.10kWh/N and 5.22kWh/N respectively while the energy throughput, for Benin city, Katsina, Lagos and Nsukka are 7.47kWh/N, 6.62kWh/N, 5.74kWh/N and 5.58kWh/N respectively. The highest and least costs of 0.168  $\text{\$/kWh}$  and 0.111  $\text{\$/kWh}$  were recorded by Yola and Abuja because the Northern part of the country has significant improvement in the overall system cost of energy supplied. The implementation of the stand-alone PV- wind energy system is a more viable option. This will reduce the larger land area needed for the stand-alone hybrid renewable energy system.

**Keywords::** Key Performance Index (KPI), Solar Radiation, Photovoltaic, Cost of Energy, Loss of Supply Probability, Loss of Power Supply Probability, Energy Throughput, Energy Contribution.

## 1.0 Introduction

Electricity is the most desirable form of energy, which plays a vital role in the socio-economic and technological development of a country. With an increase in the population and economic development, the electricity demand of the country multiplies. If the rise in demand is not met satisfactorily, this can lead to a shortage in electricity supply with adverse socio-economic and environmental implications [7],[10],[12],[16].

The renewable energy system design integrates renewable energy mix, such as biomass, wind and solar energy. Large area of land, water and social impacts characterize the electricity production from biomass and this requires further study to verify the techno economic viability of its power generation. However, it may be required to shift demand to other energy sources such as wind and solar. These are useful sources for renewable energy generation because they are both technically and environmentally viable options [15],[16],[18].

Wind energy is one of the most viable and promising sources of renewable energy. Accurate estimate of wind speed distribution, selection of wind turbines and the operational strategy and management of the wind turbines are essential factors affecting the wind energy potential. The adjustment of the wind profile is necessary to account for the effects of the wind shear inputs. Accurate assessment of wind power potential at a site requires detailed knowledge of the wind speeds at different heights [2],[3],[7],[8],[9]..

### Photovoltaic Conversion system

The performance of the photovoltaic conversion system (PVCS) depends majorly on its orientation and period of services. The orientation of the PV sources is described with its tilt angle and the azimuth, both relate to the horizontal. Temperature affects crystalline cells and their performance decreases as cell temperature rises. A significant issue of concern is the heat built- up under the PV modules, resulting in the possible structural damage of the panel. Generally, there are two steps in determining the available solar energy when supplying a remote load. The first step involves the determination of the solar radiation that arrives on the earth at the PV panel's location. The next step is modeling of the panel itself, considering its efficiencies, losses and physical orientations. Each step requires a model that deals with many variables and inputs into the second stage of the model and utilizes the result of the first step [[1],[4],[5],[6]].

### Hybrid Energy System

The fluctuating renewable energy supplies load demands and non-linear characteristics of some components complicate the design of hybrid systems. The overall assessments of autonomous hybrid energy system depends on economic and environmental criteria, which are often conflicting. The technical constraints in hybrid energy systems relate to system reliability. Several reliability indices have been employed for the evaluation of generating systems. The most technical approaches used for the evaluation of power system reliability are the loss of load probability, loss of load power supply and loss of power supply probability. Several other factors, which constitute to the expected probability of renewable energy system influence the economic stability[[11],[17].

### Energy Storage System

Power fluctuations can be incurred since the renewable energy is highly dependent on weather conditions. The use of batteries in medium and high power application is remarkable. The required energy storage capacity can be reduced to a minimum when there is optimal sizing of the energy system at a given site. The rate of prediction at which the energy storage unit charges/discharges when generated power is more or less than the demanded power requires accurate energy storage model[13],[14],[16],[18].

## 2.0 Materials and Method

The major key performance indices (KPI) namely: energy contributions of the PV, wind and grid, the energy throughput of the system and the cost of energy were computed using the mathematical relations below:

The systems cost of energy (COE) in #/kWh is defined by:

$$COE = \frac{C_{ann.sys}}{E_{ann.sys}} \quad 1$$

Subject to the reliability condition:

$$\left[ \begin{array}{l} S_{imin} \leq S_i \leq S_{imax} \\ LPSP = 0 \end{array} \right] \quad 2$$

Where

$S_i$  = size of each system component i

$S_{imin}$  and  $S_{imax}$  are the minimum and maximum acceptable values for  $S_i$

LSP = loss of power supply probability of the system and  $E_{ann.sys}$  is the total annual energy demand to be served by the system (kWh/yr). The systems annualized cost ( $C_{ann.sys}$ ) is defined by:

$$C_{ann.sys} = \frac{1}{LN} \sum_{i=1}^n (C_{Li} + C_L) \quad 3$$

In terms of the percentage contribution of the individual sources, the energy contributions of the system can be expressed as:

$$EC_{es} = \frac{100 \times \eta_{es} \sum_{i=1}^n E_{es}(t)}{\sum_{i=1}^n E_{hs}(t)} \quad 4$$

Where  $E_{es}$  and  $E_{hs}$  are the energy production of each source and the hybrid system respectively for a simulation period N.

The performance characteristic of the system is determined in terms of its reliability in providing a cost-effective energy solution for satisfying the energy demand within the entire period N. The reliability of the energy supply defined in terms of the ratio of the total deficit energy supplied to that of the total load required during the period N is:

$$\eta_{rel} = 1 - LOSP \quad 5$$

and the loss of power supply probability (LPSP) is:

$$LPSP = \frac{\sum_{i=1}^n E_{det}(t)}{\sum_{i=1}^n E_d(t)} \quad 6$$

Where  $E_{det}(t)$  and  $E_d(t)$  are the deficit energy supplied and energy demand respectively at time 't', both expressed in kWh. The energy throughput the system is defined as:

$$K_t = \frac{\eta_{rel}}{COE} \quad 7$$

Equation (7) above expresses the techno- economic stability of the system per unit cost of energy supplied. A higher energy throughput is an indication of a more superior system performance.

### 3.0 Discussion of Results

Observation of the system's key performance indices shows that the renewable energy contribution increases with increasing latitude. The percentage of the grid electricity purchased decreases from the southern to the Northern parts of Nigeria as shown in Figure 1. This is due to the dependence of renewable resources on climatic conditions. Renewable source contributed largely throughout the studied locations due to the vast resource availability and the economic and technical viability of the renewable resources for sustainable electricity supplied. The energy contribution of the PV sources is illustrated in Figure 1. Katsina recorded the highest PV energy contribution of 55.84 while Abuja had the least PV energy contribution of 32.63 due to the percentage variation of the renewable energy contribution in the Northern part of the country which are compensated for through grid electricity purchase.

The percentage PV contribution of Benin City, Lagos, Nsukka and Yola are 34.58%, 55.32%, 39.12% and 42.02% respectively as illustrated in Figure 1

Figure 2 shows the percentage energy contribution of wind source. Abuja recorded the highest percentage wind energy contribution of 70.69% while Yola with a percentage wind energy contribution of 22.81% is the least in this range. This is because the operating hours of the wind turbine generator in Abuja are large compared to Yola.

Solar has a higher contribution of 55.84% compared to the 38.84% of wind energy, which is an indication that Katsina is densely populated. The percentage energy contribution of wind for Benin City, Katsina, Lagos and Nsukka are 66.71%, 38.34%, 22.01% and 34.92% respectively.

Figure 3 shows the energy contribution of the grid for selected cities used as case studies in this research paper. The percentage grid contribution of Abuja, Benin City, Katsina, Lagos, Nsukka and Yola are 88.88%, 10.71%, 17.32%, 34.68%, 37.96% and 48.17%

respectively. From this list, Abuja appeared as having the highest percentage grid contribution of 88.88% and Benin City had the least percentage grid contribution of 10.71%.

The contribution of wind energy is largely limited by the sharp decrease in the annual average wind speed in the southern part of the country. The performance of the wind energy conversion system varies only from about 22.18% in Yola to 70.69% in Abuja. This is because a large fraction of solar energy is required to compensate for the available grid electricity supplied. This increase is an indication of the presence of the southwest trade wind that blows from the Atlantic Ocean in this region. The performance of solar conversion system is almost evenly distributed with peak values of about 55.84% and 55.32% for Katsina and Lagos respectively.

The renewable source contribution is about 67% of the total energy requirement of base station cities and compared to the Northern part of the country. Figure 4 shows the energy contribution of PV, wind and grid, out of the six selected cities used as case studies in this research paper, Benin City recorded the highest energy contribution of 44.96% while Lagos recorded the least percentage energy contribution of 37.39%. This is because the implementation of the system will eliminate the need for the fossil fuel generators and reduce the dependence of the base station loads on the erratic grid supply from about 37.39% to as low as 17.12% in Lagos. This will mean a reduction in the pollutant emission released into the atmosphere as a result of consumption of electricity produced by the grid and fossil fuel generators.

The energy throughput of the selected cities is illustrated in Figure 5. The energy throughput of Abuja, Benin City, Katsina, Lagos, Nsukka and Yola are 8.10kWh/N, 7.47kWh/N, 6.62kWh/N, 5.74kWh/N, 5.58kWh/N and 5.22kWh/N respectively. Abuja and Yola recorded the highest energy and least energy throughput of 8.10kWh/N and 5.2kWh/N respectively.

Figure 6 shows the economic loss of the selected cities used as case studies in the research paper. The variation in the cost of grid diesel produced electricity which results from the cost variation per litre of diesel consumed due to the additional cost of transportation from one part of the country to another.

Yola recorded the highest economic cost of 0.168N/kWh, while Abuja with an economic cost of 0.111N/kWh is ranked the least of all the selected cities used. The larger percentage renewable contribution within the northern part of the country has significant improvement on the overall system cost of energy supplied.

In Yola, the grid system tends to provide a higher economic performance of about 73 % and a technical cost of about 62% at a power supply probability of about 43%

The energy throughput of the grid system is lower, 5.22kWh for Yola as compared to the highest value of 8.10kWh/N for Abuja. This implies that the cost of the supply decreases with a percentage improvement of about 66.34% and percentage of grid electricity purchase decreases from southern to Northern Nigeria. The corresponding energy throughput varies from about 5.22kWh/N in Yola to 8.10kWh/N in Abuja with an average value of 6.66kWh/N.

The average energy throughput of the grid connected renewable energy system is equivalent to an annual cost of electricity consumption of about N3.8 billion. The results of this research paper indicate that the implementation of the stand-alone PV-wind energy system is a more viable option. Even though, remote cell site expansion may be feasible, the expansion possibilities in most cities in the country are a difficult task. This may reduce the larger land area needed for the larger optimal operational site of the stand-alone hybrid renewable energy system.

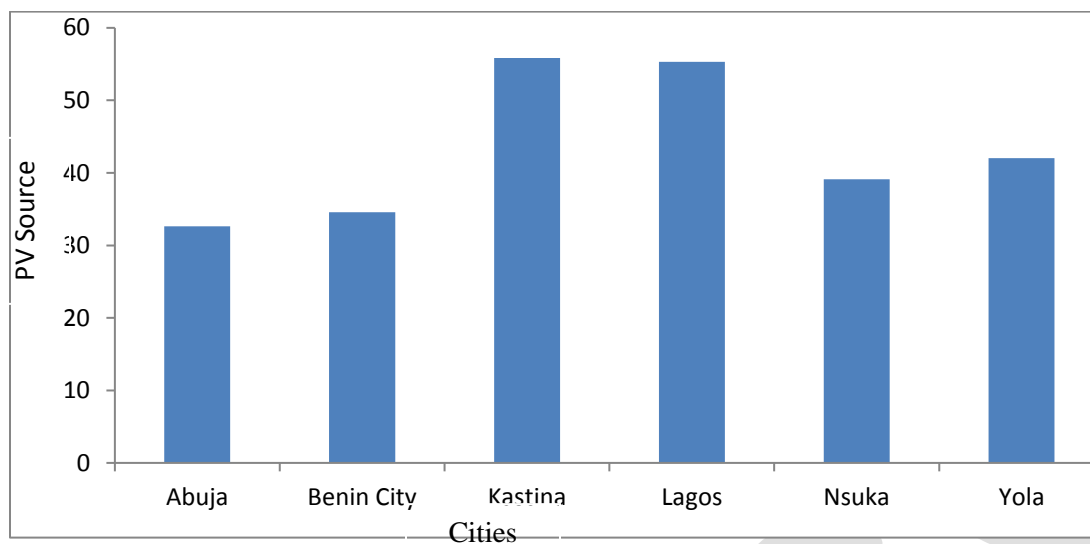


Figure 1: Energy Contribution of PV Source.

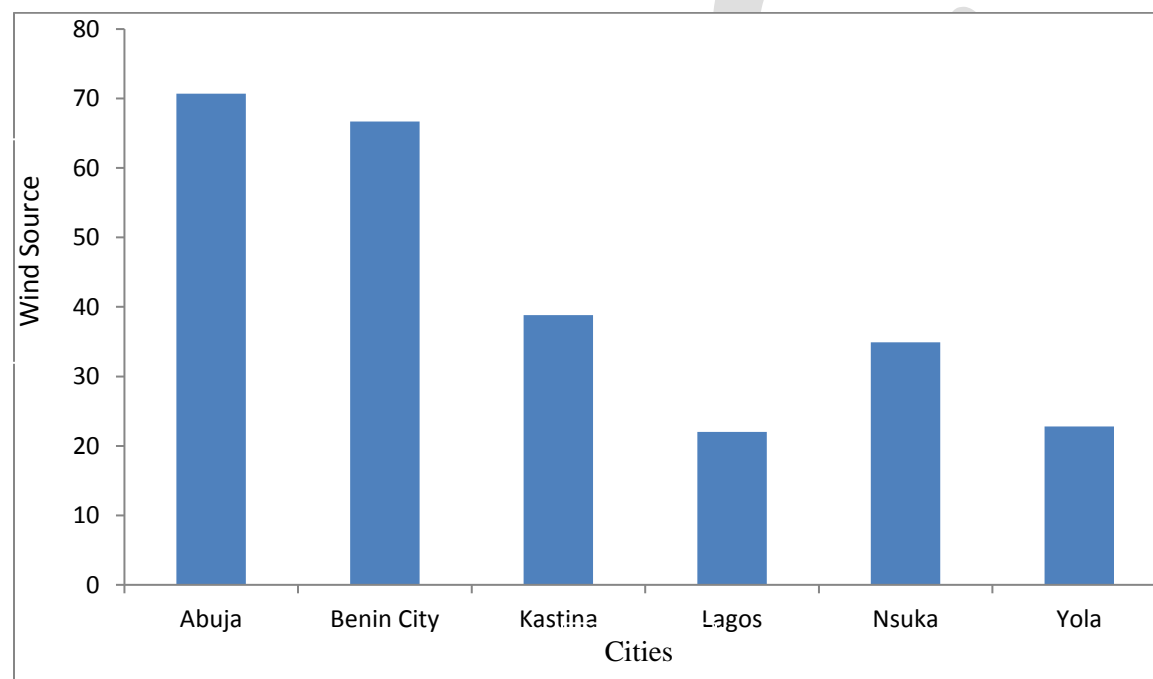


Figure 2: Energy Contribution of Wind Source

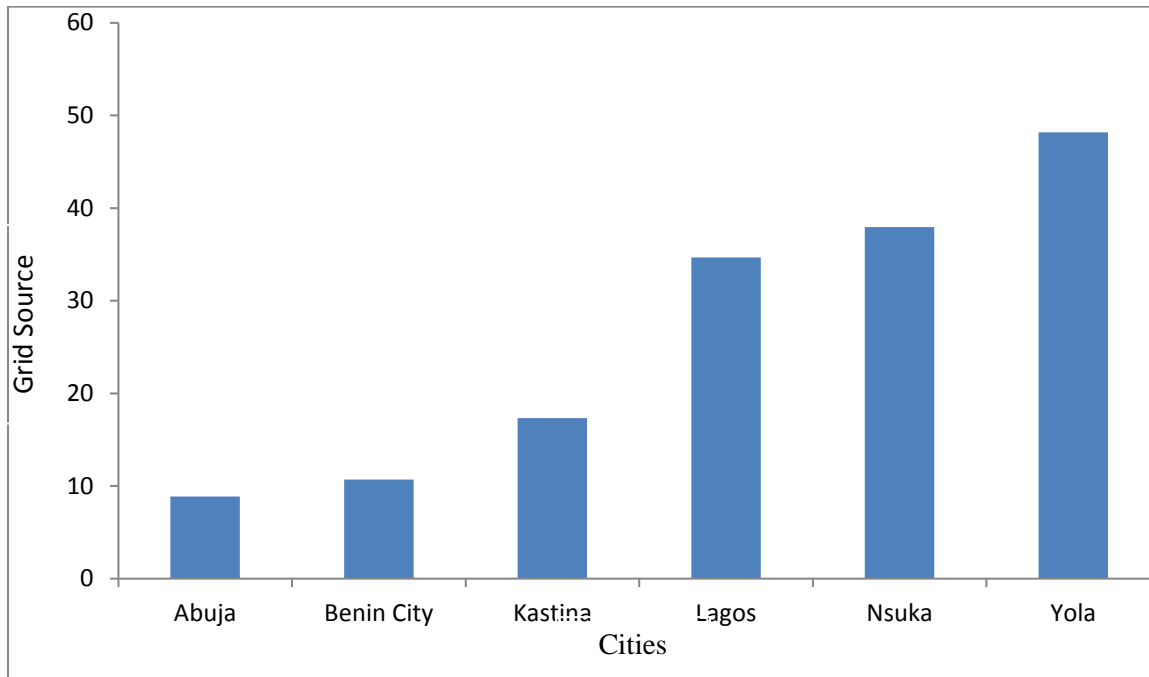


Figure 3: Energy Contribution of Grid Source

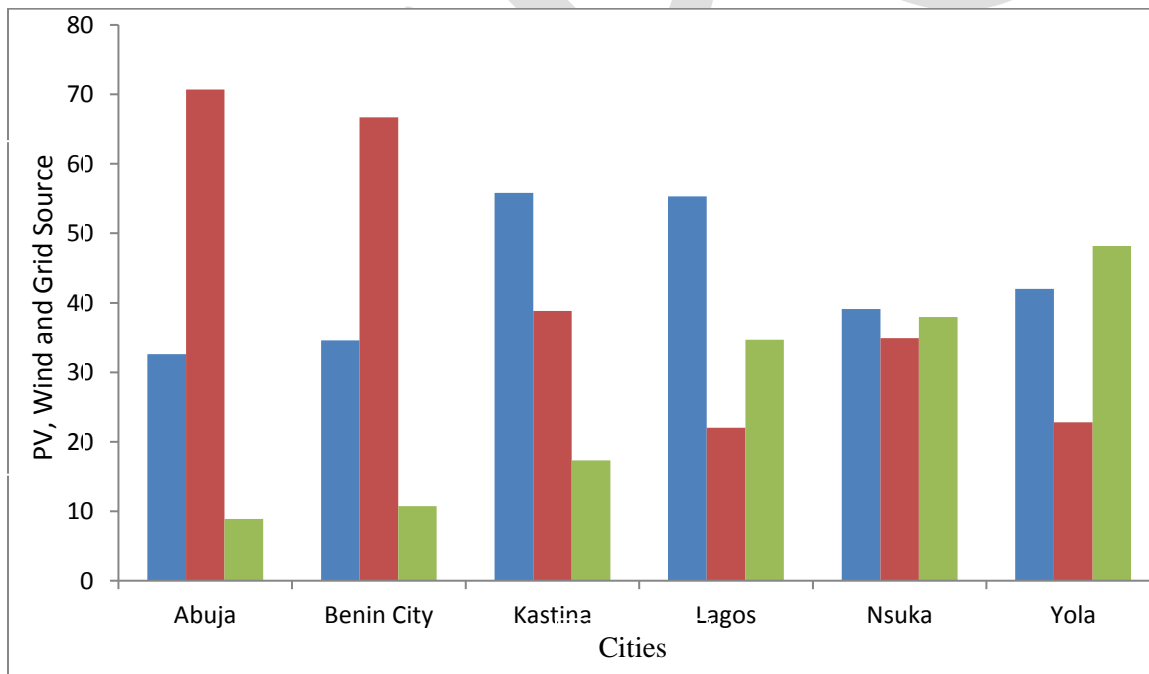


Figure 4: Energy Contribution of PV, Wind and Grid Sources

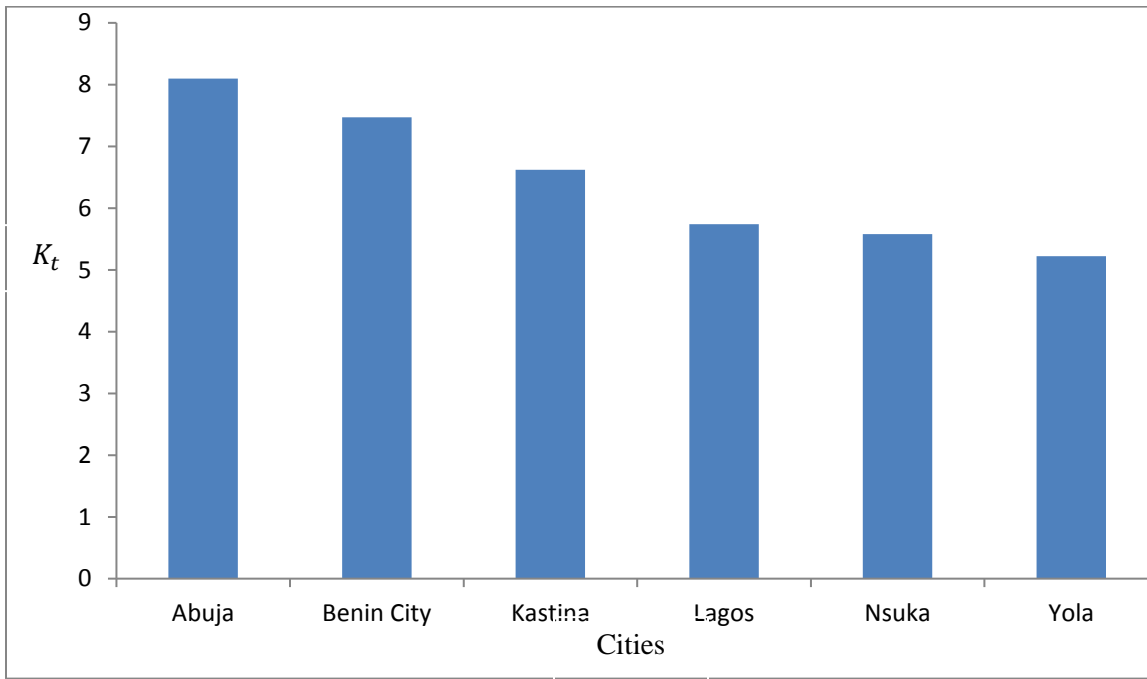


Figure 5:Energythroughput  $K_t$  of the cities

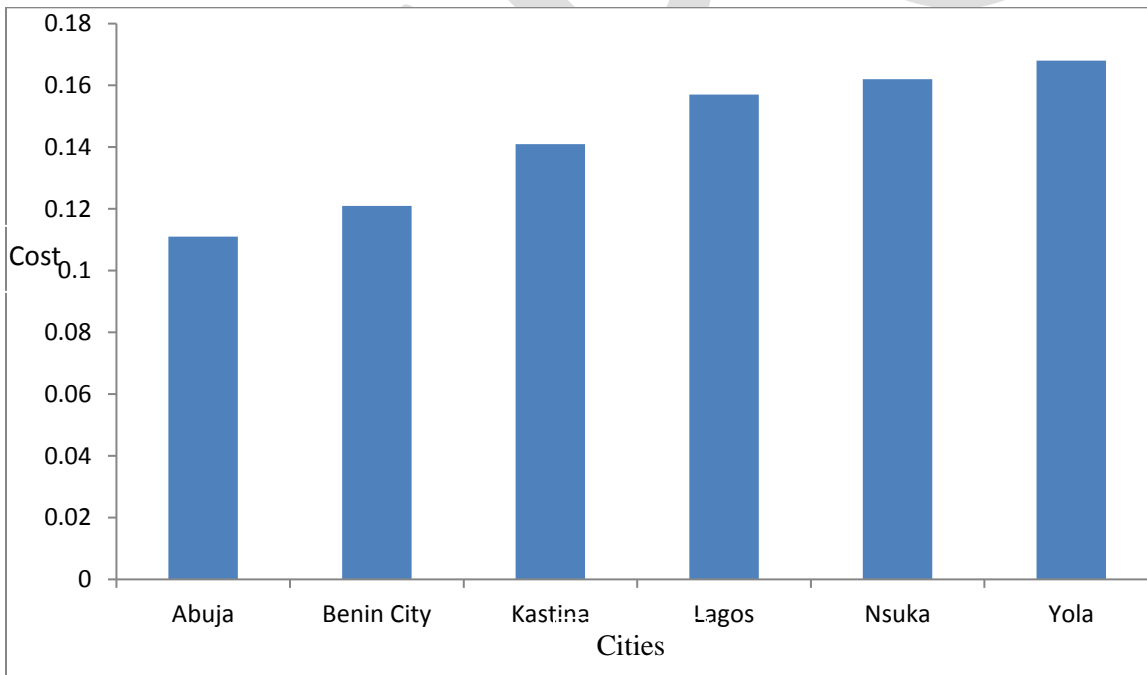


Figure 6: Cost of the cities

#### 4.0 Conclusion

A key performance index approach for assessment of global solar radiation in Nigeria has been presented. The system key performances indices show that the renewable energy contribution increases with increasing latitude. The percentage of the grid electricity purchased decreases from the Southern to the Northern parts of Nigeria as a result of the dependence of renewable resources on climatic conditions.

