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DESIGN OF GENETIC ALGORITHM BASED PI CONTROLLER FOR SPHERICAL TANK SYSTEM

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ABSTRACT
Many practical processes exhibit nonlinear behaviour. However most controller design approaches are based on linear models. Although linear model based control methods are well established they don't give satisfactory control performance, when the controlled process is highly non-linear. The non-linearities of practical processes are normally very complex. It is quite difficult to derive complete knowledge of such non-linearities. In this paper non linear process such as spherical tank system is taken as for study. It is difficult to derive a mathematical model for a non linear system. Hence, in this work an attempt is made to find the process model by block box modelling and derived model is approximated as first-order with dead time at three different operating points, a conventional PI controller was designed for this model and its parameters are obtained by Zielger Nichols method. Genetic is a stochastic algorithm based on principles of natural selection and genetic algorithm are a stochastic global search method that mimics the process of natural evolution In this paper ,it is proposed that the controller be tuned using the genetic algorithm technique. Genetic algorithm tuned PI was developed for improving the performance of the nonlinear system. The performance of conventional PI controller is compared with genetic algorithm tuned PI controller .Simulation results shows GA based PI controller provides satisfactory performance in terms of set point tracking. Finally, the controller robustness is examined and it is shown that the designed controller is robust against model parameters changes.

Keywords: Genetic algorithm, PI controller, Spherical tank system, Robustness.

I. INTRODUCTION
The PID controller is the most common form of feedback in use today. According to an estimate nearly 90% of the controllers used in industries are PID controllers. The family of PID controllers is rightly known as the building blocks of control theory owing to their simplicity and ease of implementation. Designing and tuning a PID controller appears to be conceptually intuitive, but can be hard in practice, if multiple (and often conflicting) objectives are to be achieved. A conventional PID controller with fixed parameters may usually derive poor control performance when it comes to system complexities. The major problems in applying a conventional controller (PI) in a level controller are the effects of non-linearity in a spherical tank. The nonlinear characteristics of a spherical tank such as saturation and fiction could degrade the performance of conventional controllers. An accurate nonlinear model spherical tank level is difficult to controller to be obtained. A genetic algorithm (GA) is a search technique used in computing to find true or approximate solutions to optimization and search problems. GA is composed of two main elements, which are strongly related to the problem being solved – the encoding scheme and the evaluation function [6]. The encoding scheme is used to represent the possible solutions to the problem. Individuals can be encoded in some alphabets, like binary strings, real numbers, and vectors. While applying GA practically, a population pool of chromosomes is installed and, initially, they are set to a random value. The individuals in the population are then evaluated. The evaluation function is provided by the programmer and gives the individuals a score based on how well they perform at the given task. Two individuals are then selected based on their fitness, the higher the fitness, the higher and the chance of being selected. . In this paper non linear process such as spherical tank system is taken as for study. It is difficult to derive a mathematical model for a non linear system. Hence, in this work an attempt is made to find the process model by block box modelling and derived model is approximated as first-order with dead time at three different operating points, a conventional PI controller was designed for this model and its parameters are obtained by Zielger Nichols method. The performance of conventional PI controller is compared with genetic algorithm tuned PI controller .

II. MODELING OF A SPHERICAL TANK
A. Experimental setup of Spherical tank system
The laboratory set up for spherical tank system is shown in Figure 1, it consists of a spherical tank, a water reservoir, pump, rotameter, a differential pressure transmitter, an electro pneumatic converter (I/P converter), a pneumatic control valve, VMAT-01 data acquisition module and a Personal Computer .The Differential Pressure Transmitter (DPT) output is interfaced with computer using VMAT-01 module in the RS-232 port of the PC. VMAT-01 data acquisition module supports one analog input and one analog output channels with the voltage range of ±5 volt and two Pulse Width Modulation (PWM) output. The sampling rate of the module is 0.1 sec and baud rate is 38400 bytes per sec with 8-bit resolution. The controller model is developed using

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Simulink blockset in MATLAB software and is then linked via this VMAT-01 module with the sampling time of 0.1 second. The pneumatic control valve is air to close, adjusts the flow of the water pumped to the spherical tank from the water reservoir. The level of the water in the tank is measured by means of the DPT and is transmitted in the form of (4-20) mA via I/P convert to the VMAT-01 data acquisition module. After computing the control algorithm in the PC, control signal is transmitted to I/P converter in the form of current signal (4-20) mA, which passes the air signal to the pneumatic control valve. The pneumatic control valve is actuated by this signal to produce the required flow of water at the inlet of the tank. There is a continuous flow of water in and out of the tank.

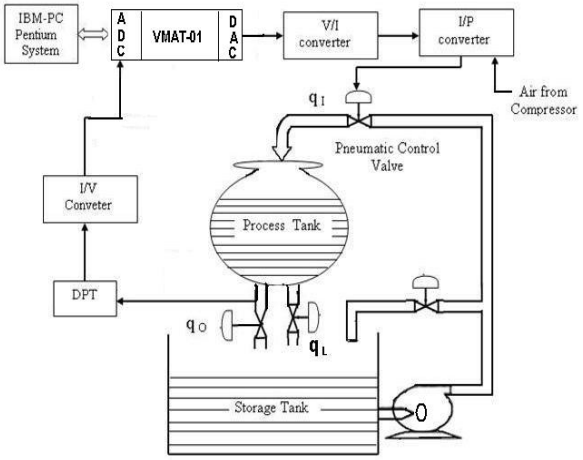

Figure-1: Block diagram representation of a liquid level control of a spherical tank

III. SYSTEM IDENTIFICATION

The system identification problem deals with the determination of a mathematical model for a system or a process by observing the input-output data [3]. In most practical systems, such as industrial processes, the actual parameter values within a known model structure are unknown [4]. The need for more accurate knowledge of system parameters has increased with recent advances in adaptive and optimal control [5]. System identification for the spherical tank system is done using black box modeling in real time.

For fixed input flow rate and output flow rate, the Spherical tank is allowed to fill with water from (0-50) cm height. At each sample time the data from differential pressure transmitter is being collected and fed to the system through the serial port RS - 232 using VMAT-01 data acquisition module. Thereby the data is scaled up in terms of level. Using the open loop method, for a given change in the input variable; the output response for the system is recorded. A first order system with dead time represented by the following transfer function

$$y(s) = \frac{Ke^{-\theta s}}{\tau s + 1} u(s) \qquad (1)$$

Where K = process gain, =Time constant, θ =dead time,

The output response to a step input change

$$y(t)z = \begin{cases} 0 & \text{for } t < \theta \\ K\Delta u\{1 - \exp(-(t-\theta)/\tau_p)\} & \text{for } t \geq \theta \end{cases} \qquad (2)$$

The measured output is in deviation variable form. The three process parameters can be estimated by performing a single step test on process input [4,5]. The process gain is found as simply the long term change in process output divided by the change in process input. Also the time delay is the amount of time, after the input change, before a significant output response is observed .Two point method is used for estimating the process parameters as shown in Figure 2. The process gain is calculated by

$$K = \frac{\Delta}{\delta} = \frac{\text{Change in process output}}{\text{Change in process input}}$$

The parameters of FOPTD transfer function model is obtained by letting the response of the actual system and that of the model to meet at two points which describe the two parameters τ and θ. Here the time required for the process output to make 28.3% and 63.2% respectively. The time constant and time delay can be estimated from equation 3 and equation 4

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$$\tau = 1.5(t_{63.2\%} - t_{28.3\%}) \quad (3)$$

$$\theta = t_{63.2\%} - \tau \quad (4)$$