Kaduna recorded the highest PV energy contribution of 55.84 while Abuja had the least PV energy contribution of 32.63 due to percentage variation of the renewable energy contribution in the Northern part of the country which are compensated for through grid of electricity purchase. Abuja recorded the highest percentage wind energy contribution of 70.69% while Yola had the least percentage wind energy contribution of 22.81% due to the long operating hours of the wind turbine generator.

The energy throughput of Abuja, Benin City, Kastina, Lagos, Nsuka and Yola are 8.10kWh/N, 7.47kWh/N, 6.62kWh/N, 5.74kWh/N, 5.58kWh/N and 5.2kWh/N respectively. Yola recorded an economic cost of 0.168 #/kWh which appeared to be the highest in this range because the grid system tends to provide a higher economic performance of about 73% and a technical cost of about 62% at a power supply probability of about 43%.. Abuja with an economic cost of 0.111 #/kWh is ranked least in this range.

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# A framework to audit log files to find operations at the storage level at HDFS

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**Abstract:** With enormous data present all over the world, the need of managing the data has also risen. Hadoop is used to maintain and process such large amount of data. Hadoop is an Apache framework which is used to store and process large amount of data. The data is stored in a distributed environment in Hadoop. Hence, Hadoop consists of hadoop distributed file system which is used to store this large amount of data. The data present in such a large scale and complex structure is termed as big data. Map reduce is used for large scale data processing. The data is processed by breaking down it into various jobs which are fed as input to map tasks and reducer processes the data came as output from the mapper. Various scheduling algorithms are proposed to schedule these jobs. This paper covers the simulation study of various scheduling algorithms and audits log files to find operations at storage level. The results show that there is about 15.68% decrease in execution time of word count program when fair scheduler is used as compared to default FIFO scheduler. Also for pcap file of ack packets the execution time is reduced by 14.73% when fair scheduler is used.

**Keywords:** Hadoop, map reduce, big data, capacity, fair, scheduler, auditing

## INTRODUCTION

Due to rapid development of internet applications, the demand of computing power has risen manifolds. Many new technologies like grid computing, cloud computing, distributed computing or parallel computing have emerged to provide enormous computing power. [1] Due to invention of cloud computing, more and more applications are now deployed in the cloud environment enabling people to have access to data at very less rate. The amount of data that we are producing has increased manifolds as a result it has led to the invention of big data.

### 1. BIG DATA

Big data is basically a terminology that is used for very massive data sets that have a large variation along with complex structure. These are the characteristics that usually add difficulties like storing the data, analyzing it and further applying procedures after which results are to be extracted. [2] Big Data is related to data that surpasses the usual storage, processing power, and computing capacity of traditional databases and data analysis techniques. Moreover, to process such a large amount of data, Big Data requires a large set of tools and methods which can be applied to analyze and extract patterns from large-scale data. Big data can be characterized by three Vs: Volume, Variety and Velocity. Here volume means that there is large amount of data present which can be in the order of terabytes or petabytes. With variety we understand that the data comes from varied sources like text, audio, video, images etc. Velocity defines how the data is kept in motion and how the analysis of streaming data is done.

### 2. HADOOP

Hadoop is one of the technologies to tame big data. HADOOP is basically a framework provided by Apache which is used to run applications on systems which includes thousands of nodes and data is in the order of terabytes. It handles large amount of data by distributing it among the nodes. [3] It also helps system to work properly even when a node in the network fails. As a result risk of catastrophic system failure is reduced. Apache HADOOP consists of the HADOOP kernel, HADOOP distributed file system (HDFS) and map reduce paradigm. [4]

### 3. HADOOP DISTRIBUTED FILE SYSTEM

Hadoop solves the problem of storing large amount of data by placing in to number of clusters. There is a fault-tolerant storage system present in HADOOP which is called HADOOP Distributed File System, or HDFS. [5] With HDFS we can store huge amounts of information along with scaling up incrementally and surviving the system failure without threat of losing data. HDFS stores large amount of data across multiple machines. These files are stored in redundant fashion so that whenever any node crashes, the data can be easily recovered.

### 4. MAP REDUCE

Map reduce is a paradigm used for parallel processing of data using two functions: map and reduce. [6] It provides scheduling, parallelization, replication and failover. Using map and reduce phase map reduce basically encodes data for faster processing. It is a framework that can be used to process large chunks of data in parallel on large clusters of commodity software reliably. The map reduce algorithm comprises of two phases: map and reduce. In map phase input data is taken and converted into some other form. Also individual elements are broken down into elements (key/value pairs). The input to reduce task is the output of map task and reduce phases processes the input. Map reduce has master and workers and the work between them is collaborative in nature.

### 5. SCHEDULING ALGORITHMS

There are various algorithms proposed for scheduling of applications in cloud environment. Basically, scheduling can be defined as method to select and decide the task which is most appropriate to execute. It is also defined as allocation of machines to tasks so that makespan of workflow is minimized. [6] Algorithms like data aware scheduling algorithms, first come first serve, round robin, minimum completion time, heterogeneous earliest finish time etc can be used for scheduling workflows in a HADOOP environment. FIFO scheduling algorithm is the default algorithm provided by Hadoop architecture. In FIFO scheduling, jobs are executed in first come first serve order. A FIFO queue is maintained by FIFO scheduler that keeps multiple tasks in it. Fair scheduler works on the concept that resources are assigned to job so that every job gets an equal share of the available resources as a result jobs that require more time to execute don't starve. Several queues are created instead of pools in capacity scheduling. Each queue has a configurable number of map and reduce slots and each queue is also assigned a guaranteed capacity. The scheduler monitors the queue and if a queue is not consuming its allocated capacity, the excess capacity can be temporarily allocated to other queues.

### LITERATURE SURVEY

Although Hadoop is a new technology but a lot of research has been done in this field by many researchers. A lot of things have been proposed and many new algorithms have been developed to strengthen the features provided by Hadoop framework. Some of the work done by the researchers is listed below:

**Laurent Bobelin, Patrick Martineau et al(2016):** Big data has revealed itself as a powerful tool for many sectors ranging from science to business. Distributed data-parallel computing is then common nowadays: using a large number of computing and storage resources makes possible data processing of a yet unknown scale. But to develop large-scale distributed big data processing, we have to tackle many challenges. One of the major complexities is scheduling. As it is known to be an optimal online scheduling policy when it comes to minimize the average flowtime, Shortest Processing Time First (SPT) is a classic scheduling policy used in many systems. The author has integrated this policy into Hadoop, a framework for big data processing, and realized an implementation prototype. The paper has described this integration, as well as tests results obtained on test bed. [7]

**Xiangming Dai et al.(2016):** In this paper, the author has proposed a novel task scheduling algorithm for Hadoop map reduce called dynamic priority multi queue scheduler (DPMQS). DPMQS i) increases the data locality of jobs, and, ii) dynamically increases the priority of jobs that are near to completing their Map phase, to bridge the time gap between the start of the reduce tasks and the execution of the reduce function for these jobs. The author has also discussed the details of DPMQS and its practical implementation,

then assessed its performance in a small physical cluster and large-scale simulated clusters and compared it to the other schedulers available in Hadoop. Both real experiments and simulation results show that DPMQS decreases significantly the response time, and demonstrate that DPMQS is insensitive to changes in the cluster geometry. [8]

**Divya M, Annappa B(2015):** Hadoop map reduce is one of the largely used platforms for large scale data processing. Hadoop cluster has machines with different resources, including memory size, CPU capability and disk space. This introduces challenging research issue of improving Hadoop's performance through proper resource provisioning. The work presented in this paper focuses on optimizing job scheduling in Hadoop. Workload Characteristic and Resource Aware (WCRA) Hadoop scheduler is being proposed by the author which classifies the jobs into CPU bound and Disk I/O bound. Based on the performance, nodes in the cluster are classified as CPU busy and Disk I/O busy. The amount of primary memory available in the node is ensured to be more than 25% before scheduling the job. Performance parameters of Map tasks such as the time required for parsing the data, map, sort and merge the result, and of Reduce task, such as the time to merge, parse and reduce is considered to categorize the job as CPU bound or Disk I/O bound. Tasks are assigned the priority based on their minimum Estimated Completion Time. The jobs are scheduled on a compute node in such a way that jobs already running on it will not be affected. Experimental result has given 30 % improvement in performance compared to Hadoop's FIFO, Fair and Capacity scheduler. [5]

**Ping Li et al. (2015):** YARN is used to provide resource management and scheduling for large scale map reduce environments. However it faces two major challenges: ability to automatically tailor and control resource allocations to different jobs to achieve their service level agreements and to minimize the energy consumption of the cloud computing system. The author has proposed a scheme which is SLA aware energy efficient scheduling scheme and is used to allocate optimal number of resources to map reduce applications. Job profiling is also performed to obtain the performance characteristics for different phases of a map reduce application which is used during resource provisioning in order to meet the specified SLA. Also, the authors have designed an online user space governor based dynamic voltage and frequency scaling scheme so that the CPU frequency for upcoming tasks can be dynamically changed. Their scheme have achieved better SLA conformance with low resource cost and energy consumption. [9]

**PEI Shu-jun et al. (2015):** The paper has focused on the insufficient thought for the task locality of FIFO scheduler of the hadoop scheduler. The authors have proposed task locality improvement scheduler. The jobs are set and processed to several job queues according to probability threshold level of task locality. The tasks are executed locally immediately if the local node is idle or they will have to wait until the local node becomes idle for execution. The task locality is improved by 98% and performance is improved by 10.9%. [10]

**Qutaibah Althebyan et al. (2014):** Map reduce is a paradigm used for parallel processing of data using two functions: map and reduce. Scheduling is the major problem faced by map reduce. The authors have proposed a new scheduling algorithm which is based on multi threading principle. In their scheme the cluster is divided into multi blocks where in each block is scheduled by a special thread and the scheduling is done synchronously. Simulation time and energy consumption is the parameter on which their algorithm is being tested. The results show that the proposed algorithm is 47% better as compared to FIFO algorithm. [11]

## PROPOSED WORK

The implementation of hadoop creates a set of pools where the jobs are placed for selection by the scheduler. By default, all pools have equal shares, but configuration is possible to provide more or fewer shares depending upon the job type. The number of jobs active at one time can also be constrained, if desired, to minimize congestion and allow work to finish in a timely manner. Due to increased size of data files, size of log files (files which records the data activity), intrusion detection system faced so many problems and gives inaccurate results for detecting the attackers.

The objective of the study is to perform simulation study of various scheduling algorithms present in hadoop framework. We will also assign a set of shares to each pool to balance resources across jobs in pools. The implementation is set to allow interactivity among Hadoop jobs and to permit greater responsiveness of the Hadoop cluster to the variety of job types submitted. Moreover, the implementation audits log files to find if any, malicious operations are performed or any malicious user is manipulating the data in the nodes.

## IMPLEMENTATION

The implementation for the above proposed work is done using Hadoop 0.20.2 along with the net stress and wireshark tool. Netstress is a tool used to measure network performance. It employs bulk data transfer with the help of Layer 3 protocols TCP and UDP. Wireshark is a packet analyzer tool which is used to capture network packets and display the packet data as detailed as possible. The work flow of the proposed work is as follows:

- Flooding is done on data node of the network.
- Live traffic is captured.
- Job is assigned to the job tracker.
- Map and reduce function is applied on the job.
- Result is formulated.

The study revolves around analyzing the results provided by various scheduling algorithms like default FIFO scheduler, capacity scheduler and fair scheduler. For getting the optimal results mapred-site.xml file is configured accordingly.

To audit log records mapred-site.xml file for capacity scheduler is modified and the simulation is done against that file.

We sent the jobs to the data node of hadoop. The respective jobs we sent to the data node are class file of word count program and pcap file of ack packet generated using netstress and wireshark. The action performed on pcap file is that of rate generation. The maximum map and reduce tasks which can be performed by capacity scheduler is 5.

Also, we have built a code which audits log files and records any malicious activity. The code sends the block to the invalid set stating that this particular block can harm the network.

## RESULTS

Word count file and pcap file is sent simultaneously as two jobs to the data node and the results are noted. Since, we have taken default, capacity and fair scheduler in consideration in our study, the following graph shows the time taken for execution for both word count program and rate generation program.

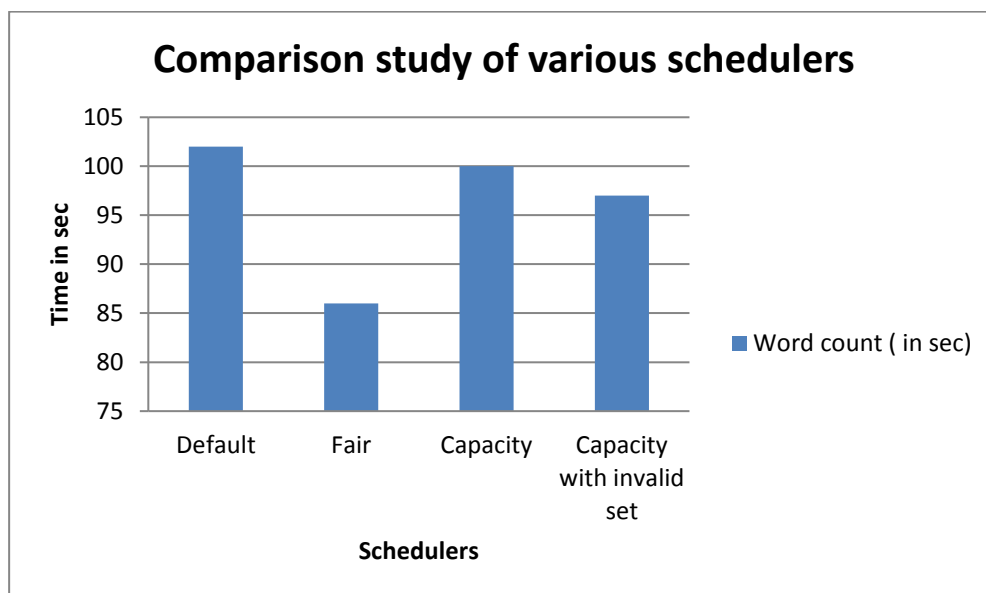


Figure 5: Comparison study of various schedulers on word count program

As we can see from the above graph, the execution time for word count program is maximum for default scheduler i.e. 102 seconds while for fair scheduler it is 86 seconds. The execution time for capacity scheduler is 100 seconds. The time taken by capacity scheduler while sending invalid blocks to invalid set is 97 seconds. We can see clearly that each scheduler is taking less time as compared to the default scheduler provided by hadoop framework. Moreover fair scheduler is taking 15.68% less time as taken by default scheduler.

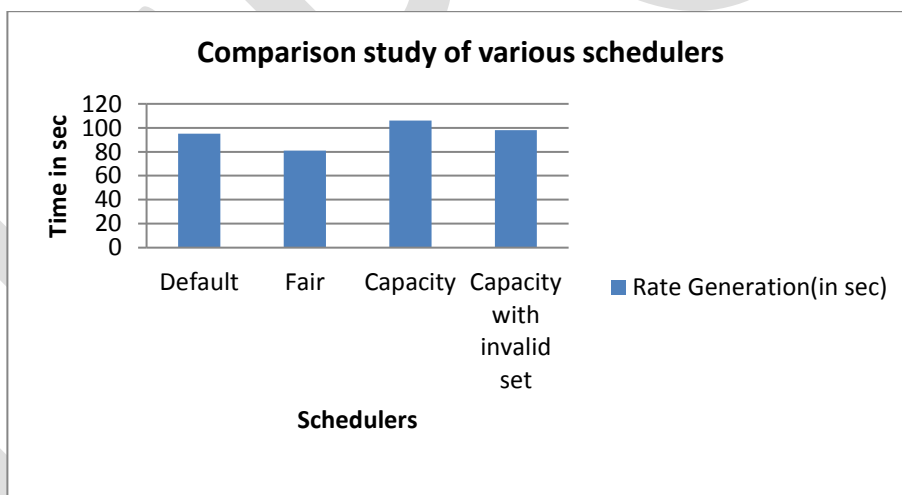


Figure 6: Comparison study of various schedulers on rate generation file

When pcap file is sent to the data node for map and reduce function, the default scheduler takes 95 seconds while fair scheduler takes 81 seconds. The time taken by capacity scheduler and capacity scheduler which sends invalid block to invalid set is 106 seconds and 98 seconds respectively. We can see that there is again a 14.73% decrease in time when fair scheduler is reduced.

```
apache.hadoop.hdfs.StateChange: BLOCK* NameSystem.allocateBlock: /home/hduser/g2/_logs/history/localhost_1495960278729_job_20170528140
apache.hadoop.hdfs.StateChange: BLOCK* NameSystem.addStoredBlock: blockMap updated: 127.0.0.1:50010 is added to blk_144873420110267747
apache.hadoop.hdfs.StateChange: DIR* NameSystem.completeFile: file /home/hduser/g2/_logs/history/localhost_1495960278729_job_201705281
apache.hadoop.hdfs.StateChange: BLOCK* NameSystem.addToInvalidates: blk_-3881823594529903027 is added to invalidSet of 127.0.0.1:50010
apache.hadoop.hdfs.StateChange: BLOCK* NameSystem.addToInvalidates: blk_1778306763947891413 is added to invalidSet of 127.0.0.1:50010
apache.hadoop.hdfs.StateChange: BLOCK* NameSystem.addToInvalidates: blk_699065722306535230 is added to invalidSet of 127.0.0.1:50010
apache.hadoop.hdfs.server.namenode.FSNamesystem.audit: ugi=hduser,hadoop ip=/127.0.0.1 cmd=delete src=/home/hduser/tmp/blk_
apache.hadoop.hdfs.StateChange: BLOCK* ask 127.0.0.1:50010 to delete blk_-3881823594529903027_1101 blk_699065722306535230_1104 blk_17
apache.hadoop.hdfs.server.namenode.FSNamesystem.audit: ugi=hduser,hadoop ip=/127.0.0.1 cmd=delete src=/user/hduser/PcapRa
apache.hadoop.hdfs.StateChange: BLOCK* NameSystem.allocateBlock: /user/hduser/PcapRate_out/home/hduser/a2/_logs/history/localhost_1495
apache.hadoop.hdfs.StateChange: BLOCK* NameSystem.addStoredBlock: blockMap updated: 127.0.0.1:50010 is added to blk_-69439721827560247
apache.hadoop.hdfs.StateChange: DIR* NameSystem.completeFile: file /user/hduser/PcapRate_out/home/hduser/a2/_logs/history/localhost_14
```

Figure 7: Audited log records

As it can be seen from the above figure, some blocks are moved to invalid set of the node. This shows that log files are audited and any malicious activity can be found in the invalid set.

## CONCLUSION

Hadoop can be used for processing multiple jobs in a distributed environment. When jobs are sent to the data node, a decrease in the execution time can be seen while using fair scheduler as compared to default scheduler. A decrease of 15.68% is seen in the case of word count program while a decrease of 14.73% is seen in the case of rate generation program. Moreover, some blocks are moved to invalid set as a result of auditing.

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# Production Planning through Operation Management integrated with Work Place Layout, Inbound Supply Chain and Inventory Management System for the highest Productivity

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**Abstract**—Now days industries are to adapting new and more and more technologies and methodologies but by these approaches they are reaching at a limited percentage of productivity and efficiency. We are working for an emergence of Systematic process & integrating these major strategies for the better efficiency and the productivity. We are integrating planning of production through a system of Operation Management merging with subsystems of this process as Work Place Layout, Inbound Supply Chain and Inventory Management System for the better productivity. With work place Well-designed workplaces eliminate waste and help to optimize material, people, and information flow it can control & Create high-performance work spaces or manufacturing divisions involves much more than moving machines and people closer together. The job flows in arrangement with worth streams rather than according to purposeful teams or department. Inbound supply chain refers to the transport, storage and SCM of goods coming into a business to the manufacturing point by which we can eliminate and reduce the lead time of inventory. Inventory is one of its main resources and belongs to a speculation that is fixed up until the item is sold or used in the production of an item that is sold. It also costs money to store, track and insure inventory. Inventories which are mismanaged can create momentous economic problems for a industry, whether the unprofessional conduct results in an inventory glut or an inventory deficiency. To controlling this process, we are integrating Operations management is concerned with converting materials and labor into goods and services as efficiently as possible to maximize the profit of an business it also consists that the direction of business practices to create the highest level of effectiveness possible within an business.

**Keywords**— Production Planning, Operation Management, Inbound Supply Chain, Work Place Layout, Inventory Management, Supply Chain Management, Manufacturing.

## INTRODUCTION

This dissertation belongs to generate highest productivity which involves some well-designed sequenced planning process these are interconnected strategies to reach highest productivity. We are integrating three process together in sequenced planning procedure first we applied a proper base as operation management it will work like a platform for the other implementing technologies in which we are implementing work place layout planning/management/design which will need we will apply as per requirements for the highest productivity. In next we will implement the inbounds or you can say inner supply chain management system for the preventing shortage of the raw material and it will also help for the keep store smartly managed and it will maintain a minimum level of inventory for controlling the over inventory, short supply time of raw material and over inventory. In another next planning we are implementing the inventory management for the inventory wastage and decreasing inventory carrying cost. Inventory carrying cost can help to boost the financing conditions of the company it will help to achieve higher productivity. These methodologies will perform the planning under the platform of the operation management the function of operation management is in that dissertation is to only control the overall process which can effect on planning in Work place design/planning/management, Inbound interconnected supply chain management and inventory management.

After successfully implementation this methodology can achieve the highest productivity. Inventories that are mismanaged can create significant financial problems for a business, whether the mismanagement results in an inventory glut or an inventory shortage. To scheming this method, we are put together operation management is with materials and production into supplies and services as efficiently as possible to take advantage of the profit of an business it also consists that the administration of business practices to create the highest level of efficiency possible within an organization. These approaches they are reaching at a limited percentage of productivity and efficiency. We are working for an emergence of Systematic process & integrating these major strategies for the better



Figure 8-Functional Process

efficiency and the productivity. We are integrating planning of production through a system of Operation Management merging with subsystems of this process as Work Place Layout, Inbound Supply Chain and Inventory Management System for the better productivity. With work place Well-designed workplaces eliminate waste and help to optimize material, people, and information flow it can control & Create high-performance work spaces or manufacturing divisions involves much more than moving machines and people closer together. The work flows in arrangement with importance streams rather than according to efficient teams or departments. Inbound supply chain refers to the transport, storage and SCM of goods coming into a business to the manufacturing point by which we can eliminate and reduce the lead time of inventory.

Operations management is primarily concerned with preparation, uniting and supervising in the contexts of production, manufacturing or the SCM of services. As such, it is SCM-absorbed, ensuring that an society successfully turns inputs to outputs in an resourceful manner. The inputs themselves could represent everything from materials, apparatus and technology to human resources such as employees or labors.

Examples of the types of duties or profession allocations this involves are procurement (acquiring goods or services from external sources), handling relations with those involved in events, and educating a company's sustainability with esteem to its use of capitals.

Basically, getting everything 'just right' and receiving everything 'just right' is exactly what inventory management is all about. Good record management is all about having the right amount of product, at the right value, at the right time, and in the right place.

Right Amount- Stocking the right amount is truly important. If you order too little, your customers will start looking away when you're out-of-stock of popular items. But if you order too much, there's a chance you'll be fixed with lots of extra stock that you'll be forced to sell at clearance prices or risk contribution them become obsolete. In a poll by GetApp, defendants were asked how they total when to reorder... and a resounding 46% of them decided based on physical from previous months! If you're part of that 46%, you'd want to kind sure you've got the right data - which means looking for a solution that'll habitually track your record movements as much as possible. In fact, even if you're chose to use approximating software (15%) or formulas (13%), you're still going to need material from the preceding months. (If you're wondering about the remaining 26%, they selected "Other" - we're still betting physical from previous months' factor in somewhere though!)

Right Cost- You don't want to be paying more for your harvests than you have to, but lower prices aren't always better. Independents often potential price amount breaks - you just have to order 20% more stock to save 10% - and you may find by hand digging into your reserves to make this acquisitions.

But is that the best outstanding for your occupational? After all, buying stock is only the beginning. There's a whole host of categorical costs attached to your products. The more stock you have on pointer, the more you'll have to spend on storing facilities while snowballing your risk of having crops going out-of-date.

A good example of design absolutely affecting a company's employee charisma and retaining rates can be found in Clifford Chance's new Canary Wharf offices. while the world's major law firm stimulated its offices accessible of the urban area of London and into Canary Wharf in 2003, it desirable to find a way to convince current personnel to make the change with it.

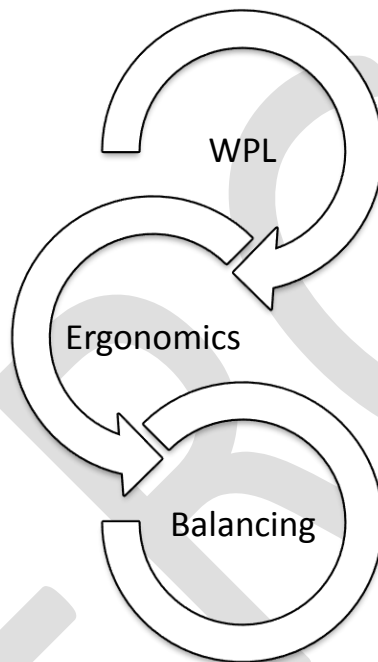


Figure 2- Work Place Layout Functions

Gensler treated Allen & Overy managers to a day on the London Eye helm in order to inspiration ideas for the law firm's new workplaces outside of the characteristic corporate setting. The new office's design merged a 24/7 coffee shop, a full refectory that also helped as a large conference room, a sky-lit spinning pool on the eighth ground with opinions of the docks, a full-time gym with coaches, a travel action, a bank and a coiffeuse, among other amenities. The client required to find and keep the best aptitude, and didn't want employees to worry about discovery time to deal with private matters and shops. The thinking was, "If you're going to give me 10 hours a day as a lawyer, then I'm going to give you all of this." The new office project providing a high-performance effort situation that services both staffs and clients.

## **LITERATURE REVIEW**

**Chris Vosssays** that in hispaper reviews the use of case study investigation in operations management for theory development and testing. It draws on the works on case research in a number of disciplines and uses examples drawn from operations organization research It provides guidelines and a roadmap for operations running researchers wishing to design, develop and conduct case-based research Case research has steadily been one of the most powerful research methods in operations administration, particularly in the development of new theory. This is particularly true in today's atmosphere.

**LEDA V. ROTH AND LARRY J. MENOR** wrote in their research paper offers visions concerning a research agenda for service operations management (SOM). First, we stimulate the need for a SOM agenda. The urgency for SOM research is driven by the needs

of the fast rising and evolving service sector of our national economy and the dearth of linked processes management research. Second, we offer a theoretical outline that paints a broad-based picture of key architectural elements in the SOM study landscape.

**Ibrahim H. Garbie** says that Ergonomics is anxious with making the workplace as efficient, safe and comfortable as possible. Effective request of ergonomics in work system design can achieve a balance between worker physiognomies and task demands. This can enhance operator productivity, provide worker safety and bodily and mental well-being and job satisfaction. Many research studies have shown optimistic effects of applying ergonomic values in workplace design, machine and tool design, environment and facilities design. there has to be a determination of how the info will be gathered.

**Uday Apte**, says that the facility sector represents the largest and the fastest growing segment of the economies of the United States and other industrialized countries. For example, in 2006, services accounted for roughly 83% of the total service in the United States. The sheer size and ongoing growth of the service sector and of service jobs, the lack of significant productivity development within services, and a late start in the research on the operational issues of services make service processes an important and fertile area of research.

**Dr. K. CHANDRASEKAR** involved in competitive business environment, organizations can no longer afford to waste the potential of their workforce. There are key factors in the employee's workplace environment that impact greatly on their level of motivation and performance.

### PROPOSED METHODOLOGY

In proposed methodology, we are applying this for the increasing manufacture with the help of three major tools

- Work Place Layout
- Inbound Supply Chain
- Inventory Management

On the platform of Operation Organization for control this tools activities. Operation Management is a very vast field but we are using it like a supervisory tool to these three above itemized tools.

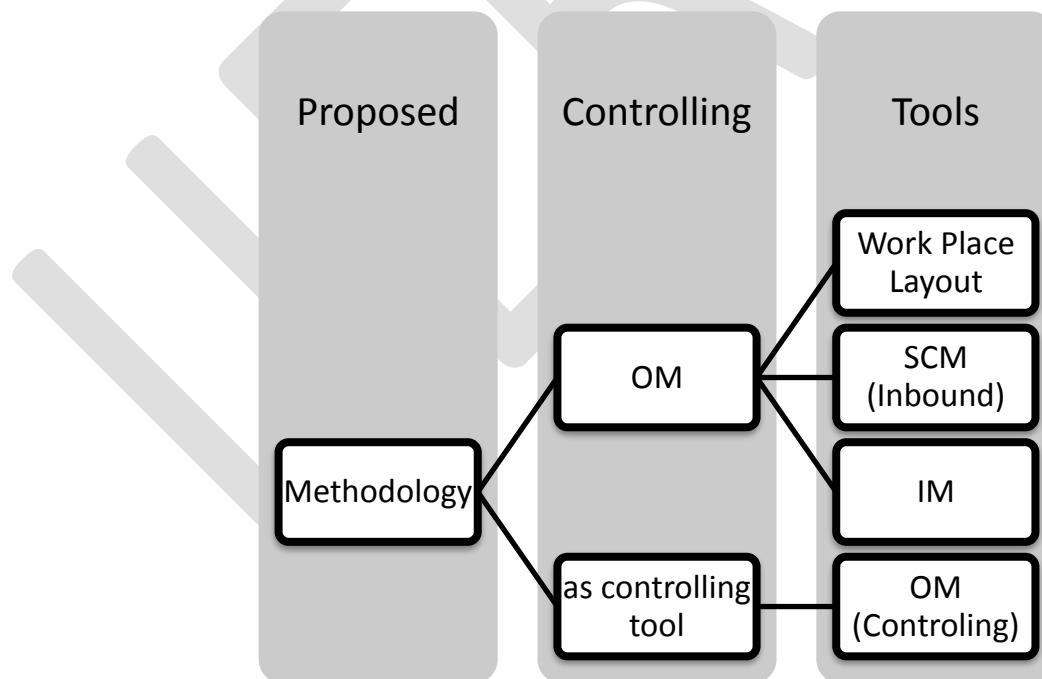


Figure 3- Proposed Methodology

As we are discussing we are taking a mechanism shop's shop floor if we follow Principle of Production Planning and Switch: "The highest efficiency in production is obtained by manufacturing the required amount of a product, of the required quality, at the required

time by the best and inexpensive method" - PPC is a tool to coordinate all manufacturing activities in a production organization. Production planning and control essentially consists of planning manufacture in an engineering organization before actual production activities start and training control doings to ensure that the planned production is realized in terms of amount, quality, SCM timetable and cost of production. Manufacture planning includes the organization of an overall manufacturing / functioning system to produce a product. The numerous activities involved in production preparation are designing the produce, determining the equipment and capacity requirement, scheming the layout of physical facilities and material and material handling system, decisive the sequence of processes and the nature of the operations to be performed along with time requirements and specifying certain production quantity and quality levels. Impartial of production planning is to provide a physical system together with a set of employed guidelines for efficient conversion of raw resources, humanoid skills and other inputs into finished products. Volume of Production:

### **Factors determining Production Preparation Procedures:**

The production planning used, varies from business to company. Production planning may begin with a product idea and a plan for the project of the product and the entire production/operating system to production the product. It also includes the task of planning for the industrial of a modified version of a current product using the existing facilities. The wide difference between preparation procedures in one company and another is primarily due the differences in the financial and technical condition under which the firms operate. The three major factors decisive production-planning procedures are:

The amount and intensity of production preparation is determined by, the volume and character of the operation and the nature of the industrial processes. Production planning is expected to reduce industrial costs. The planning of manufacture in case of custom order job shop is limited to preparation for gaining of raw materials and components and willpower of works centers, which have the volume of industrial the product.

### **Nature of Production Processes:**

In job shop, the production groundwork may be informal and the growth of work methods is left to the individual workman who is highly talented. In high volume production, many products contrive are complicated and they put huge amount of effort in designing the product and the commerce processes

### **Scope of machine shop production planning**

Production Planning and Control encompasses following areas:

- **Materials:** Planning for obtaining of raw materials, components, and spare parts in the right quantities and stipulations at the right time from the right source at the right price. Purchasing, storage, inventory control, calibration, variety reduction, value analysis, and review are the other activities related with material.
- **Methods:** Choosing the best method of dispensation form several alternatives. It also including determining the best classification of operations (process plans) and preparation for tooling, jigs and fixtures etc.
- **Machines and equipment's:** Industrial methods are related to production facilities available in the manufacture systems. It includes facilities planning, capacity planning, allocation, and use of plant and equipment's, machines etc.
- **Manpower:** Preparation for manpower (labor and managerial levels) having appropriate skills and knowhow.
- **Routing:** Decisive the flow of work material handling in the plant, and sequence of operations or processing steps. This is connected to consideration of appropriate shop layout and plant layout, temporary storage sites for raw materials, components and semi-finished goods, and of materials treatment systems.

### Advantages of Proposed Methodology

- **Improving Quality**  
How several times has a manager brainstormed ways to growth the frequency with which personnel perform quality control drafts? New floor layouts are the perfect chance to reduce the footsteps/effort mandatory to QC products while care key personnel at or close their primary workplaces.
- **Operator Efficiency**  
Reviewing machine-manning supplies by looking at the current mix also can be factored hooked on new floor layouts. That does small runs may advantage from having an operator that can change over and over to the next job. A shop that does very extended runs, or has been clever to schedule parallel size work to lines, can bring prime operator work positions to within a few steps of each other to decrease redundant people.
- **Planning for Expansion**  
Planning for future machine developments and elevations can pay massive dividends when the time is taken to factor in floor planetary.
- **Less travel time of Material Layout Concepts**  
In each layout, it must be strong-minded where the incomplete product arrives the and wherever finished goods leave. Machine arrangement comes next. Typically, the highest layout chance/variable is the conveyor transfer among the equipment, so careful consideration should be given to this capital expense.

### RESULT

- **Workplace Layout**  
As we develop the new shop floor plan can lead to less travel time of material it simply means that you can deliver material in very short time. So, it is clear that material will take less time to travel inn shop floor so performance rating will increase.
- **Inbound Supply Chain**  
The Inbound SCM Information Source facilitates the collection of inbound SCM data for analysis purposes. In a mixed system landscape, inbound distributions may be processed in different systems. However, you want to use the inbound SCM data from all systems for analysis purposes. To do this, you can set up a dominant system with the changed or canceled inbound SCM data (an information view of inbound distributions). As a next step, the information view of inbound deliveries can be used as the input for tools in the back-end system that monitor inbound deliveries or measure the performance of suppliers, for example. Previously there is no inbound scm info system was there. Implementation can be increase 20-30 percentage.
- **Inventory Management**  
Inventory management is a discipline mainly about stipulating the form and location of stocked goods. It is mandatory at different locations within a facility or within many locations of a supply network to precede the regular and planned course of production and stock of materials. Previously there were two inventory locations. Implementation one on the middle of the shop floor as per design. It can reduce assembly time and shorter assembly time lead to better and on time dispatch based on customer requirements, by delivering systems which move through each clearly defined phase, within scheduled time frames and cost estimates.

### ACKNOWLEDGMENT

In performing our dissertation, we had to take the help and instruction of some esteemed persons, who deserve our supreme gratitude. The finishing point of this assignment gives us much Pleasure. We would like to show our gratitude, Mr. Rajneesh Rai. & Mr. Y.P. ladhe.

### CONCLUSION

In sum, the available research determines that openings can have both direct and indirect belongings on worker's strength and well-being. Product will travel less and dispatch will be possible before delivery date. There is collecting evidence that the appearances of the physical work location can function as a coping reserve and provide many opportunities for renovation. Workplace design is a

much-referenced catchword when it comes to following and civilizing employee efficiency. If your business has an chance to renovate you may find physically considering new layout choices. Without a doubt, logistics and inbound supply chain management will endure to grow in standing as companies continue to pursue subcontracting, expand their international processes, and do business in a worldwide economic environment. It is one of the most significant aspects of any professional. The characteristic of this part of the professional is whether or not you can content the mandate of your clients if you aren't sure if you take all the materials accessible to make the final invention.

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# HEAT TRANSFER AND FLUID FLOW ANALYSIS OF CIRCULAR RECEIVER TUBE OF SOLAR COLLECTOR

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**Abstract:** Solar Energy is radiant light and heat from the Sun, It is an important source of renewable energy that is available in abundant and can be converted to other form of energy by latest technology. Effective utilization of solar energy is one of the challenges faced globally. One of such problem is address in this thesis. Effective Utilization of solar energy for heating water using solar heat is addressed. Efficiency of Solar heater can be addressed if we research on Operating conditions (isolation, tracking mode, operating temperature, flow rate, etc.), Properties of material. , Receiver design parameter, Concentrator geometry. In this thesis we have taken Receiver design parameters as a parameter to improve the efficiency of solar heater. Bother experimental and CDF analysis is carried and compare for Circular Shape receiver.

**Key Words-** Solar Heater, Solar Heater Receiver, Circular Section Receiver, CFD Analysis, Fluid Flow.

## 1. INTRODUCTION

Globally organizations are working towards generation of clean, safe, low cost, pollution free Energy. Solar energy is one among that is available is freely and in abundant quantity. It is inexhaustible source of energy. Solar energy has been identified as one of promising alternative energy source from the future. Solar energy can be harnessed using a range of ever –evolving technologies such as solar water heater, photovoltaic conversion, biomass, Solar Cell etc. Now it is also important how efficiently we can convert solar energy in usable form of energy. In this thesis we will be exploring the ways to optimize the efficiency of solar heater by optimizing the design of Receiver Tube. Many designs have been considered for concentrating collectors. Parabolic trough Collector (PTC) is receiving attention wide range of applications in domestic as well as industrial process of heat generation. A parabolic collector includes the receiver tube, concentrator and power transmission collector structure. The Receiver is the element of system where solar radiation is absorbed and converted to thermal energy. The performance of any solar energy system improves if the receiver efficiency is increased, all other variable being constant. The performance of the receiver should be maximized independent of the rest of the system if such steps does not significantly increase the receiver cost.

## 2. Scope of Work

CFD analysis of receiver tube for different geometries with and without insert to analyze heat transfer and flow characteristic

Comparing experimental and CFD result of the receiver tubes.

## 3. Experimental Setup

- Metal frame of length 1200mm and height 750mm with M6 nut-bolt.
- Inlet pipe is assembled with the help of elbow on frame.
- Rotameter fixed with inlet pipe.
- Outlet pipe is assembled with the help of elbow and T-junction pipe on frame.
- Flanges are fixed with the washer to connect the receiver pipe.
- Inlet and outlet valve for thermocouple are assembled at inlet and outlet respectively.
- Flow control valves are fixed with pipe at inlet and outlet respectively
- Heaters are assembled on the receiver pipe; heater-1 to heater-9 respectively.
- Jack connector on receiver pipe to connect heater to demonstrator.
- Water storage tank of 750 litres.



Figure 1: Experimental Setup

#### Receiver Dimension

Length: 1m

Diameter: 0.025 m

#### Steps

- Start the pump and fluid is allowed to flow for few minutes.
- Switch on the demonstrator and set resistance as per requirement with the help of dimmer stat. Heater will start automatically.
- The flow rate of fluid through the test section is set at desired value and changed through flow control valve.
- Outlet is sent to the drainage directly.
- The variations in wall temperature at all 9 locations are observed until constant then outlet bulk temperature of fluid is monitored.
- At steady state condition, all thermocouple readings are recorded.
- The electrical power is kept constant for change of fluid flow rate.
- Repeat the same process with and without insert for different pipe shapes.
- Calculate Reynolds no, heat discharge, Nusselt no, Efficiency and friction factor from the data.
- The different data is recorded in similar way for each experimental run at the steady state conditions.

#### Calculation

	Flow Rate (LPM)	Q (J/sec)	Efficiency %	$h(w/m^2C)$	Nu	V(m/s)	Re	Friction Factor
Circular Pipe without Insert	2	200.73	77.5	313.59	13.06	0.068	2122.35	$9.94 \times 10^{-3}$
	4	193.37	74.92	325.83	13.57	0.1346	4203.92	$8.67 \times 10^{-3}$
	6	191.95	74.48	356	14.83	0.204	6367.04	$7.97 \times 10^{-3}$
	8	187.6	74.45	361.2	15.05	0.2714	8470.66	$7.53 \times 10^{-3}$

	10	184.8 4	72.12	403.88	16.28 2	0.338	10549 .3	$7.2 \times 10^{-3}$
Circular Pipe with Insert	2	204.7 5	78.48	325	13.54	0.048 4	1510. 79	0.01059
	4	201.9	77.74	353	14.70 8	0.095 65	2985. 39	$9.28 \times 10^{-3}$
	6	191.9 5	74.13	389.6	16.23	0.144	4494. 38	$8.55 \times 10^{-3}$
	8	185	71.7	403.57	16.8	0.192 7	6014. 35	$8.07 \times 10^{-3}$
	10	175	69.73	437.93	18.2	0.24	7490. 64	$7.72 \times 10^{-3}$

Table 1: Experimental Value and Calculation

#### 4. CFD Analysis

Numerical analysis using CFD is carried out with plain absorber tube as well as tube with inserts for all circular geometric shapes using same flow parameter derived from experimentation.

The fluid flow simulation is accomplished using commercial CFD software Fluent R.17.0

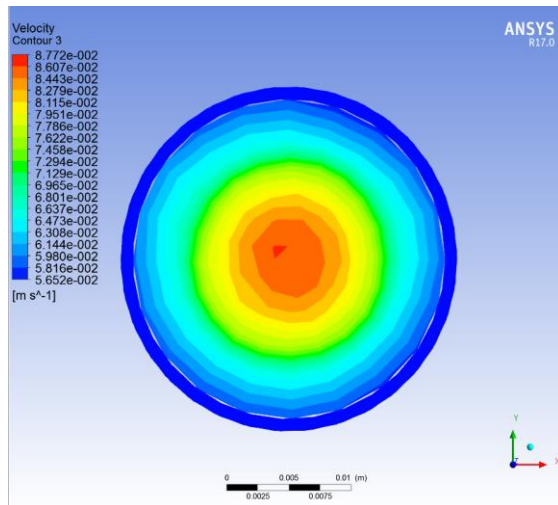
Meshing of the model of absorber tube is done using pre-processor ICEM CFD meshing tool.

Some assumptions were made for CFD analysis which are:

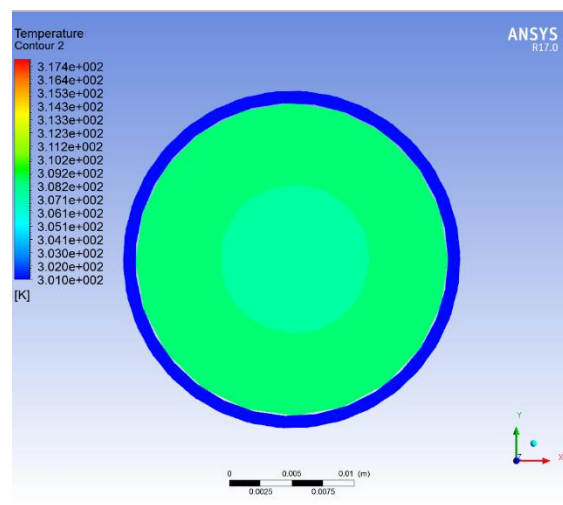
- Steady state heat transfer is considered so that the heat flux at the wall does not change.
- The contact thermal resistance between the wall and the fluid is not considered.
- Thermal conductivity of the absorber tube material is uniform and constant.
- The radiation heat transfer from the absorber tube is neglected.

#### 5. RESULT AND DISCUSSION

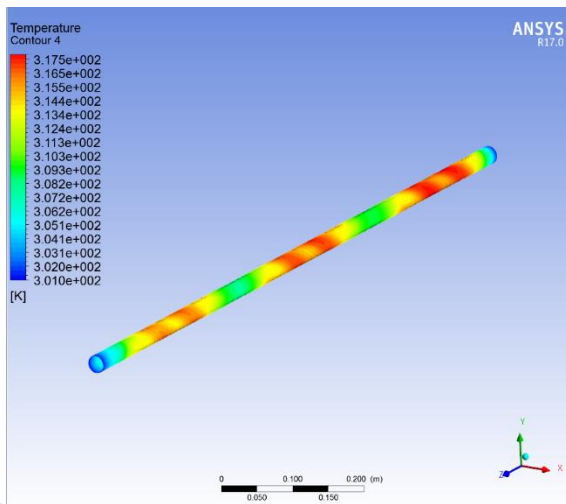
##### CFD Analysis for Circular (Pipe) Receiver without Insert



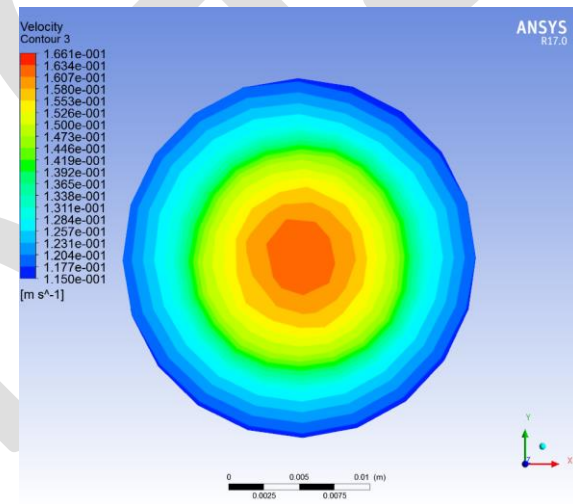
**Figure 2: Velocity Contour for 2 LPM**



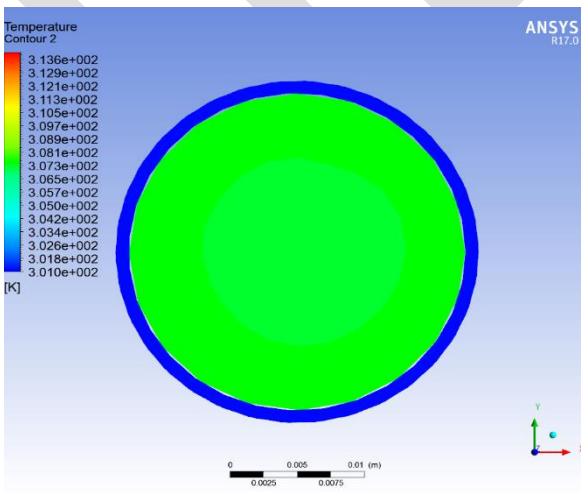
**Figure 3: Fluid Temperature at 2 LPM**



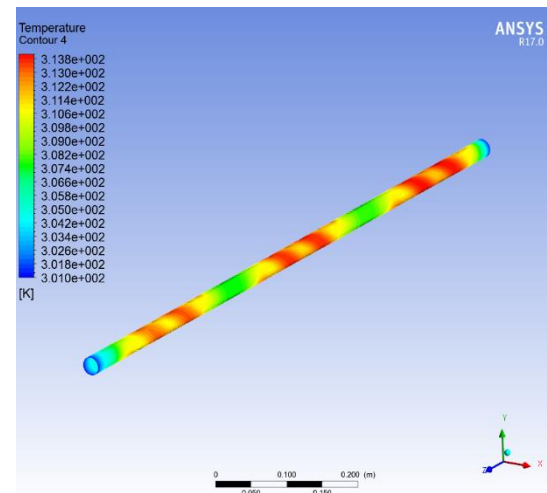
**Figure 4: Surface Temperature at 2 LPM**



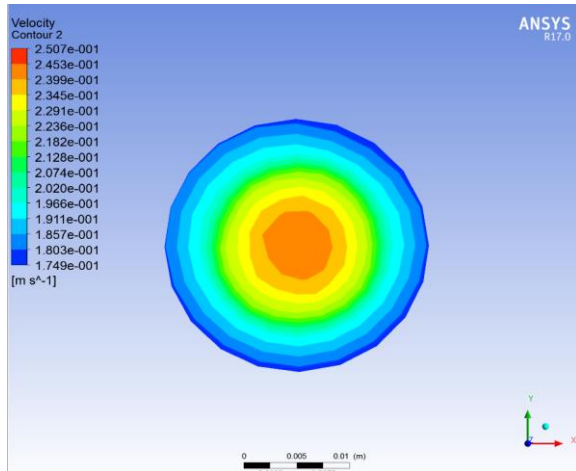
**Figure 5: Velocity Contour for 4 LPM**



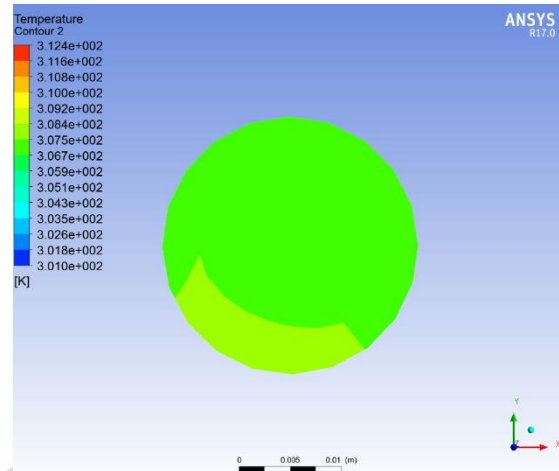
**Figure 6: Fluid Temperature at 4 LPM**



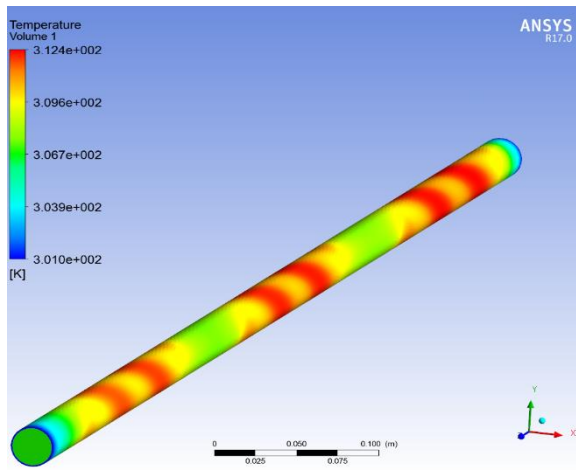
**Figure 7: Surface Temperature at 4 LPM**



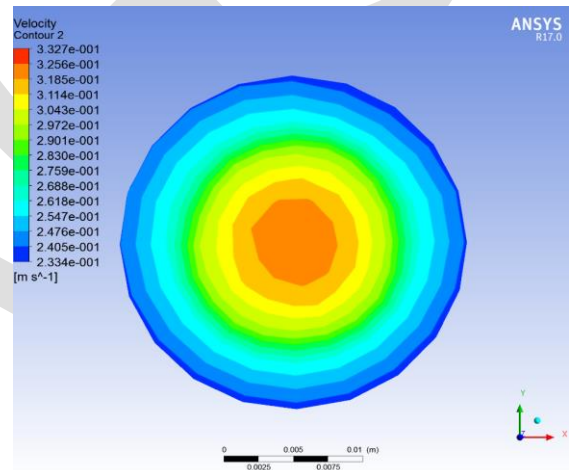
**Figure 8:** Velocity Contour for 6 LPM



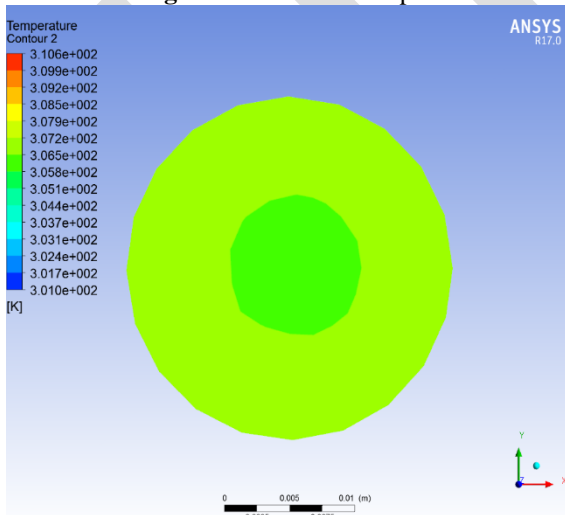
**Figure 9:** Fluid Temperature at 6 LPM



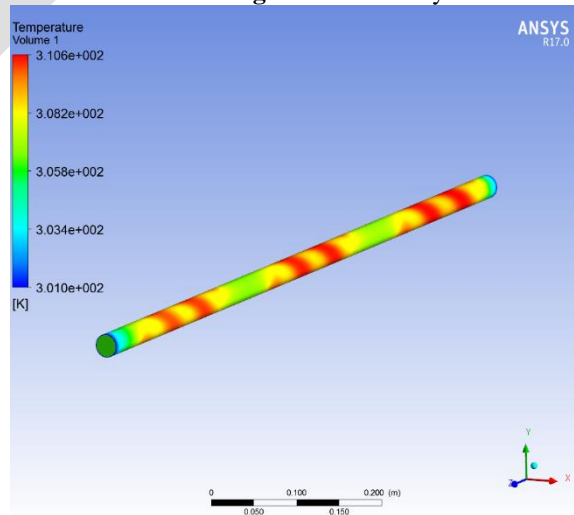
**Figure 10:** Surface Temperature at 6 LPM



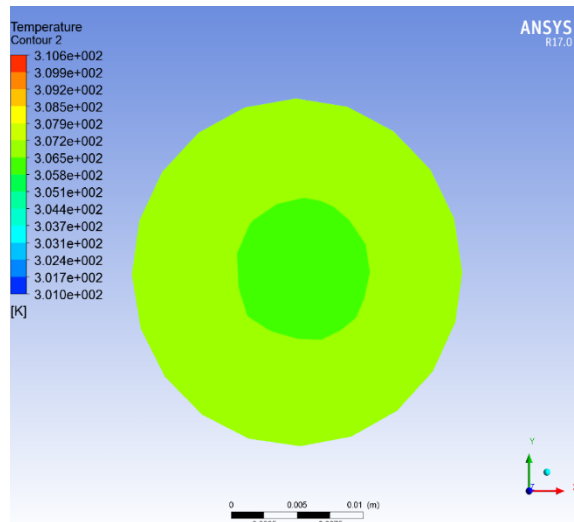
**Figure 11:** Velocity Contour for 8 LPM



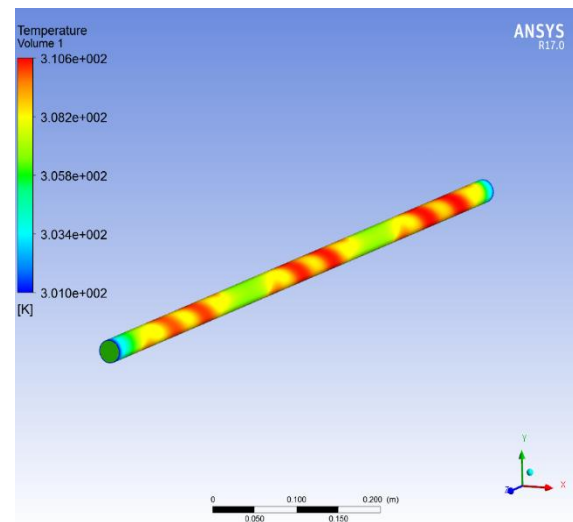
**Figure 12:** Fluid Temperature at 8 LPM



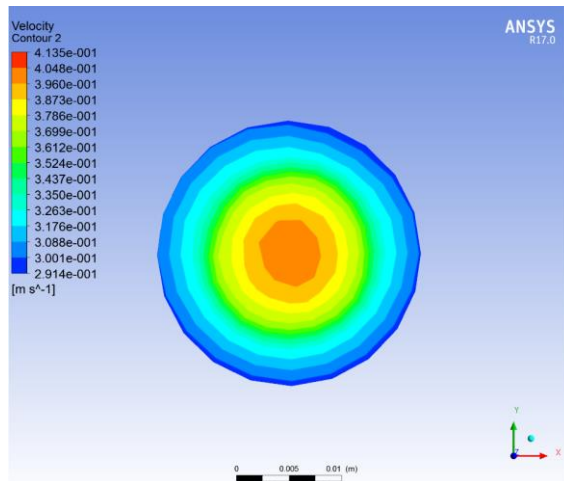
**Figure 13:** Surface Temperature at 8 LPM



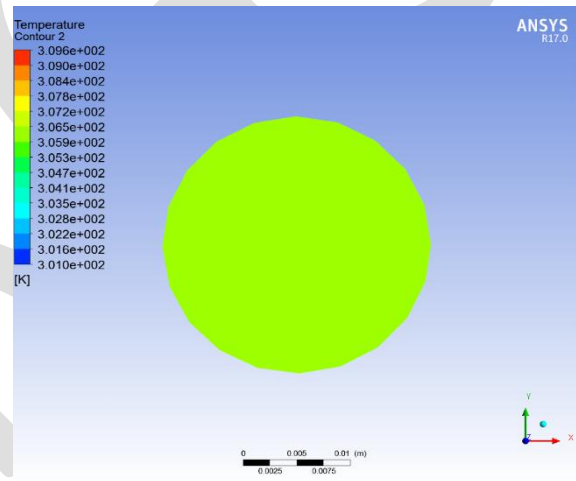
**Figure 14:** Fluid Temperature at 8 LPM



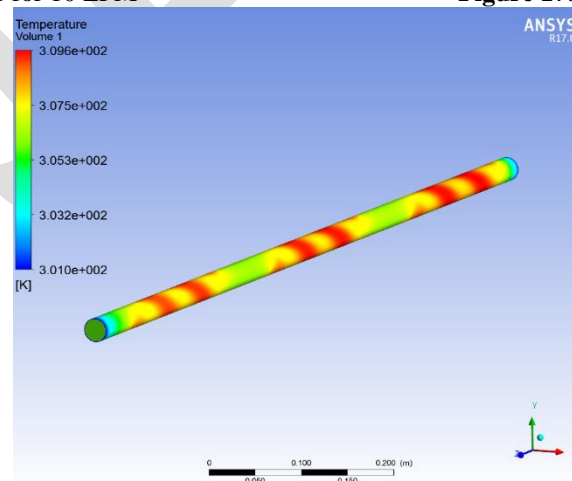
**Figure 15:** Surface Temperature at 8 LPM



**Figure 16:** Velocity Contour for 10 LPM



**Figure 17:** Fluid Temperature at 10 LPM



**Figure 18** Surface Temperatures at 10 LPM

## CFD Analysis for Circular (Pipe) Receiver with Insert

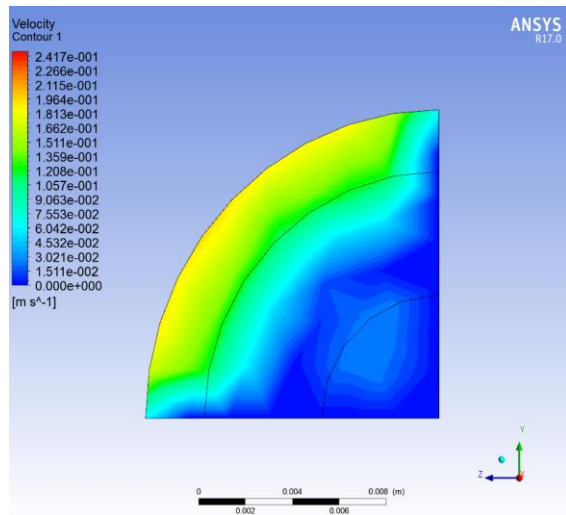


Figure 19: Velocity Contour for 2LPM

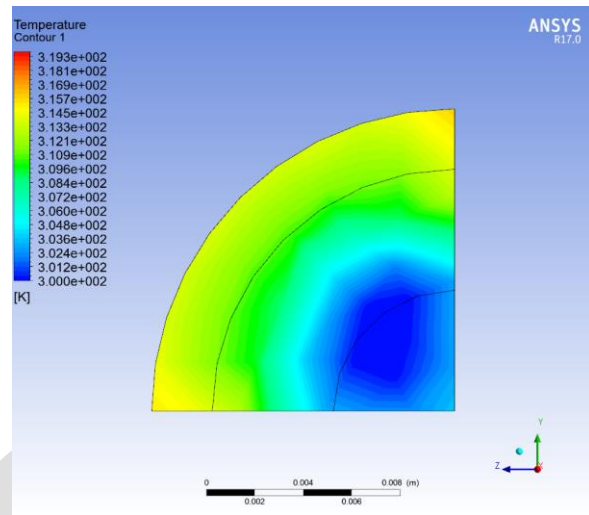


Figure 20: Fluid Temperature at 2 LPM

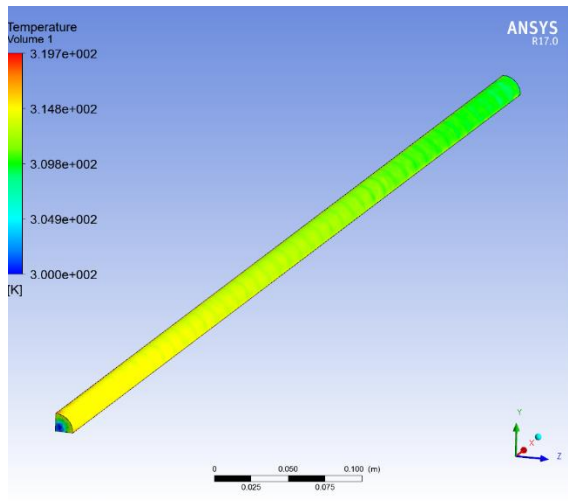


Figure 21: Surface Temperature at 2 LPM

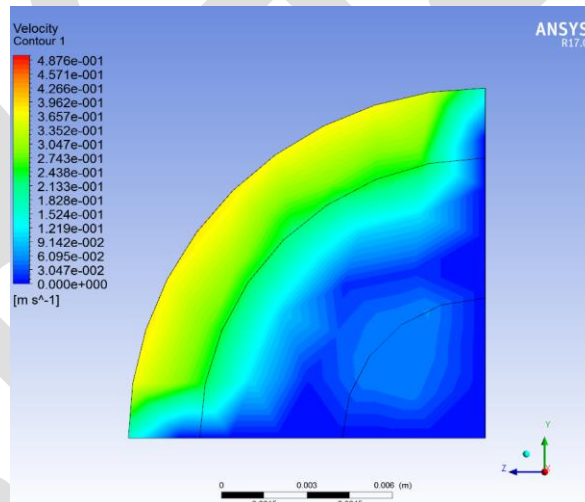


Figure 22: Velocity Contour for 4 LPM

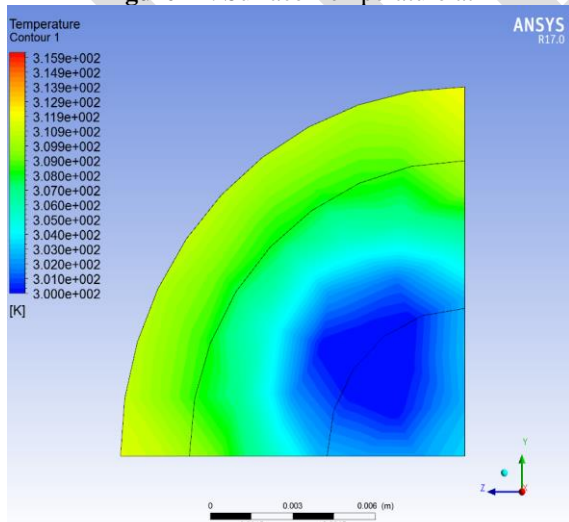


Figure 23: Fluid Temperature at 4 LPM

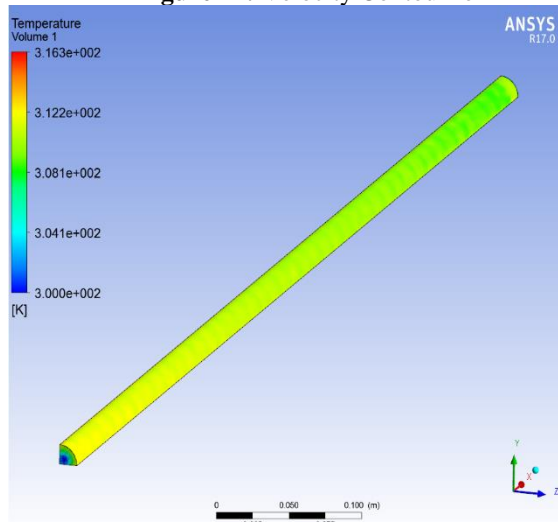
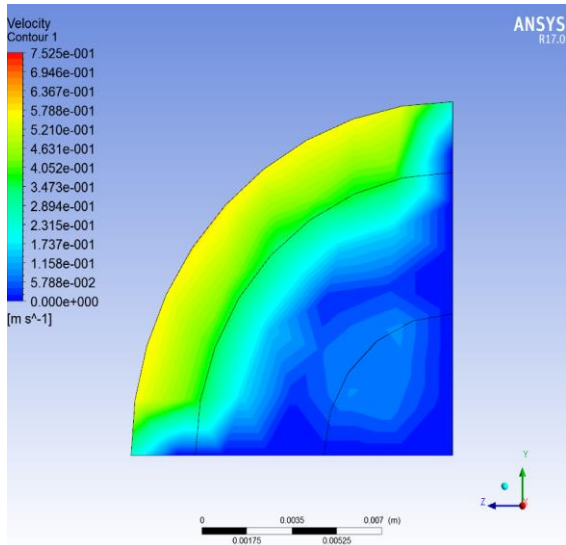
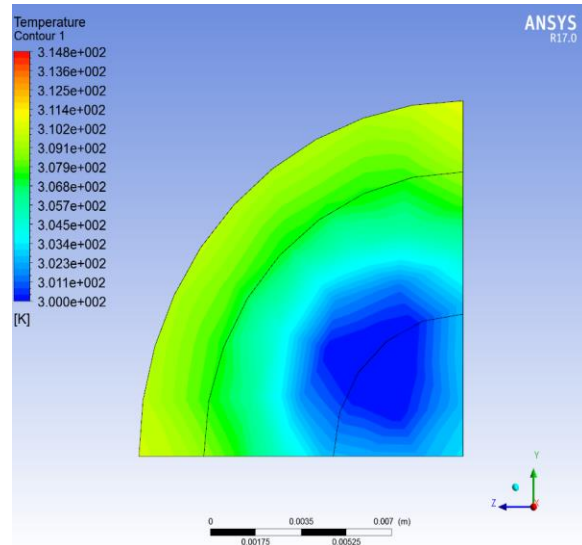


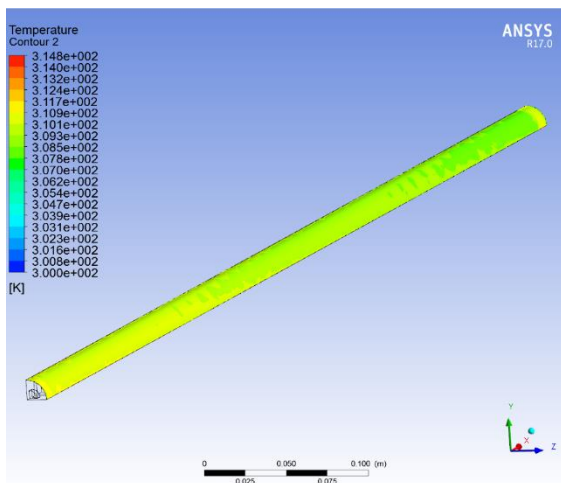
Figure 24: Surface Temperature at 4 LPM



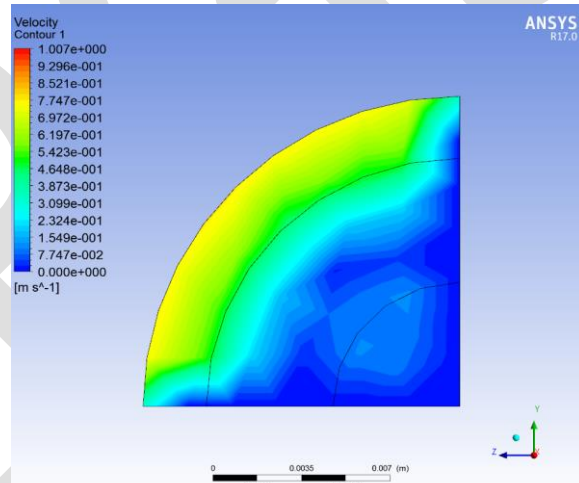
**Figure 25: Velocity Contour for 6 LPM**



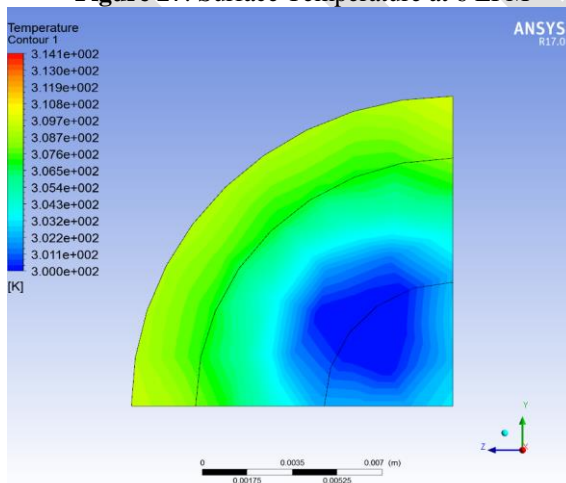
**Figure 26: Fluid Temperature at 6 LPM**



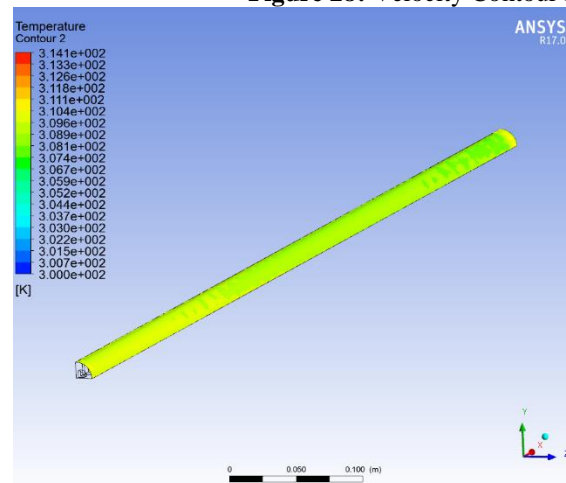
**Figure 27: Surface Temperature at 6 LPM**



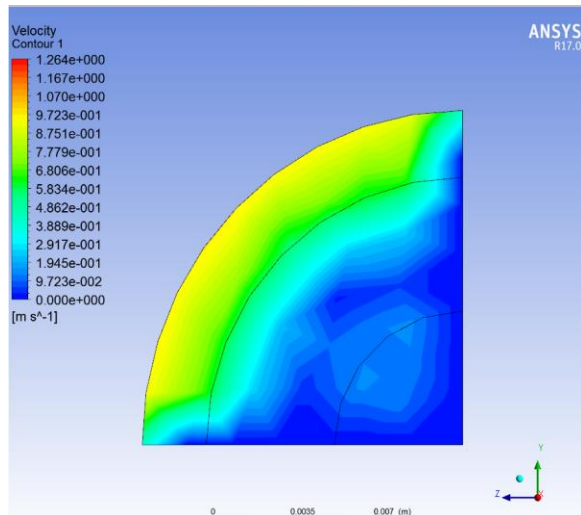
**Figure 28: Velocity Contour for 8 LPM**



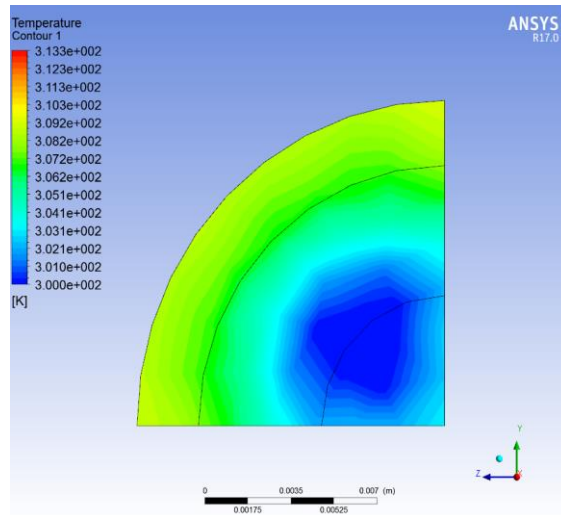
**Figure 29: Fluid Temperature at 8 LPM**



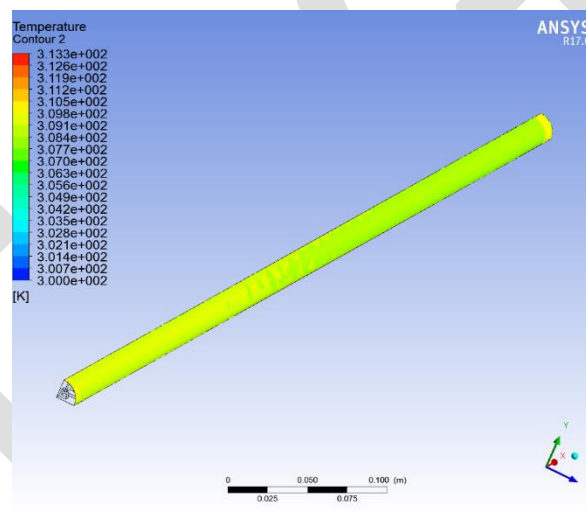
**Figure 30: Surface Temperature at 8 LPM**



**Figure 31: Velocity Contour for 10 LPM**



**Figure 32: Fluid Temperature at 10 LPM**



**Figure 33: Surface Temperature at 10 LPM**

**From CFD Analysis of Circular Pipe (Receiver) without Insert**  
(Value are round off to 2 decimal places)

Flow Rate		Velocity (m/s)	Surface Temp	Fluid Temp
2 LPM	Min	$5.65 \times 10^{-2}$	$3.01 \times 10^2$	$3.01 \times 10^2$
	Max	$8.77 \times 10^{-2}$	$3.17 \times 10^2$	$3.17 \times 10^2$
4 LPM	Min	$1.15 \times 10^{-1}$	$3.01 \times 10^2$	$3.01 \times 10^2$
	Max	$1.66 \times 10^{-1}$	$3.14 \times 10^2$	$3.14 \times 10^2$
6 LPM	Min	$1.75 \times 10^{-1}$	$3.01 \times 10^2$	$3.01 \times 10^2$
	Max	$2.51 \times 10^{-1}$	$3.12 \times 10^2$	$3.12 \times 10^2$
8 LPM	Min	$2.33 \times 10^{-1}$	$3.01 \times 10^2$	$3.01 \times 10^2$
	Max	$3.33 \times 10^{-1}$	$3.11 \times 10^2$	$3.11 \times 10^2$
10 LPM	Min	$2.91 \times 10^{-1}$	$3.01 \times 10^2$	$3.01 \times 10^2$
	Max	$4.14 \times 10^{-1}$	$3.10 \times 10^2$	$3.10 \times 10^2$

**From CFD Analysis of Circular Pipe (Receiver) with Insert**

Flow Rate		Velocity (m/s)	Surface Temp	Fluid Temp
2 LPM	Min	$1.511 \times 10^{-2}$	$3.00 \times 10^2$	$3.00 \times 10^2$
	Max	$2.42 \times 10^{-1}$	$3.20 \times 10^2$	$3.19 \times 10^2$
4 LPM	Min	$3.05 \times 10^{-2}$	$3.00 \times 10^2$	$3.00 \times 10^2$
	Max	$4.88 \times 10^{-1}$	$3.16 \times 10^2$	$3.16 \times 10^2$
6 LPM	Min	$5.79 \times 10^{-2}$	$3.00 \times 10^2$	$3.00 \times 10^2$
	Max	$7.53 \times 10^{-1}$	$3.15 \times 10^2$	$3.15 \times 10^2$
8 LPM	Min	$7.75 \times 10^{-2}$	$3.00 \times 10^2$	$3.00 \times 10^2$
	Max	$1.01 \times 10^0$	$3.14 \times 10^2$	$3.14 \times 10^2$
10 LPM	Min	$9.72 \times 10^{-1}$	$3.00 \times 10^2$	$3.00 \times 10^2$
	Max	$1.26 \times 10^0$	$3.13 \times 10^2$	$3.13 \times 10^2$

## 5. ACKNOWLEDGMENT

I express my sincere thanks to Prof. M.A.Kadam for his kind cooperation for presenting this paper. I additionally extend my genuine on account of every single other individual from the workforce of mechanical building division and my companions for their co-operation and consolation

## 6. Conclusion

The 2-D numerical analysis is able to predict the fluid flow and heat transfer characteristics for plain absorber tube and with inserts for circular geometric shapes.

At 2 LPM for all the pipes plain as well as with inserts temperature difference between outlet and inlet fluid temperature is maximum

The results of CFD analysis are compared with experimental results and found deviation less than 7%, thus validating present CFD analysis.

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IJERGS

# DESIGN AND FABRICATION OF LOW COST COCONUT DEHUSKING MACHINE

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**Abstract**— This paper presents the design and fabrication activities involved in developing an automated coconut de-husking machine. The main purpose of this machine is to eliminate the skilled operator involved in de-husking the coconut and to completely automate the dehussing and crown removing process. Although coconut dehussing machines have already been demonstrated in the work and also in some small-scale industries, the process is either manual or semi-automatic. A completely automated machine with manual loading and unloading of coconuts will yield productivity higher than the existing process. Because of that, the current work is mainly focused on an automated machine for dehussing and crown removing. Also, we can yield lot of useful and commercial products from coconut at various stages of its lifecycle. The machine aims at de-husking and removing the crown of the de-husked coconut of various sizes. In order to get to know about the different sizes of the coconut, various places are visited where exuberant yielding of coconuts are made. Also, dimensional data of coconuts have been collected. Based on the survey the maximum and minimum sizes of the coconut are determined. The machine is designed to accommodate different sizes of the coconut that are cultivated anywhere in the world. Also, various experiments have been conducted on both dry and mature coconuts in order to determine the force required to de-husk the coconut.

**Keywords**— Coconut de-husking, Crown, Automation, Manual loading, Semi-automatic, Skilled operator, Commercial product, Productivity.

## INTRODUCTION

Farm mechanization increases the effective utilization of machines to increase the productivity of land and labour. Besides it helps in reducing the drudgery, time and cost of cultivation in farm operations. In farm mechanization, the operations are divided into three i) Pre-harvesting operation ii) Harvesting operation iii) Post-harvesting operation. Coconut (*cocosnucifera*) is one of the world's most useful and important perennial plants. The coconut fruit is made up of an outer exocarp, a thick fibrous fruit coat known as husk; underneath is the hard-protective endocarp or shell.

The coconut palm is widely cultivated in the tropics. India is the world's third largest producer of coconuts after the Philippines and Indonesia. Other producers are Thailand, Malaysia, Papua New Guinea and the Pacific Islands. With coconut plantations extending over more than a million hectares, India produces about 5500 million nuts a year. Copra produced in the country is about 0.35 million tons and India accounts for about 50% of the world trade in coir. Coconut plantations are mostly concentrated in the coastal and deltaic regions of south India. In India, the crop is produced mainly by small and marginal farmers who number about 5 million. The average size of holding is as small as 0.25 hectares. With agricultural labour problems worsening and water resources dwindling, more and more plantation acreage is being converted from arca to coconut since the latter is easier to grow and more remunerative

Almost all the parts of coconut are useful. The meat of immature coconut fruit can be made into ice cream while that of a mature coconut fruit can be eaten fresh or used for making shredded coconut and livestock feed. Coconut milk is a refreshing and nutritious drink while its oil is use for cooking and making margarine. Coconut oil is also very important in soap production. The shell is used for fuel purpose, shell gasifier as an alternate source of heat energy. The husk yields fibres used in the manufacture of coir products such as coir carpets, coir geo-textile, coir composite, coir safety belts, coir boards, coir asbestos and coir pith. Coir is a versatile natural fibre extracted from mesocarp tissue, or husk of the coconut fruit. Generally, fibre is of golden colour when cleaned after removing from coconut husk. Coir is the fibrous husk of the coconut shell. Being tough and naturally resistant to seawater, the coir protects the fruit enough to survive months floating on ocean currents to be washed up on a sandy shore where it may sprout and grow into a tree, if it has enough fresh water, because all the other nutrients it needs have been carried along with the seed.

## 1.1 Physical properties of coconut

Coconuts are of different shapes and sizes<sup>[7]</sup> not all are the same. so that we can analyze the average of a coconut shape and size.

Table No. 1 Physical properties of coconut

Particulars	Dry coconut
Shape	Ovoid
Length, (mm)	210-270
Diameter, (mm)	160-206
Weight, (kg)	0.62-1.25
Shell Diameter, (mm)	80-120
Husk Thickness-at pedicel end, (mm)	62
Husk Thickness-at apex end, (mm)	34
Husk Thickness-1/4 distance from pedicel end, (mm)	32
Husk Thickness-1/2 distance from pedicel end, (mm)	24
Husk Thickness-3/4 distance from pedicel end, (mm)	28

## 2. Design and working

The experimental setup of our project consists of a frame on which the entire components are mounted. The dehusker is present at the Centre which is delivered motion with the help of a motor and the chain drive. Also at the top of the dehusker, a plate is mounted which helps to prevent the slipping of the coconut fibres while the dehusking operation.

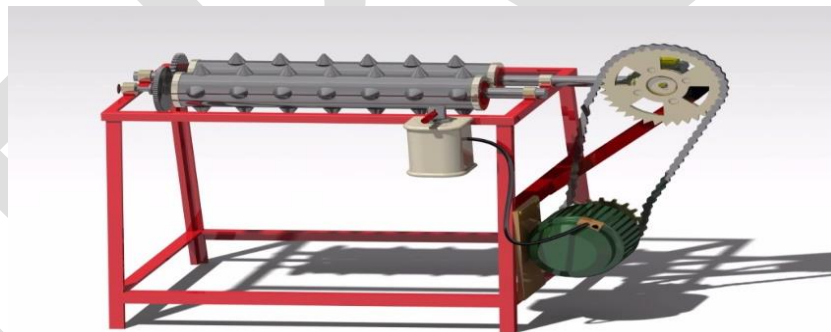


Figure No.1: CAD Model

Placing the coconut on the rollers which having spikes, the rollers are connected with shaft which is rottated by an electric motor. Thus the husk can peel of due to the opposing motion of rotating rollers. We can peel any coconut which is having dimension as mensioned earlier.

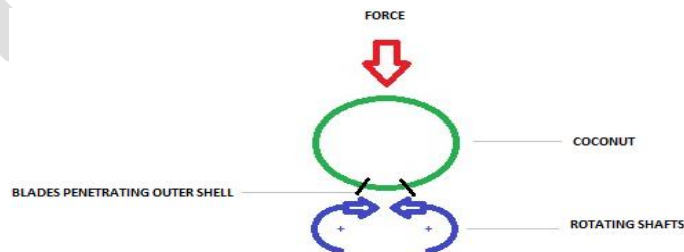


Figure No.2: Principle Of Working

### 3. Components and Description

- [1] Hollow Shafts with Spines
- [2] Worm and worm wheel
- [3] Cutting Pins
- [4] Spur Gear
- [5] Bearing with Bearing Cap
- [6] Chain Drive
- [7] Electric Motor

#### 3.1 Hollow Shafts with Spines

The dimensions of cylinders are designed in a manner to obtain effective mesh with coconut husk. Assumptions used,

1. Coconut contacts with cylinder at an average angle of 30-degree contact sector .
2. The 1/6th of width of coconut should be inserted into the intermediate space between cylinders. (Approximately 30mm).



Figure No.3: Roller with Spines

#### 3.2 Worm and worm wheel

A worm drive is a gear in which a worm meshes with a worm gear. The two elements are also called the worm screw and worm wheel. <sup>[1-3]</sup>The terminology is often confused by imprecise use of the term worm gear to refer to the worm, the worm gear, or the worm drive as a unit. Like other gear arrangements, a worm drive can reduce rotational or transmit higher torque. The image shows a section of a gear box with a worm gear driven by a worm. A worm is an example of a screw, one of the six simple machines.

<sup>[12]</sup>A gearbox designed using a worm and worm-wheel is considerably smaller than one made from plain spur gears, and has its drive axes at 90° to each other. With a single start worm, for each 360° turn of the worm, the worm-gear advances only one tooth of the gear. Therefore, regardless of the worm's size (sensible engineering limits not withstanding), Given a single start worm, a 20-tooth worm gear reduces the speed by the ratio of 20:1. With spur gears, a gear of 12 teeth must match with a 240-tooth gear to achieve the same 20:1 ratio Therefore, if the diametrical pitch (DP) of each gear is the same, then, in terms of the physical size of the 240-tooth gear to that of the 20-tooth gear, the worm arrangement is considerably smaller in volume.

#### 3.3 Cutting Spines

The adhesion between fibers in the husk is greater than that between the shell and the husk; hence separation occurs at the husk-shell interface. The thickness of fiber is in the range of 20 to 40mm. <sup>[4]</sup> The dimension of tynes should be so selected that to get effective penetration with coconut. The tynes can be attached to cylindrical rollers either by welding or by using fasteners. The advantage of using fasteners is that the damaged tynes can be easily replaced.



Figure No.4: Spine

### 3.4 Spur Gear

Gears are commonly used to transmit rotational motion between machinery shafts. The spur gears, which are designed to transmit motion and power between parallel shafts, are the most economical gears in the power transmission industry. <sup>[10-12]</sup> The internal gears are spur gears turned "inside out". In other words, the teeth are cut into the inside diameter while the outside diameter is kept smooth. This design allows for the driving pinion to rotate internal to the gear, which, in turn, allows for clean operation. Intended for light duty applications, these gears are available only in brass. When choosing a mating spur gear, always remember that the difference in the number of teeth between the internal gear and pinion should not be less than 15 or 12.

Perhaps the most often used and simplest gear system, external spur gears are cylindrical gears with straight teeth parallel to the axis. They are used to transmit rotary motion between parallel shafts and the shafts rotate in opposite directions. They tend to be noisy at high speed as the two gear surfaces come into contact at once. Internal spur gears: The internal spur gear works similarly to the external spur gears except that the pinion is inside the spur gear. They are used to transmit rotary motion between parallel shafts but the shafts rotate in the same direction with this arrangement.

### 3.5 Bearing with Bearing Cap

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other. Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

The bearings are pressed smoothly to fit into the shafts because if hammered the bearing may develop cracks. Bearing is made up of steel material and bearing cap is mild steel. Ball and roller bearings are used widely in instruments and machines in order to minimize friction and power loss.

### 3.6 Chain Drive

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. <sup>[7-8]</sup> It is also used in a wide variety of machines besides vehicles. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations, a second gear is placed and the power is recovered by attaching shafts or hubs to this gear.

Though drive chains are often simple oval loops, they can also go around corners by placing more than two gears along the chain; gears that do not put power into the system or transmit it out are generally known as idler-wheels. By varying the diameter of the input and output gears with respect to each other, the gear ratio can be altered. For example, when the bicycle pedals' gear rotates once, it causes the gear that drives the wheels to rotate more than one revolution.

### 3.7 Electric Motor

It is found to drive the roller shaft which fixed on the end of the frame structure. <sup>[8-9]</sup> The free end of the shaft in the motor a large pulley is found around which the belt runs. Single phase induction motors require just one power phase for their operation. They are commonly used in low power rating applications, in domestic as well as industrial use.

An induction motor is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. An induction motor can therefore be made without electrical connections to the rotor. An induction motor's rotor can be either wound type or squirrel-cage type.

#### 4. EXPERIMENTAL SETUP



Figure No.5: Experimental setup

#### 5. ADVANTAGES

1. Skilled labor is not required.
2. Easy operation
3. It can be transported easily from one place to another since dismantling and assembling is simple.
4. Maintenance is easy.
5. Investment is very low(below 5000 rupees)

#### CONCLUSION

An automated machine for coconut dehusking and crown removal has been developed for the small-scale farm holders in the agricultural and rural areas. The operation of the machine is simple and the maintenance of the machine is also not expensive. The machine can dehusk an average of 200 coconuts per hour. Introducing this machine in the farm areas can reduce the risk involved in the use of spikes in dehusking the coconut and also eliminates the skilled manpower required for dehusking the coconuts. The machine can also be integrated along with the further processing steps of the nuts such as the production of copra.

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## Density and viscosity study of N-(4-bromophenyl) maleanilic acid and N-(4-bromophenyl) maleimide in aqueous DMSO at 298.15 and 303.15 K

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**Abstract**— Density and viscosity of N-(4-bromophenyl) maleanilic acid and N-(4-bromophenyl) maleimide have been measured in 80% aqueous dimethyl sulfoxide at 298.15 and 303.15 K. From the experimental data, parameters such as apparent molar volume, limiting apparent molar volume, semi-empirical parameter, Falkenhagen and Jones Dole viscosity coefficients were evaluated. Using these parameters, molecular interactions such as solute-solute, solute-solvent and solvent-solvent were predicted.

**Keywords** — N-(4-bromophenyl) maleanilic acid, maleimide, apparent molar volume, solute-solute interactions.

### INTRODUCTION

Maleimide is an important multifunctional heterocyclic moiety because of its applications in pharmacology [1-3] biology [4-5] synthetic chemistry [6]. The parameters such as density, viscosity, apparent molar volume, molar volume at infinite dilution, and Jones-Dole equation parameters 'A' and 'B' are useful to throw light on the type of molecular interactions present and to understand different biochemical aspects at the body temperature. The results were interpreted in terms of solute-solute and solute-solvent interactions in these systems. Dimethyl sulfoxide (DMSO) is aprotic and strongly associated due to highly polar S=O group. The study of DMSO is important because of its application in medicine [7]. Density and viscosity of some 4-substituted N-phenyl maleimides in aqueous dimethyl sulfoxide have been studied at 308.15 K [8].

### EXPERIMENTAL

N-(4-bromophenyl) maleanilic acid (1) and N-(4-bromophenyl) maleimide (2) were synthesized [9] and purified by recrystallization technique. Triple distilled water and analytical reagent grade DMSO of minimum assay of 99.9% obtained from SD Fine Chemicals were used for preparation of solution at room temperature in a molar range of  $2 \times 10^{-3}$  to  $1 \times 10^{-2}$  mol.L<sup>-1</sup>.

The pycnometer and Ubbelohde viscometer was calibrated [10] using triple distilled water. The density and viscosity of distilled acetone and toluene were evaluated with respect to density of water.

Desired temperature was maintained with the help of thermostatic water bath. The flow time was recorded by using digital stop watch. The solution viscosities were measured by using Ubbelohde viscometer at 298.15 and 303.15 K. The apparent molar volumes,  $\phi_v$  were calculated using the following equation [11-12].

$$\phi_v = \frac{1000 (\rho_0 - \rho)}{C \rho_0} + \frac{M_2}{\rho_0}$$

Where  $M_2$ ,  $C$ ,  $\rho_0$  and  $\rho$  are the molar mass, concentration (mol. L<sup>-1</sup>) and densities of the solvent and the solution respectively. The apparent molar volumes  $\phi_v$  were plotted against the square root of concentration according to the Masson's equation [13]

$$\phi_v = \phi_{ov} + S_v C^{1/2}$$

Where  $\phi_{ov}$  is the limiting apparent molar volume and  $S_v$  is semi empirical parameter or experimental slope, which depends on the nature of solvent, solute and temperature.

The viscosity results of the aqueous solutions of N-(4-bromophenyl) maleanilic acid and maleimides were analysed using Jones-Dole equation [14]

$$\frac{\eta_r - 1}{C^{1/2}} = A + B C^{1/2}$$

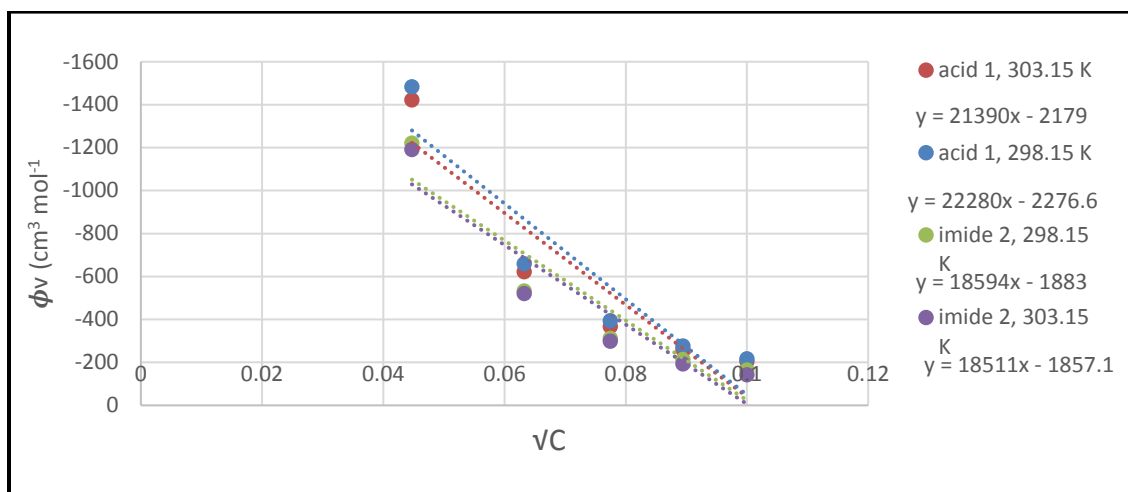
Where  $\eta_r = \eta/\eta_0$ ,  $\eta$  and  $\eta_0$  are relative viscosity, viscosities of the solution, solvent respectively and  $C$  is the molar concentration. The linear plot for  $(\eta_r - 1)/C^{1/2}$  vs  $C^{1/2}$  were obtained. The intercept ( $A$ ) coefficient shows solute-solute interaction and the slope ( $B$ ) reflect the solute-solvent interaction.

## RESULTS AND DISCUSSION

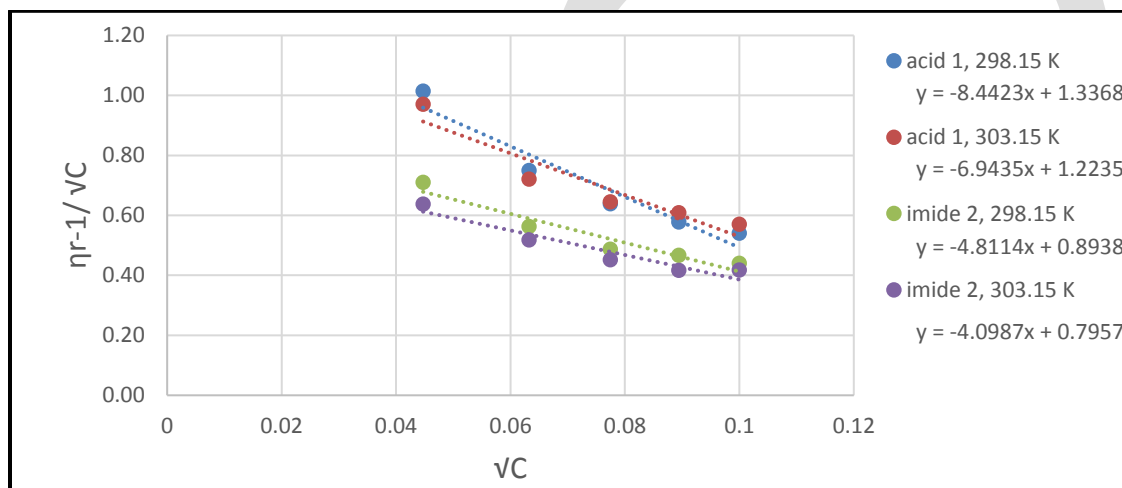
Density, apparent molar volume, viscosity and relative viscosity of N-(4-bromophenyl) maleanilic acid and maleimide in 80 % aqueous DMSO solution at 298.15 and 303.15 K temperature are shown in Table 1. For both maleanilic acid (1) and maleimide (2), the density and apparent molar volume  $\phi_v$  increases with increase in concentration. The more negative  $\phi_v$  values of 1 than 2 gives evidence of strong molecular association i.e. presence of electrostriction and hydrophilic interaction (solute solvent interactions). Figure 1 shows linear plots of  $\phi_v$  vs  $C^{1/2}$  of maleanilic acid and maleimide solution at 298.15 and 303.15 K respectively. Masson's parameter  $\phi_o$  (limiting apparent molar volume) and  $S_v$  (experimental slope or semi empirical parameter or associated constant) were obtained from linear plots are listed in table 2. The negative values of  $\phi_o$  shows weak or absence of solute-solvent interactions. The positive value of  $S_v$  indicates the presence of solute-solute interactions. Compound 1 has more solute-solute interactions than that of 2. The viscosity of solution increases with increase in concentration. Figure 2 shows variation of  $(\eta_r - 1)/C^{1/2}$  against  $C^{1/2}$  at 298.15 and 303.15 K. Positive values of Falkenhagen coefficient 'A' shows strong solute-solute interactions. The negative values of Jones-Dole coefficient 'B' shows weak solute-solvent interactions. Jones-Dole coefficient representing measure of order and disorder introduced by solute in solvent (solute-solvent interactions). The Jones-Dole parameters are listed in Table 2. The value of 'A' for compound 1 is high indicates the presence of strong solute-solute interactions in an acid than in maleimide.

**Table 1:** Densities ( $\rho$ ) ( $\text{g}\cdot\text{cm}^{-3}$ ), apparent molar volumes  $\phi_v$  ( $\text{cm}^3\cdot\text{mol}^{-1}$ ), viscosities ( $\eta$ ) and relative viscosities ( $\eta_r$ ) of N-(4-bromophenyl) maleanilic acid (1) and maleimide (2) in aqueous DMSO solution at 298.15 and 303.15 K.

Comp.	Conc. (C) $\text{mol dm}^{-3}$	$\sqrt{C}$	Density ( $\rho$ ) (g/cc)	$\phi_v$ ( $\text{cm}^3\cdot\text{mol}^{-1}$ )	Viscosity ( $\eta$ )	Relative viscosity ( $\eta_r$ )
<b>298.15 K</b>						
<b>1</b>	0.002	0.0447	1.09996	-1483.383	3.46082	1.04534
	0.004	0.0632	1.10014	-660.0618	3.46754	1.04737
	0.006	0.0775	1.10038	-394.7441	3.47446	1.04947
	0.008	0.0894	1.10074	-275.7692	3.48177	1.05167
	0.01	0.1	1.10124	-217.1561	3.48952	1.05401
<b>2</b>	0.002	0.0447	1.09935	-1221.571	3.41579	1.03174
	0.004	0.0632	1.09951	-532.8096	3.42860	1.03561
	0.006	0.0775	1.09973	-312.3451	3.43545	1.03768
	0.008	0.0894	1.10005	-213.5161	3.44877	1.04171
	0.01	0.1	1.10048	-164.2537	3.45629	1.04397
<b>303.15 K</b>						
<b>1</b>	0.002	0.0447	1.09771	-1422.262	3.12168	1.04341
	0.004	0.0632	1.09786	-622.4887	3.12826	1.04560
	0.006	0.0775	1.09808	-366.5612	3.14119	1.04993
	0.008	0.0894	1.09849	-260.3056	3.15467	1.05443
	0.01	0.1	1.09899	-204.7785	3.16226	1.05697
<b>2</b>	0.002	0.0447	1.09717	-1191.936	3.07712	1.02851
	0.004	0.0632	1.09734	-520.1268	3.08990	1.03278
	0.006	0.0775	1.09753	-299.2370	3.09658	1.03502
	0.008	0.0894	1.09776	-193.3623	3.10338	1.03729
	0.01	0.1	1.09812	-141.7198	3.11670	1.04170



**Figure 1:** Plot of  $\phi_v$  vs  $c^{1/2}$  of N-(4-bromophenyl) maleanilic acid and maleimide in 80 % aqueous DMSO solution at 298.15 and 303.15 K.



**Figure 2:** Plot of  $(\eta_r-1)/c^{1/2}$  vs  $c^{1/2}$  of N-(4-bromophenyl) maleanilic acid and maleimide in aqueous DMSO solution at 298.15 and 303.15 K.

**Table 2:** Masson and Jones-Dole Parameters of N-(4-bromophenyl) maleanilic acid (1) and maleimide (2) in aqueous DMSO Solution at 298.15 and 303.15 K.

Comp.	$\phi_{o_v}$	$S_v$	A ( $\text{dm}^{3/2}\text{mole}^{-1/2}$ )	B ( $\text{dm}^3\text{mole}^{-1}$ )
<b>298.15 K</b>				
1	-2276.6	22280	1.3368	-8.442
2	-1883.0	18594	0.894	-4.811
<b>303.15 K</b>				
1	-2179.0	21390	1.2235	-6.944
2	-1857.1	18511	0.796	-4.099

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#### CONCLUSION

In the present work we have systematically reported densitometry and viscometric study of N-(4-bromophenyl) maleanilic acid and maleimide in 80 % aqueous DMSO solution at 298.15 and 303.15 K. It has been observed that negative values of apparent molar volume indicates strong molecular association in both 1 and 2. Positive values of  $S_v$  and viscosity constant 'A' indicate the presence of strong solute-solute interaction which decreases with rise in temperature. These interactions are found to be more in N-(4-bromophenyl) maleanilic acid than the N-(4-bromophenyl) maleimide. The value of Jones-Dole coefficient 'B' indicates strong interactions between solute and solvent at higher temperature, whereas Falkenhagen coefficient 'A' indicates strong solute-solute interaction at lower temperature. The Jones Dole and Masson's equations are found to be obeyed for study of maleimides and its derivatives in 80 % aqueous DMSO solution system at 298.15 and 303.15 K.

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# Estimation of Rain attenuation and Ionospheric delay at a Low-Latitude Indian Station

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**Abstract**— India falls under low-latitude region and in this study Ahmedabad region (23.0225° N, 72.5714° E) is considered. In satellite link design system rain plays a crucial part and attenuation caused by rain is severe in Ku and Ka bands. This paper involves the rain attenuation estimation using data collected over Ahmedabad region. The data is taken from IMD (Indian Meteorological Department). Rain is dominant over 10 GHz which is a tropospheric phenomenon whereas Ionospheric effects are predominant below 6 GHz. Ionosphere is a dominant source of range errors for the users of Global Positioning System (GPS) satellite signals. This study also focuses on the delay due the Ionosphere in Ahmedabad region along with TEC measurements. The integrated water vapor content in atmosphere is also estimated from the data of GPS receiver. The data is taken from Space Application Centre (SAC-ISRO) and Ahmedabad airport station. The analysis is done for the Monsoon period of year 2016. The platform used for implementation is MATLAB.

**Keywords**— Global Positioning system, Total electron content, IWV, Rain Attenuation, ITU-R Model, Ionospheric delay, Tropospheric delay

## INTRODUCTION

The Earth-Space communication involves many challenges, one of them being the link design for satellite systems. When the radio wave propagates from earth to satellite or vice-versa, it encounters certain kind of delays and disturbances. The attenuation caused above frequency range of 10 GHz is generally categorized into the tropospheric effects and those less than 6 GHz usually comprises of Ionospheric effects. The attenuation caused by troposphere includes rain attenuation, cloud attenuation, scintillation effects, gaseous absorption, melting layer attenuation etc as explained in [1]. This study focuses on attenuation due to rain in Ahmedabad region (2010-2014) in three different climates i.e. pre-monsoon period, monsoon period and post monsoon period. The frequency band taken is Ku (12-18 GHz) and Ka (26-40 GHz).

For climate monitoring and prediction the relative humidity data are useful. In greenhouse gases the atmospheric water vapor is crucial and dominating, so the feedback of water vapor in global warming is substantial. Due to increasing carbon dioxide and other gases the climate gets warmed and the water vapor is increasing rapidly which has effects on heat balance of the earth. The water vapor varies in space and time. The surface based GPS measurements provides high resolution information and also provides data at similar quality under all weather conditions [2]. In the surface based techniques the integrated water vapor and delay is estimated using the signals obtained from the dual frequency GPS receiver. So the integrated water vapor content is estimated in monsoon period of 2016 using the data of dual frequency GPS receivers in Ahmedabad region. Ionosphere being a dispersive medium affects signal proportionally to the inverse of the square of their frequencies. It can thus reveal information about the Total Electron Content (TEC) of the electron

density which is a major parameter of the ionosphere. The data collected from receiver is also used to estimate the ionospheric delay at Space application centre (SAC-ISRO) Ahmedabad. Thus signals from GPS satellites encounters delay from ionosphere which results in range errors that can vary from a few meters to tens of meters [3].

## 2. Methodology

### 2.1 Calculation of Rain Attenuation by ITU-R model

In satellite communication, for Rain attenuation prediction the standard ITU-R [4] model is used which is applicable to 55 GHz frequency and the input parameters required are: Latitude of earth station  $\varphi$  (deg), point rainfall rate  $R_{0.01}$  (mm/h), altitude of earth station above mean sea level  $h_s$  (km), frequency, elevation angle  $\theta$  (deg). The specific attenuation due to rain is given by

$$\gamma = k(R_{0.01})^\alpha \left( \frac{dB}{km} \right) \quad (1)$$

Where  $k$  and  $\alpha$  are frequency and polarisation dependent coefficients given in [4] [5].

Hence the attenuation can be obtained as

$$A_{0.01} = \gamma L_e \quad (2)$$

Where  $L_e$  is effective path length through rain (Km)

The complete procedure is given in [1] and is the most accurate of all models and well tested by ITU-R.

### 2.2 Calculation of integrated water vapor (IWV) from Zenith path delay (ZPD)

The zenith path delay includes zenith hydrostatic delay (ZHD) and zenith wet delay (ZWD) and the latter is linked to IWV [6].

$$ZPD = ZHD + ZWD \quad (3)$$

The zenith wet delay (ZWD) directly relates to IWV and is dependent on vertical distribution of water vapor:

$$IWV \cdot \rho_{H_2O} = k \cdot ZWD \quad (4)$$

Where  $\rho_{H_2O}$  is the density of water and  $k$  is the proportional constant given as

$$\frac{1}{k} = 10^{-6} \left( \frac{c_1}{T_m} + c_2 \right) R_v \quad (5)$$

Where  $c_1 = (3.776 \pm 0.03)10^5 \frac{k^2}{hPa}$  and  $c_2 = (17 \pm 10)10^5 \frac{k}{hPa}$

$T_m$  is the vertically integrated mean temperature and  $R_v$  is the specific gas constant for water vapor (461.45 J/kg/K).

### 2.3 Calculation of Ionospheric delay from dual frequency GPS receiver

To investigate earth's ionosphere, the Total Electron Content (TEC) measurements obtained from GPS receivers is used as an important method. The delay here is determined using code observables at L1 (1575 MHz) and L2 (1227 MHz) GPS frequencies [7]. To estimate the GPS receiver position, the pseudorange measurements are carried out. The position estimate depends on observation, receiver, and satellite measurements.

A GPS operates on two different frequencies  $f_1$  and  $f_2$  which can be derived from fundamental frequency  $f_0=10.23$  MHz as follows:

$$f_1=154 f_0 = 1575.42 \text{ MHz and } f_2=120 f_0 = 1227.60 \text{ MHz}$$

Thus TEC can be estimated by using the below relation:

$$TEC = \frac{(P_1 - P_2)}{40.3} \frac{1}{\left(\frac{1}{f_1^2} - \frac{1}{f_2^2}\right)} \quad (6)$$

Where  $P_1$  and  $P_2$  are pseudorange at L1 and L2 respectively

$$\text{Delay experienced by signal 1 at frequency } f_1 \text{ can be written as } S_{f1} = \frac{40.3}{f_1^2} TEC \quad (7)$$

and similarly

$$\text{Delay experienced by signal 2 at frequency } f_2 \text{ can be written as } S_{f2} = \frac{40.3}{f_2^2} TEC \quad (8)$$

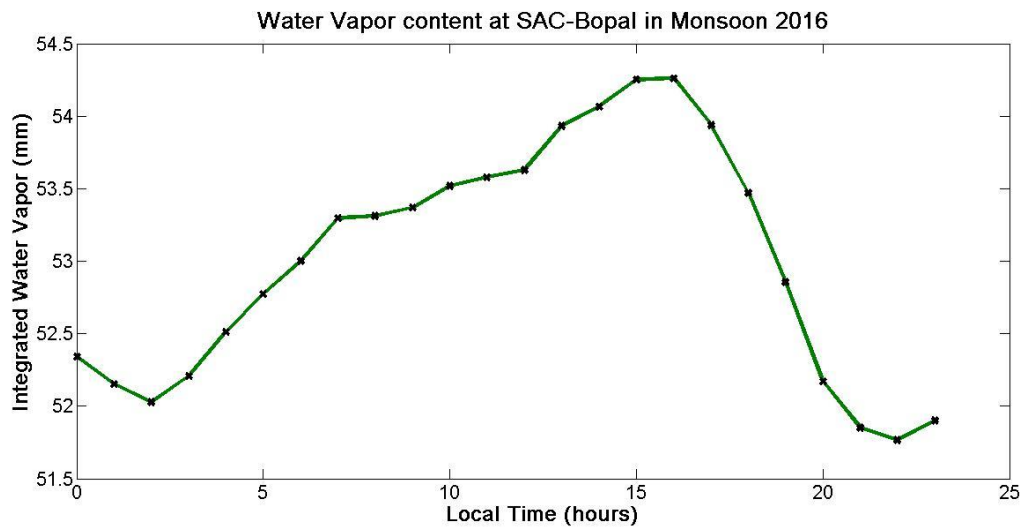
Hence by estimating TEC using pseudo range, the ionospheric delay can be computed for both the frequencies.

### 3. Result and Discussions

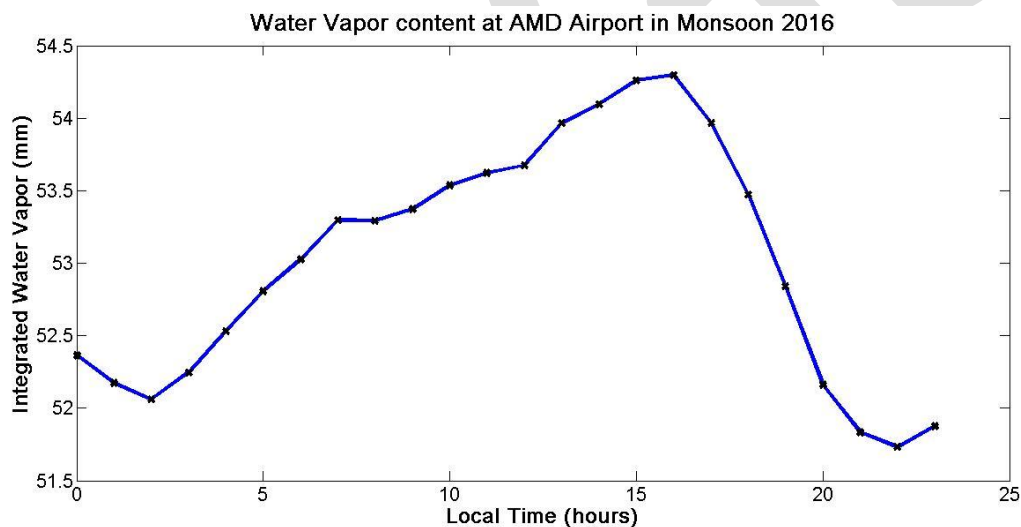
The surface based GPS-measurements of Zenith path delay can be used to derive vertically integrated water vapor (IWV) of the atmosphere. In this study the data of three months monsoon period is taken from the dual frequency GPS receiver to calculate the tropospheric delay and integrated water vapor content of the atmosphere. The GPS derived values of IWV are used for all operational analysis of IWV. The platform used for implementation is MATLAB.

Fig 1 depicts the analysis of integrated atmospheric water vapor content at SAC-bopal Ahmedabad in the monsoon period of 2016.

It can be observed from the figure that the atmospheric water vapor content has maximum value around 54 mm. In Fig 2 the water vapor content is also ~54 mm since the data is taken for SAC and airport station and the distance between the stations is about 33 km so it is also evident that the delay and water vapor content doesn't change for very smaller distance.



*Fig 1: GPS derived integrated water vapor at SAC station*



*Fig 2: GPS derived integrated water vapor at AMD airport station*

Ahmedabad region ( $23.0225^{\circ}$  N,  $72.5714^{\circ}$  E) is a moderate rainfall zone with station height of 53 meters and average rain rate of about 700 mm. Fig 3 represents the attenuation graph of Ahmedabad in Monsoon period of five years (2010-2014) through ITU-R Model. The x-axis labels rainfall rate and y-axis labels attenuation. It can be observed that with increase in frequency as well as rainfall rate the attenuation is increasing and is highest at 40 GHz. The maximum value of attenuation is about 78 db for rainfall rate of 270 mm at 40 GHz whereas minimum value corresponds to about 20 db at 12 GHz in monsoon period (July-September). The data is taken from IMD (Indian Meteorological Department).

The post monsoon (October-December) characteristics of Ahmedabad region are shown below in Fig 4. The maximum attenuation estimated is around 9.5 db at 40 GHz. Since it is a low rainfall region the attenuation observed is less as compared with the high rainfall zones. The figure depicts the attenuation observed for 12-40 GHz bands. The rainfall rate (which depends on geographical area) and frequency has much greater impact on attenuation.

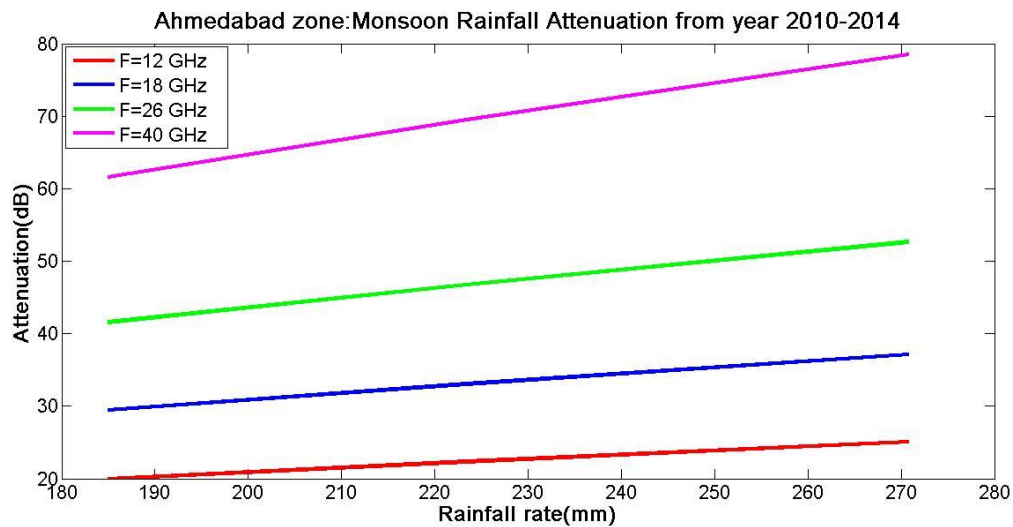


Fig 3: Monsoon Attenuation in Ahmedabad using ITU-R

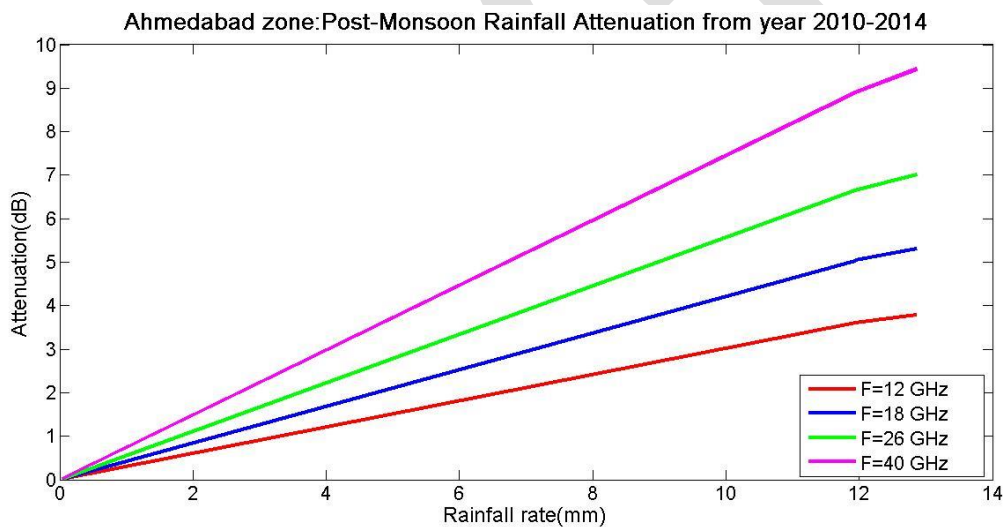
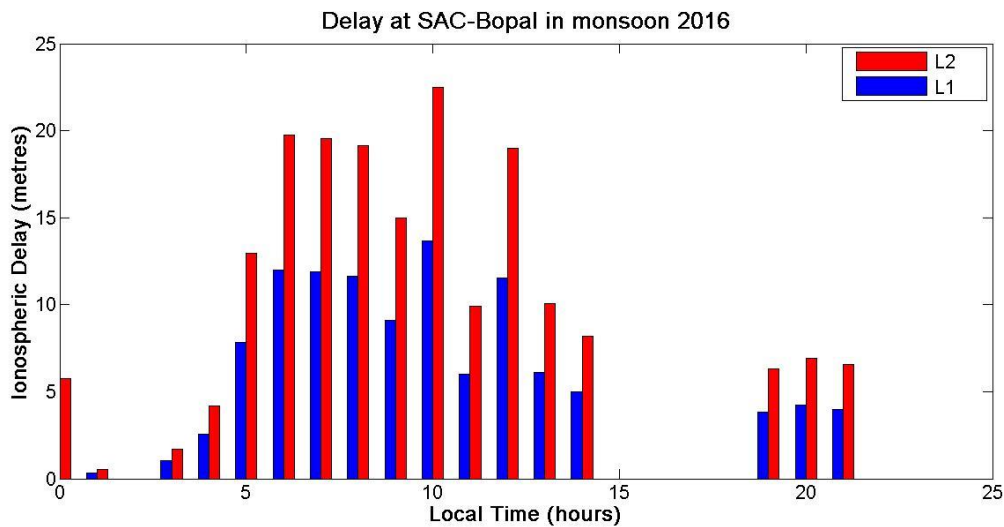


Fig 4: Post-Monsoon Attenuation in Ahmedabad using ITU-R

To determine the ionospheric delay in dual frequency GPS receiver the data is taken from Space Application Centre (SAC-ISRO) (Bopal campus), Physical Research Laboratory (PRL) and Ahmedabad airport station in monsoon period (July to September) of 2016. The given below Fig 5 shows the analysis of GPS data at SAC-bopal station and the estimated delay at both frequencies ( $f_1$  and  $f_2$ ) respectively. The first epoch was at 5:30 Hrs. The plot is given with respect to IST (IST=UT +5.5 hrs). The histogram represents the delay at ionosphere at a given time.



*Fig 5: Ionospheric delay vs. IST at L1 and L2 for SAC*

The maximum ionospheric delay observed at L1 is around 14 meters and delay at L2 is ~22 meters. It is quite clear from the plot that ionospheric delay starts rising from morning from about 3 meters and achieves a wide range of ~8 to 12 meters around local noon. Then the delay starts decreasing and attains the minimum value at evening. This is due to features of equatorial ionosphere and is known as plasma depletions.

#### ACKNOWLEDGMENT

I express my gratitude to Dr. Kaushik Gopalan, Space Application Centre (SAC) for his valuable and much needed assistance in the successful completion of the work. I would also like to thank Dean and Director, PRL for providing me a platform to carry out my Project work at PRL. I also thank SAC, IMD (Indian Meteorological Department) which is the source of GPS data and rainfall data respectively.

#### CONCLUSION

In this study an attempt was made to estimate the delay in Ionosphere and Troposphere at Ahmedabad station. By using the dual frequency code observations the ionospheric delay is estimated. The hourly ionospheric delay is about 1.5 to 16 meters. The GPS measurements are also used to obtain information about water vapor content of troposphere. The atmospheric water vapor content observed is ~ 54 mm. Also the effect of rain is studied in Ku (12-18 GHz) and Ka (26-40 GHz) bands which is a major source of degradation at high frequencies in satellite communication. Rain attenuation is a tropospheric phenomenon and the results are calculated using the standard ITU-R model which is well tested and produces accurate results.

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# Performance Evaluation of AOMDV Routing Protocol with Internet of Things

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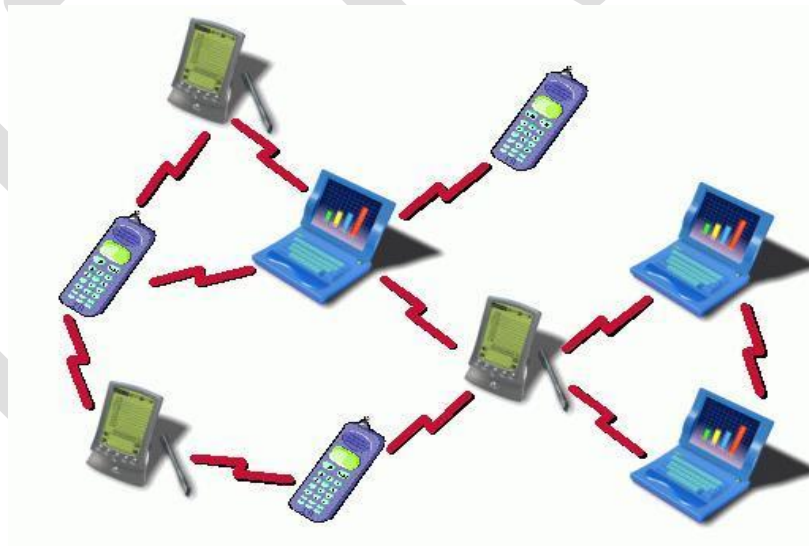
**Abstract**— Internet of things (IOT) is contains two words i.e. “Internet” which is a global dynamic interconnected networks and “Things” which shows some objects or devices. Internet of Things (IOT) refers to the dynamic network interconnecting people and things. It is usually a dynamic global network with self-configuring capabilities based on standard and interoperable communication protocols. IOT is rather a new concept in IT field. However, the research of routing protocols with Internet of Things is still an issue in many factors, while route designing is an important part in the research of routing with Internet of Things. Considered dissertations by various authors in the study of Internet of things (IOT), Routing protocols, MANET and AOMDV. All the research papers considered in this paper literature survey works on the comparative analysis on performance of networks with Internet of things.

**Keywords**— Internet of things, Routing, Protocols, AODV, AOMDV, Ad-hoc Network, Mobile Network, MANET, Wireless Network, Reactive protocol, On-demand.

## 1. INTRODUCTION

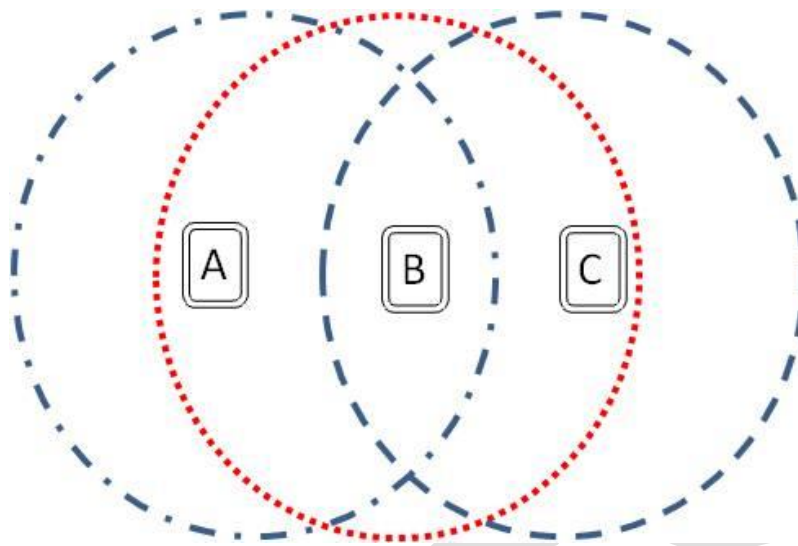
### 1.1 Mobile Ad Hoc Network (MANET)

Mobile Ad hoc Network (MANET) is a self-organizing and infrastructure-less multi-hop network which contains several wireless mobile nodes, such as Personal Digital Assistants, laptops, etc. Each node in MANET is both a host and a router; a source node therefore can reach the destination node directly or by intermediate nodes [5].



**Figure 1.1 Mobile Ad hoc Network**

The message passing between nodes in MANET is done by using multi-hop paths. Every node in the MANET shares the wireless medium. The topology of the network changes dynamically. In MANET, nodes are free to move anywhere which is the reason of frequent breaking of communication link. [14][15]



**Figure 1.2 A MANET of three nodes, where nodes A & C must discover the route through B in order to communicate.**

Figure above shows a simple example of a mobile ad-hoc network with three nodes Node A, Node B, and Node C. Assuming, Node A and Node C are not within range of each other to exchange information; however the Node B can be used to forward data packets between Node A and Node C as Node B is within the range of both Node A and Node C. The Node B will act as a router and these three nodes together form a mobile ad-hoc network having the path named as A-B-C. [16]

In a multi-hop path, if a single node goes away from the coverage of either of its two nearest nodes or the complete route may fails. In a network of mobile nodes the link breaks due to the mobility of individual nodes. Node speed is directly proportional to the number of broken links. The multi hop path must be free from route failure for a successful transmission of data packet from any source to any destination. Therefore, whenever a route breaks in the network a fresh route must to be established quickly so as to make the data packet reach at the destination successfully. So the route failure indirectly varies the end to end delay as far as a successful packet delivery is concerned. [10]

Various factors on which the performance of a MANET depends includes network size, mobility model, type of routing protocol, speed etc. and can be described in terms of end to end delay, throughput, packet delivery ratio. [10]

## **1.2 MANET Routing Protocols**

Routing is defined as “the process of moving a packet of data from source to destination by establishing the routes which the data packets follow”. Routing is generally performed by a dedicated device called a router. The routing involves two activities:

1. Determining optimal routing paths.
2. Transferring the information groups (called packets) through an internetwork. This is called as packet switching. [18]

Routing protocols use a number of metrics to compute the best path for routing the data packets to its destination such as number of hops. In the process of path determination routing algorithms initialize and maintain routing tables, which contain the total route information for the data packets. [18]

Routing protocols can be classified into three different categories:-

- a. Proactive Routing
- b. Reactive Routing
- c. Hybrid Routing [10]

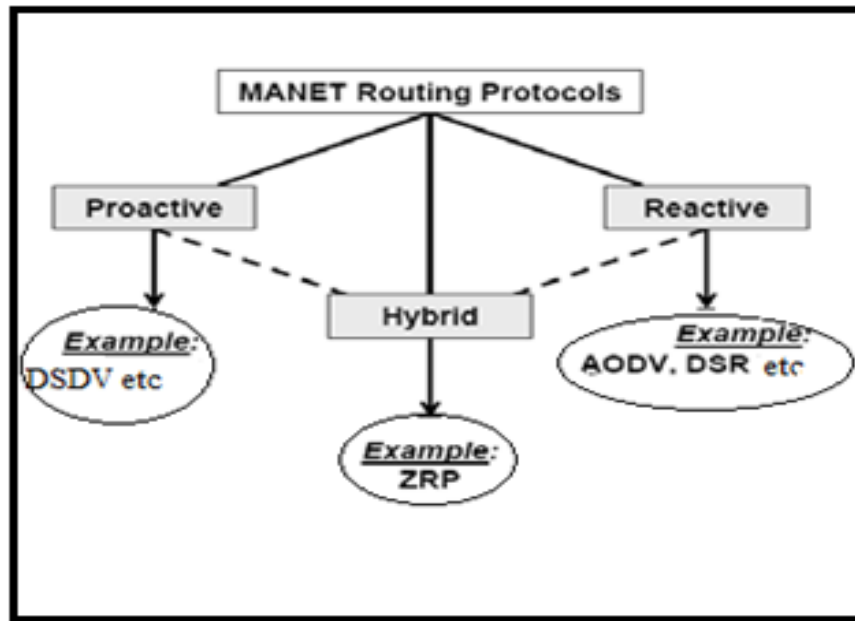


Figure 1.3 Classification of MANET Routing Protocols [16]

### 1.2.1 Proactive Routing Protocols

Proactive Routing protocols are often called as “Table-Driven” routing protocols that periodically update the routing table by continuously learning the topology of the network by exchanging topological information among the network nodes. For message passing, the route is already known and can be immediately used. The delay in communication is minimized and nodes are able to quickly determine which nodes are present or reachable in the network. The examples of such proactive routing protocols are DSDV (Destination Sequence Distance Vector), FSR (Fisheye State Routing) etc. [10] [11]

### 1.2.2 Reactive Routing Protocols

Reactive Routing protocols are often called as “On-Demand” routing protocols. When a node wants to forward the packet from source to destination, it establishes route for that destination based on the current network situation. [10]

### 1.2.3 Hybrid Routing Protocols

Hybrid Routing protocols combine the advantages of proactive and reactive routing schemes. All the nodes in a network are divided into several zones. Communication within the zone is implemented using proactive routing whereas for communication with node out of the zone reactive routing used. The various protocols lies under this category include ZRP, LANMAR, and HSR etc. [10]

## 1.3 Ad-Hoc On-Demand Multipath Distance Vector Routing (AOMDV)

AOMDV is a multi-path routing protocol and is an extension to AODV. It also provides two main services i.e. route discovery and maintenance. Unlike AODV, every RREP is being considered by the source node and thus multiple paths discovered in one route discovery. It is the hop-by-hop routing protocol in which the intermediate node maintains multiple path entries in their respective routing table. As an optimization measure, by default the difference between primary and an alternate path is equal to 1 hop. The routing table entry at each node also consists of a list of next hop along with the corresponding hop counts. Every node maintains an advertised hop count for the destination. Advertised hop count defined as the “Maximum hop count for all the paths”. Advertised hop count is used to sent route advertisements of the destination. An alternate path to the destination is accepted by a node if the hop count is less than the advertised hop count for the destination. [19]

Table 1.1 Routing table entry structure in AODV

Destination	Sequence number	Hop count	Next hop	Timeout
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**Table 1.2 Routing table entry structure in AOMDV**

Destination	Sequence number	Advertised hop count		Route list	
		Next hop1	Last hope1	Hop Count1	Timeout1
		Next hop2	Last hope2	Hop Count2	Timeout2

#### 1.4 Introduction to Internet Of Things (IOT)

Internet of Things (IOT) refers to the dynamic network interconnecting people and things. It is generally a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols. In the IOT, smart objects/things are active participants in information where they are enabled to communicate and interact among themselves and also with the environment by exchanging data and information and effects IOT by running processes that have trigger actions and create services with/without human intervention directly [2].

Internet of things (IOT) is contains two words i.e. “Internet” which is a global dynamic interconnected networks and “Things” which shows some objects or devices. It is a self-configuring wireless network of sensors whose idea would be to interconnect everything [1] [6].

Internet of things connects all the objects/things to the internet. The information sensing devices connect things with the purpose of intelligent identification and management. Wireless technology and the internet are used majorly in the making of IOT. [6]

IPv6 has a very significant role in IOT, by using its huge bulk of address space through which one can easily allocate a unique IP address to things on this planet and could transfer the data over network [6].

Nowadays the world is entirely dependent on the information provided on internet, which is captured by taking images or through text. This needs the major involvement of a human being for collection of the information but problem is that people have limited time and less accuracy, which leads to inappropriate and inconsistent data. Hence, such a system is needed which can automatically collect the data and transfer it to the internet without any human to machine interaction [6].

## 2. LITERATURE SURVEY

A number of journals and research papers published have been studied. The various aspects of the problem were studied.

**Buta Singh et al. (2017)** analyzed the performance of MANET on the basis of routing protocol used and mobility model employed. This performance evaluation was done for AOMDV (Ad-hoc On-demand Multipath Distance Vector) routing protocol for different mobility models in MANET and later compared with AODV (Ad-hoc On-demand Distance Vector) routing protocol. This paper conclude the result that AOMDV performs better than AODV in all mobility models due to its multipath route selection mechanism which helps it to recover the broken links between source and destination and enabling selection of more reliable route between two communicating nodes. [10]

**Amol Dhumane et. al (2016)** Nodes in IoT endure constant movement that may result into out of order interconnectivity between the devices which may come across dynamic topology changes. Due to these dynamic topological changes and inadequate resources available in the IoT devices, routing of data has become a big challenge in front of the present research community. This dissertation

emphasizes on routing of data in IoT. The main aim is not only to compare, analyze and strengthen the past research work but also to welcome their findings and talk about their applicability towards the IoT [26].

**Hou Songfan, Wu Muqing, Liao Wenxing, Wang Dongyang (2015)** This dissertation presents an investigation with a goal to compare the performance of two characteristic routing protocols, AODV and DSR, in real multi-hop environment. Apart from testing the end-to-end packet loss, delay and routing path parameters, the performance of DSR and AODV routing protocols with factors of some applications based on Internet of Things (IoT), such as Radio Frequency Identification (RFID) service, voice service and temperature monitoring service are also tested [5].

**Mayuri A. Bhabad, Sudhir T. Bagade (2015)** The dissertation focus on the concept of IOT, architecture and security issues with suggested countermeasure and suggested further areas of research needed. Internet of things (IOT) is a widely distributed network of interconnected things/objects in which all the information is routed to the internet with the use of sensing devices and Radio Frequency Identification (RFID) tagging system. As IOT does not need any human to machine interaction, hence security is needed. But the rapid development of IOT has evolved with the challenges in terms of security of things [6].

**Pankaj Oli et. al. (2014)** the design of robust routing algorithms that adapt to the dynamically and erratically changing MANET network topology is the main challenging issue. MANET is a dynamic wireless self-organizing network that doesn't needs any existing infrastructure in which each node acts as a router. Each node in MANET is both a host and a router; a source node therefore can forward packets reach the destination node directly or by intermediate nodes. These nodes are free to move and organize themselves in the network and change their positions frequently. The routing protocols are categorized as Proactive, Reactive and Hybrid protocols. Reactive routing approach is widely used popular routing category for MANET. The design follows the idea that each node tries to reduce routing overhead by sending routing packets whenever a communication is needed. This paper compares AODV and AOMDV routing protocols for MANETs. The AODV is a single path routing protocol and AOMDV is a multipath version of AODV. AOMDV was designed primarily for highly dynamic ad hoc network where link failures and route breaks occurs frequently. AODV and AOMDV routing protocols are analyzed by broad simulations in ns-2 simulator and demonstrate that how pause time affect their performance. Performance of AODV and AOMDV is evaluated based on Packet Delivery Ratio, throughput, packets dropped, normalized routing overhead, end to end delay and optimal path length. [20]

**K. Vanaja et al. (2013)** Mobile Ad hoc Network (MANET) is a self-organizing, dynamically changing and infrastructure-less multi-hop network which contains several wireless mobile nodes, such as Personal Digital Assistants, laptops, etc. Forwarding packets through this dynamic network topology is a challenging issue. This paper is to investigate the environment based protocol under mobility induced link breaks. The Single path reactive routing protocol AODV and Multipath reactive routing protocol AOMDV considered analyzing the performance. The decision is made by taking the quantitative performance metrics packet delivery ratio, average end to end delay, throughput of AODV and AOMDV using Network Simulator NS-2. The performance analysis of AODV and AOMDV compares and results that out if AODV and AOMDV, AOMDV is the best suitable one in case there is a link break due to mobility with reduced packet drop ratio, improved throughput and end to end delay. [19]

**J. Y. ZHOU et al. (2013)** to improve the performance of AOMDV protocol, this paper proposed NS- AOMDV i.e. "AOMDV based on node state". In NS-AOMDV, the paper introduces node state to enhance AOMDV's performance for the selection of main path. In the process of route discovery, the rule of routing update calculates the node weight of each and every path and sorts the route list by descending value of path weight, and then chooses the path with largest weight for data transmission. NS-AOMDV also make use of energy threshold and route request (RREQ) packet delay forwarding for the ease of network congestion, limits the RREQ broadcast, and avoids low energy nodes to contribute in the establishment of the path. The results of simulation demonstrate that NS-AOMDV can effectively enhance network packets delivery rate, throughput and routing overhead in the situation of dynamically changing network topology and heavy load. [21]

**Arjun P. Athreya et al. (2013)** presented a review of correlated work in the area of self-organization and talk about the research opportunities and challenges for self-organization in the Internet of Things. The Internet of Things is a paradigm that permits the interaction of ubiquitous devices through a network to achieve common goals. So, network self-organization capabilities with these devices are required to allow for communication resilience. This paper considered the system perspective of the Internet of Things and then identifies and describes the key components of self-organization in the Internet of Things and confers enabling technologies. [25]

**Vipul Maheshwari & Shrikant Jadhav (2012)** The protocols are divided into three categories - Proactive, Reactive or Hybrid Mesh. One most popular protocol called ad-hoc On Demand Vector (AODV) is based on the approach of on-demand path selection in which the tree size is increasing in a proactive way. Also AOMDV routing protocol focuses on Ad-hoc on-demand Multi-Path Distance Vector routing and challenges AODV protocol in performance. In this paper, proposal to enhance the Ad-hoc On-demand Multipath Distance Vector (AOMDV) routing protocol to a delay-aware multi-path protocol for MANETs. The main focus is to improve the QoS in MANETs by creating a routing protocol, which considers the delay requests of real-time multimedia applications (voice and video) in making routing decisions. [17]

**Yicong TIAN, Rui HOU (2010)** this dissertation designed a routing method that can take function as routing destination not just nodes. Compared with AOMDV, simulation results demonstrate that AOMDV-IOT achieves improved performance in average end-to-end delay, packet loss and discovery frequency. This proposed work improvement proves to be more suitable for the use in internet of things [1].

**R.Balakrishna et al. (2010)** This paper evaluates the performance of the two most popular reactive routing protocols - Ad-hoc On-demand Distance Vector (AODV) routing protocol, for single path and Ad-hoc On-demand Multi-path Distance Vector (AOMDV) routing protocol. On analyzing the performance of AODV and AOMDV, AOMDV incurs more routing overhead and packet delay than AODV but it had an enhanced efficiency if it is considered for performance metrics like number of packets dropped and packet delivery. [23]

**Stephan Haller et al. (2010)** studied the objects, devices, resources, things and services, as well as also studied identification, addressing, resolution and discovery in the Internet of Things. The Internet of Things is a hyped word and comes with a lot of related terminology that is not used regularly. This paper tries to bring clarity by describing the most significant terms like things, devices, and entities of interest, resources, addressing, and identity and, more importantly, the relationships between them. [24]

**Mahesh K. Marina and Samir R. Das (2006)** This paper proposed the novel approach of developing an AOMDV for mobile ad-hoc networks. Specifically, multipath is the extension to a well-studied single path routing protocol known as ad-hoc on-demand distance vector (AODV). The resulting AOMDV protocol guarantees loop freedom and disjointness of alternate paths. Performance analysis of AOMDV with AODV using ns-2 simulations demonstrates that AOMDV is capable to effectively handle the mobility-induced route failures. Also AOMDV reduces the packet loss by up to 40% and achieves a significant enhancement in the end-to-end delay (often more than a factor of two). AOMDV also reduces routing overhead by about 30% by reducing the frequency of route discovery operations. [22]

### 3. PROBLEM FORMULATION

Internet of Things (IOT) refers to the dynamic network interconnecting people and things. It is generally a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols. IOT is rather a new concept in IT field. However, the research of routing protocols with Internet of Things is still an issue in many factors, while route designing is an important part in the research of routing with Internet of Things.

### 3.1 Problem Statement

For improving the routing of AOMDV for Internet of Things we are working on the implementation of the algorithm by optimizing the protocol, such as routing table and internet connecting table will combine into one. It is AOMDV with IOT to adapt with the usage in internet of things. Our principal goal is to find and create the connection with lowest hop count between nodes and internet efficiently. The routing protocol will find node-disjoint paths and link-disjoint paths when discovering routes. Then it will take the discovered node as destination node to send message.

Comparing AOMDV-IOT with AOMDV, simulation results show that AOMDV-IOT has better performance in terms of packet delivery ratio, average end-to-end delay, and throughput of the network.

## 4. PROPOSED WORK

AOMDV protocol is an extension based on Ad-hoc On-demand Distance Vector (AODV) and AOMDV-IOT is based on AOMDV to improve the routing of AOMDV for Internet of things. Our principal objective is to find and create the connection between nodes and internet efficiently. It will find the most appropriate link automatically, and record other links as back up. If a node need to create a link to the internet, it ought to first check its internet connecting table, if the information there is valid, the node will choose the node which hops count is the lowest, or start the routing finding process. Then it will take the discovered node as destination node to send message.

This dissertation performs following tasks to work on the implementation to improve the algorithm through optimizing the protocol, such as routing table and internet connecting table will combine into one.

- Study of AOMDV and IOT protocol
- Implementation of AOMDV and IOT protocol
- Compare the results of AOMDV and AOMDV IOT in NS2.34

## 5. RESULTS

Simulation results are evaluated with respect to the performance metrics such as number of packets received, delay introduced, packet drop in terms of throughput, number of packets, packet dropping ratio, packet delivery ratio which are described as

- **Total Packet Sent** The computation of the count value of the total number of data packets sent by cluster head node defines the total number of packets received.
- **Total Packet Received:** The computation of the count value of the total number of data packets sent by cluster head node and perceived by sink node defines the total number of packets received.
- **Total Packet Dropped** The given term is define as the difference between net data packets sent and received i.e. the total number of data packets sent and the total number of data packets received.
- **Packet Delivery Ratio** This term is stated as the number of packets successfully received with respect to the total number of packets transmitted.
- **Throughput of Network** The measure of a number of packets transmitted per second is called as Throughput.
- **Average End To End Delay** End-to-End delay indicates how long it took for a packet to travel from the source to the application layer of the destination i.e. the total time taken by each packet to reach the destination. Average End-to-End delay of data packets includes all possible delays caused by buffering during route discovery, queuing delay at the interface, retransmission delays at the MAC, propagation and transfer times.

In this dissertation AOMDV routing protocol is improved for routing with Internet of things. In order to improve the algorithm the routing protocol is optimized such that routing table and internet connecting table will combine into one. The results are shown below.

Here we compare the results of AOMDV and AOMDV-IOT. The comparison is done for 25, 50, 75 and 100 nodes.

Simulation results will show the performance evaluation of AOMDV and AOMDV-IOT based on the above listed performance metrics.

## 5.1 Simulation Results

In the simulation results we had considered four different scenarios of number of nodes in the network.

### 5.1.1 First Scenario:

For both AOMDV and AOMDV-IOT, the network has number of nodes 25. The outcome of AOMDV and AOMDV-IOT performance for 25 nodes is shown below.

**Table 5.1 Performance evaluation for number of nodes 25 (nodes = 25)**

	AOMDV	AOMDV-IOT
Total Packets Sent	53013	53013
Total Packets Received	50147	53013
Total Packets Dropped	7475	0
Packet Delivery Ratio	94.59	100.00
Throughput of network	25.0735	26.5065
Average end to end delay(ms)	0.047170916	0.001659730

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics

Total Packets Sent           :      53013
Total Packets Received       :      50147
Total Packets Dropped        :      7475
Packet Delivery Ratio        :      94.59
Throughput of the network(KBps) :      25.0735
Average End to End Delay     :0.047170916 ms
```

**Figure 5.1 Performance evaluation of AOMDV with nodes = 25 on NS 2.35 Simulator**

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics

Total Packets Sent           :      53013
Total Packets Received       :      53013
Total Packets Dropped        :      0
Packet Delivery Ratio        :      100.00
Throughput of the network(KBps) :      26.5065
Average End to End Delay     :0.001659730 ms
Metric values are correct
pc@pc-VirtualBox:~/mobiwan$
```

**Figure 5.2 Performance evaluation of AOMDV-IOT with nodes = 25 on NS 2.35 Simulator**

### 5.1.2 Second Scenario:

For both AOMDV and AOMDV-IOT, the network has number of nodes 50. The outcome of AOMDV and AOMDV-IOT performance for 50 nodes is shown below.

**Table 5.2 Performance evaluation for number of nodes 50 (nodes = 50)**

	AOMDV	AOMDV-IOT
Total Packets Sent	37571	37571
Total Packets Received	34190	37571
Total Packets Dropped	7485	0
Packet Delivery Ratio	91.00	100.00
Throughput of network	17.0950	18.7855
Average end to end delay(ms)	0.024838866	0.001686445

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics

Total Packets Sent           :      37571
Total Packets Received       :      34190
Total Packets Dropped        :       7485
Packet Delivery Ratio        :      91.00
Throughput of the network(KBps) :    17.0950
Average End to End Delay     :0.024838866 ms
```

**Figure 5.3 Performance evaluation of AOMDV with nodes = 50 on NS 2.35 Simulator**

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics

Total Packets Sent           :      37571
Total Packets Received       :      37571
Total Packets Dropped        :        0
Packet Delivery Ratio        :     100.00
Throughput of the network(KBps) :    18.7855
Average End to End Delay     :0.001686445 ms
Metric values are correct
```

**Figure 5.4 Performance evaluation of AOMDV-IOT with nodes = 50 on NS 2.35 Simulator**

### 5.1.3 Third Scenario:

For both AOMDV and AOMDV-IOT, the network has number of nodes 75. The outcome of AOMDV and AOMDV-IOT performance for 75 nodes is shown below.

**Table 5.3 Performance evaluation for number of nodes 75 (nodes = 75)**

	AOMDV	AOMDV-IOT
Total Packets Sent	30397	30397
Total Packets Received	26385	30397
Total Packets Dropped	9159	0
Packet Delivery Ratio	86.80	100.00
Throughput of network	13.1925	15.1985
Average end to end delay(ms)	0.040563530	0.001498503

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics

Total Packets Sent           :      30397
Total Packets Received       :      26385
Total Packets Dropped        :      9159
Packet Delivery Ratio        :      86.80
Throughput of the network(KBps) :      13.1925
Average End to End Delay     :0.040563530 ms
```

**Figure 5.5 Performance evaluation and of AOMDV with nodes = 75 on NS 2.35 Simulator**

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics

Total Packets Sent           :      30397
Total Packets Received       :      30397
Total Packets Dropped        :      0
Packet Delivery Ratio        :      100.00
Throughput of the network(KBps) :      15.1985
Average End to End Delay     :0.001498503 ms
Metric values are correct
```

**Figure 5.6 Performance evaluation of AOMDV-IOT with nodes = 75 on NS 2.35 Simulator**

#### 5.1.4 Fourth Scenario:

For both AOMDV and AOMDV-IOT, the network has number of nodes 100. The outcome of AOMDV and AOMDV-IOT performance for 100 nodes is shown below.

**Table 5.4 Performance evaluation for number of nodes 100 (nodes = 100)**

	AOMDV	AOMDV-IOT
Total Packets Sent	26395	26395

Total Packets Received	21793	26395
Total Packets Dropped	8713	0
Packet Delivery Ratio	82.56	100.00
Throughput of network	10.8965	13.1975
Average end to end delay(ms)	0.047285584	0.001546135

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics
Total Packets Sent      :      26395
Total Packets Received :      21793
Total Packets Dropped  :       8713
Packet Delivery Ratio   :       82.56
Throughput of the network(KBps) :    10.8965
Average End to End Delay :0.047285584 ms
```

Figure 5.7 Performance evaluation of AOMDV with nodes = 100 on NS 2.35 Simulator

```
pc@pc-VirtualBox:~/mobiwan$ awk -f myresults.awk trace.tr

Performance Metrics
Total Packets Sent      :      26395
Total Packets Received :      26395
Total Packets Dropped  :         0
Packet Delivery Ratio   :      100.00
Throughput of the network(KBps) :    13.1975
Average End to End Delay :0.001546135 ms
Metric values are correct
pc@pc-VirtualBox:~/mobiwan$
```

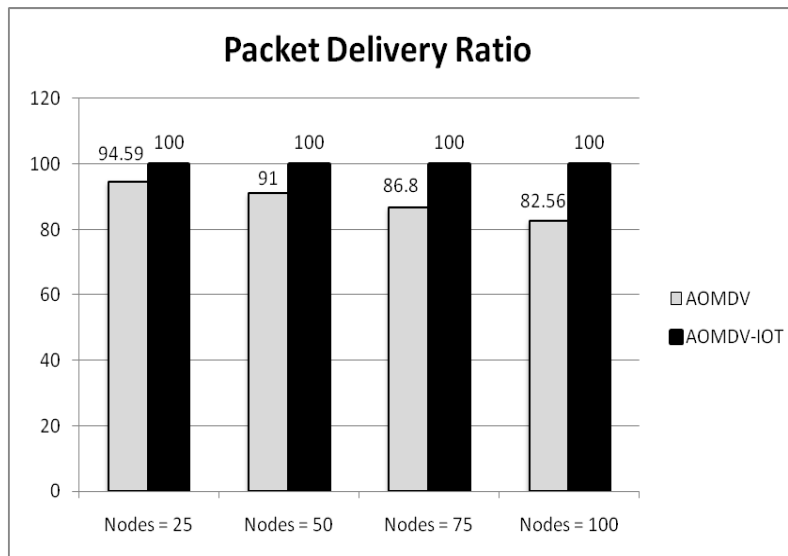
Figure 5.8 Performance evaluation of AOMDV-IOT with nodes = 100 on NS 2.35 Simulator

## 5.2 Summarize Results

Summarizing the simulation results of all the four scenarios we conclude our analysis of AOMDV and AOMDV-IOT with Packet Delivery Ratio, Throughput of Network and Average End-To-End Delay.

Table 5.5 Representing the Packet Delivery Ratio Summary for the four scenarios.

	AOMDV	AOMDV-IOT
Nodes = 25	94.59	100.00
Nodes = 50	91	100.00
Nodes = 75	86.80	100.00
Nodes = 100	82.56	100.00

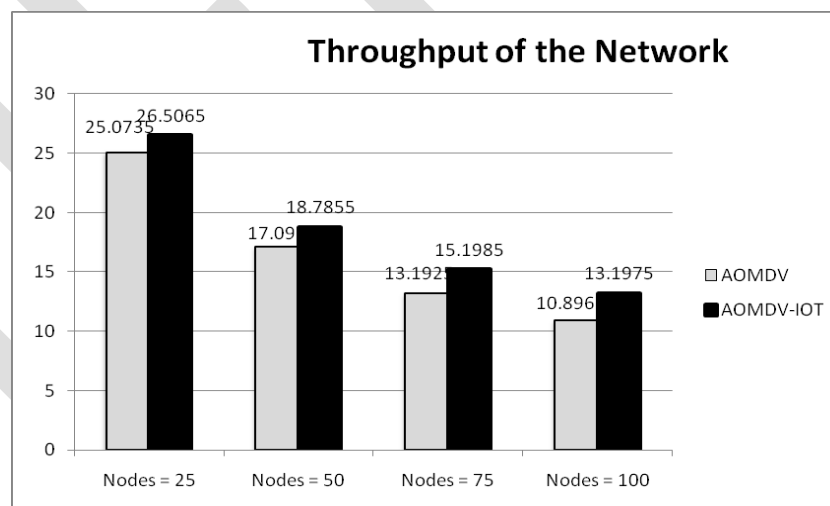


**Figure 5.9 Graph representing the Packet Delivery Ratio Summary by AOMDV and AOMDV-IOT.**

Figure 5.9 shows the Packet Delivery Ratio Summary by AOMDV and AOMDV-IOT.

**Table 5.6 Representing the Throughput of the Network Summary for the four scenarios.**

	AOMDV	AOMDV-IOT
<b>Nodes = 25</b>	25.0735	26.5065
<b>Nodes = 50</b>	17.095	18.7855
<b>Nodes = 75</b>	13.1925	15.1985
<b>Nodes = 100</b>	10.8965	13.1975



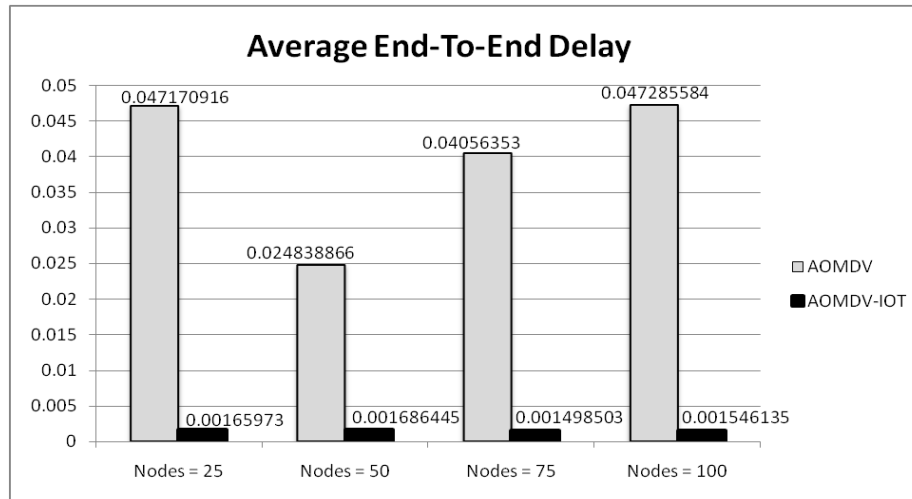
**Figure 5.10 Graph representing the Throughput of the AOMDV and AOMDV-IOT Network.**

Figure 5.10 shows the throughput of the AOMDV and AOMDV-IOT network.

**Table 5.7 Representing the Average End-To-End Delay Summary for the four scenarios.**

	AOMDV	AOMDV-IOT
<b>Nodes = 25</b>	0.047170916	0.00165973

<b>Nodes = 50</b>	0.024838866	0.001686445
<b>Nodes = 75</b>	0.04056353	0.001498503
<b>Nodes = 100</b>	0.047285584	0.001546135



**Figure 5.11 Graph representing the Average End-To-End Delay by AOMDV and AOMDV-IOT.**

Figure 5.11 shows the average end-to-end delay by AOMDV and AOMDV-IOT.

## CONCLUSION

Internet of Things has the widespread future by providing applications with many aids to users. Internet of Things has prominent benefits over the worldwide. As IOT is the new technology, it has some challenges. The presented dissertation discussed AOMDV routing protocol for Internet of Things to improve the algorithm by optimizing the protocol, such as routing table and internet connecting table are combined into one. Proposed AOMDV-IOT gives better performance in terms of Packet Delivery Ratio, Throughput of network, and Average End-to-End Delay.

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# Efficient Architecture for Matrix Multiplication using Floating Point Multiplier

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**Abstract-** A new area and delay minimization architecture is proposed in this paper for rank-1 update matrix-matrix multiplication whose inputs are double precision floating point number. The architecture design is based on pipelined multiplication which handles matrices of arbitrary size. This minimization is introduced to designers as a trade-off between bandwidth and local memory. Analysis is presented for the design parameters optimal choice. The hardware architecture for the processing element is described in Verilog Hardware description language (HDL) and synthesized for a FPGA family virtex6-SX240T. Performance of the architecture is analysed based on several parameters such as frequency, Power, Slices, bonded IOBs, DSP48E1S, LUTs, delay, and Memory usage. The experiment results show that, the proposed architecture with Rank1 update attain a delay of 7.314 ns and consumes a power of 0.326watt respectively. Comparing with other rank-1 multiplication methods our proposed algorithms utilizes 15% less available resources and improves the delay in 12%.

**Keywords**— Computation efficiency, Field Programmable Gate Array, Floating point arithmetic, Matrix, System performance, Pipeline Architecture, Processing Element.

## INTRODUCTION

Floating point multipliers are the most critical arithmetic functional units in many scientific computing applications such as seismic data processing, digital filtering, image processing etc. The throughput of the device depends on the performance of the multiplier. Basic linear algebra subprograms (BLAS) describes a set of low level routines for performing linear algebra applications such as vector addition, scalar multiplication, dot product and matrix multiplication. To improve performance many independent parallel operations are performed in Matrix multiplication. The external memory data are processed by linear array of parallel processing elements [1] which works on square matrix and does not support zero and other denormal numbers, implementation on Xilinx XC2VP125 FPGA improves the performance by accommodate 39 PEs. Linear array operator [4] broadcast matrix elements to all PEs achieve higher efficiency by reuse of data and overlap of transfers. Linear array of modular processing elements [9-11] on various target platforms improves the performance by memory switching and blocking. Parallel systolic architecture with pipelined floating point multiplier accumulator [8] consumes less hardware resources and good scalability for higher order matrices. This paper, contribute a detailed analysis of area and delay reduction in double precision floating point matrix multiplication. The processing elements are arranged in linear array with pipeline processing. This paper is well organized as follows. In section II the proposed algorithm is explained. The result is discussed in section III and the conclusion in section IV.

## MATRIX MULTIPLICATION ARCHITECTURE

The rank-1 update Matrix multiplication algorithm is described as  $C = \alpha A^T B + \beta C$  where  $\alpha, \beta = 1$ . Consider A, B and C of dimensions  $P \times Q$ ,  $Q \times R$  and  $R \times S$ , respectively. When two matrices of sizes  $S_a \times Q$  and  $Q \times S_b$  are multiplied, the result we obtained is subblock of matrix C with dimension  $S_a \times S_b$ . The processing speed is improved by broadcasting elements to all PEs and streaming in of elements to the prefetch register. The goal of this algorithm is to improves performance by complete utilization of resources and concatenation of I/O and computation. This goal is attained by high bandwidth cost and use of complete available resources.

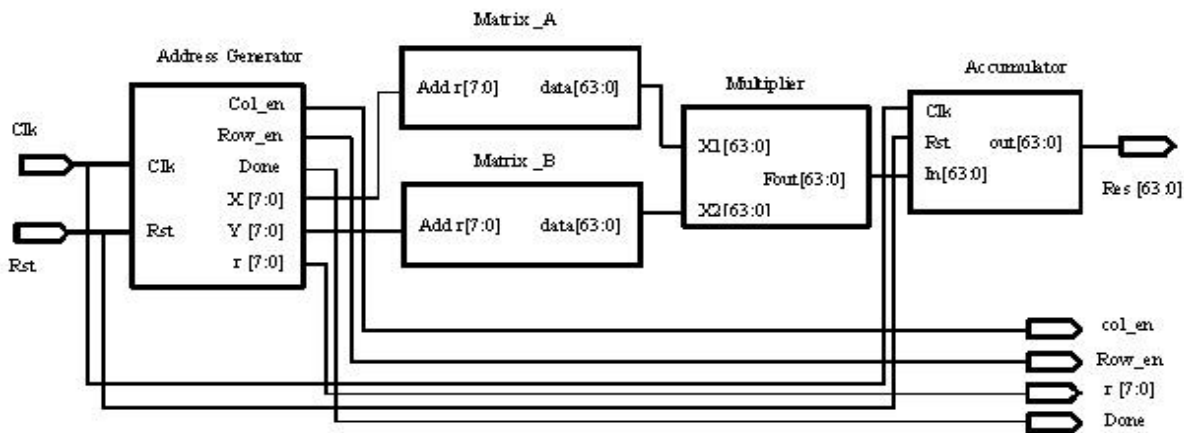


Figure 1. Components for Rank-1 update scheme

## Component description

Figure 1 shows the different components involve in the proposed architecture. The data from matrix A and matrix B is given to the multiplier and the product is store in the accumulator. In order to improve the memory access an execution unit known as the address generator is used in the processing element to generate the address for the input unit and the accumulator. The component description for figure 2(a) is given below.

- 1) Prefetch unit : This unit is used to prefetch the next row while the current row is used. The data from this unit is shifted forward serially to the next unit.
- 2) FIFO: An unexpected drop in frequency occur when the prefetch data is connected directly to the multiplier so a FIFO is placed inbetween to reduce the routing complexity.
- 3) Multiplier: The data received by the floating point multiplier is 64 bits. A standard floating point double precision multiplier is used. The output of floating point multiplier is given to BRAM block.
- 4) Adder : A standard floating point adder is used. It receive data from the multiplier and write back the result to the BRAM.
- 5) BRAM: The storage space for accumulation is dual port BRAM . Using port A the adder write back the result and read the data from BRAM using port B .
- 6) Output unit : The final updated result from BRAM is stored in the output unit.

## Data flow

Figure 2a explains the operation of the processing element . The input elements from matrix A and matrix B are streamed in the multiplier in terms of column major and row major respectively. The first row of matrix A shift into the prefetch register. After the complete loading of the elements into prefetch register, the elements of matrix B is loaded down into the working line register. In the mean while the next row of the matrix A is shifted by the prefetch register. Meantime element from matrix B is broadcast into the multiplier and the elements are processed and the result of the addition is stored in the BRAM. During the first outer products , zero is accumulated with the product after which the accumulation happen in the BRAM. The data are feeded continuously at maximum design frequency. Pipeline shall not be stalled since there is no data dependencies occur between successive multiplication. The merit of this architecture is computation and complete overlap of I/O. Therefore all PEs are in process all the time except during the initial latency period.

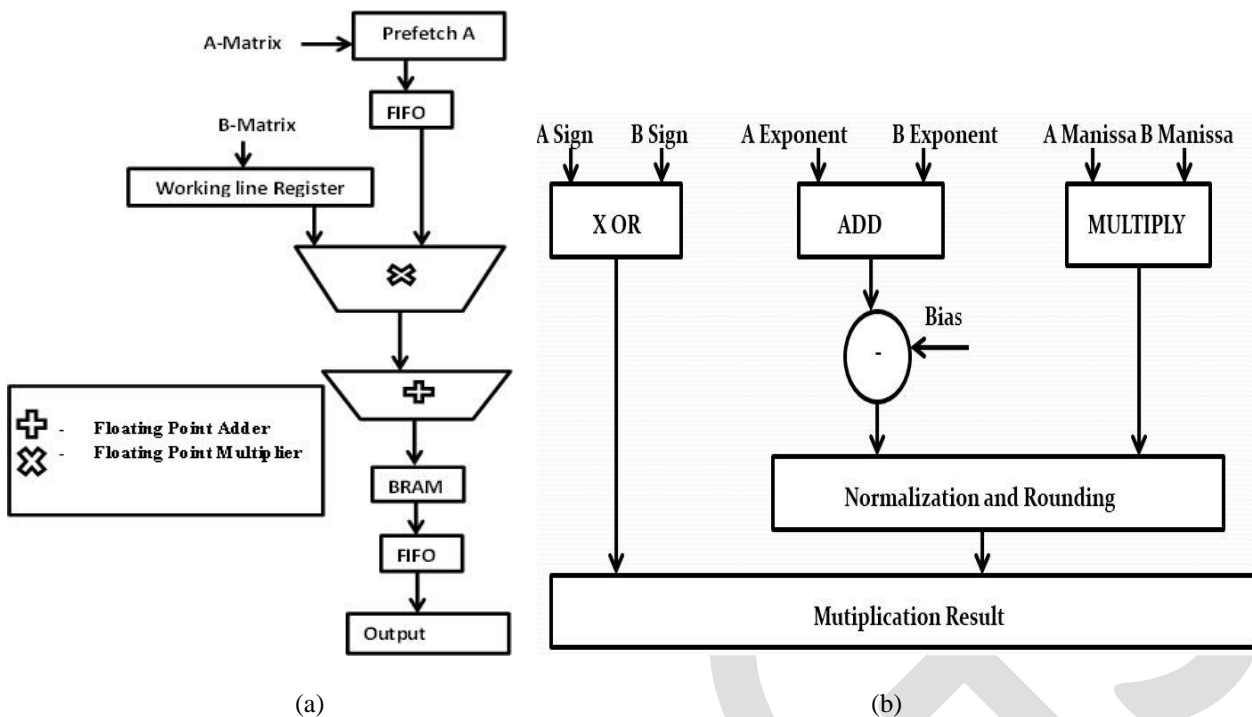


Figure 2(a).overview of proposed architecture. (b) Structure of Double Precision Floating point Multiplication

### A Double Precision Floating Point Multiplication

Figure 2(b) shows the field wise Multiplication of double precision floating point numbers. The given values are first converted into 64 bit binary number(1bit sign,11 bit manitissa,52 bit exponent),after conversion multiplication is carried out for each fields separately .

**Sign calculation:** The Sign of the number to be multiplied is obtained as follow .If the sign is negative it indicates one and if the number is positive it indicates zero. For this purpose XOR gate is used. The product is positive when the two operands have the same sign, otherwise it is negative.

$$\text{Sign}, S = S_a \text{ XOR } S_b$$

**Exponent calculation:** It is carried out by adding the exponent of number to be multiplied followed by subtracting the added value with bias. The bias value is 1023 for double precision floating point numbers. The eleven bit in the exponent represents a biased exponent, which is obtained by adding 1023 to the actual exponent. The biased exponents allow a range of actual exponent values from -1022 to +1023.

**Mantissa calculation:** The 52 bit mantissas of the two numbers are multiplied and subjected to normalization and rounding. The mantissa bit of multiplication after, the normalization is applied to final resultant for bring back the 64-bit format.(i.e.) sign-exponent-mantissa.

### DESIGN EVALUATION

Xilinx ISE13.5 is used for implementation and simulation of the design respectively. The design was ported to the virtex-5 SX240T FPGA. The performance of our algorithms is analyze using different parameters like frequency, delay, power, memory, number of slices used and bonded IOB. Figure3 and figure 4 shows the output wave form and technology schematic for floating point multiplication

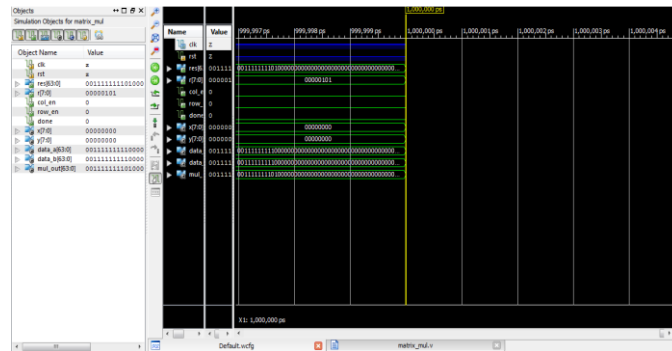


Figure 3 Output Waveform for Double Precision Floating point Matrix multiplication

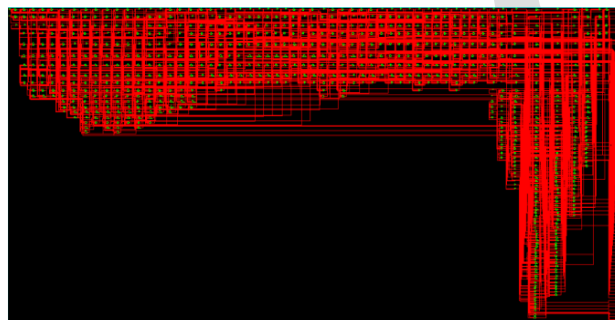


Figure 4. Technology Schematic for floating point matrix multiplication

Table 1 gives the performance analysis of architectures on different devices . On comparing, Pipelined architecture consumes less power and delay than other architectures. When compared with other architecture the memory usage is 5% less for some devices, the delay and the power consumed is reduced by 0.75%. Our architecture accommodate more number of PEs (more than 40) by proper pipelining and usage of available resources. On comparing our algorithms with other rank 1 update scheme, as reported [10,11] by scaling 20 PEs the degradation in frequency by 35% and in our architecture we scale more than 40 PEs with negligible degradation in frequency and delay. Design requires square matrices [1, 10], our architecture support matrix of arbitrary sizes. Using intermediate term partaking the area reduced to 10% when compared with [1, 4, and 9]. Our floating point MAC unit support zeros and abnormal numbers. For Computation and overlapping I/O our algorithm used pipeline processing in resist to memory switching [1,10].

TABLE 1. PERFORMANCE ANALYSIS OF ARCHITECTURES ON DIFFERENT DEVICES.

Pipelining Architecture				
DEVICES	Power (W)	Frequency (MHZ)	Delay (ns)	Memory (M Byte)
VIRTEX 4	0.176	118.23	8.456	220.68
VIRTEX 5	0.382	131.89	7.582	224.648
VIRTEX 6	2.520	189.517	5.277	202.416
VIRTEX 7	-	231.722	4.3162	231.856

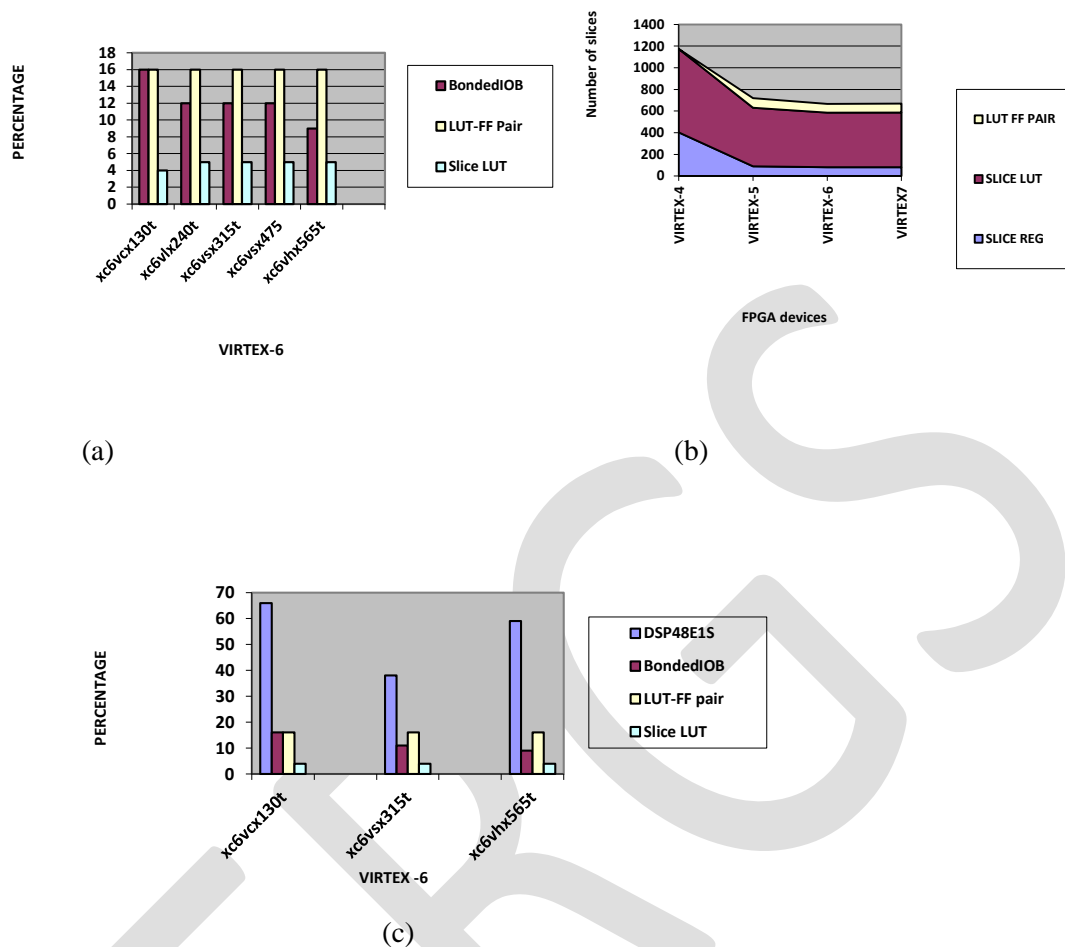


Figure 3. Comparison of various parameters on (a) Different devices for pipelined multiplication. (b) Different virtex family for floating point multiplication.

## CONCLUSION

In this paper the design for matrix multiplication is presented with trade-off between frequency and memory. In matrix multiplication Multipliers are the foremost element in area and delay consumption. The performance investigation shows that the performance of our algorithm improved in term of delay and area. The algorithms with a design frequency of 189.517MHZ on virtex-5 SX240T FPGA attain a sustain peak performance.

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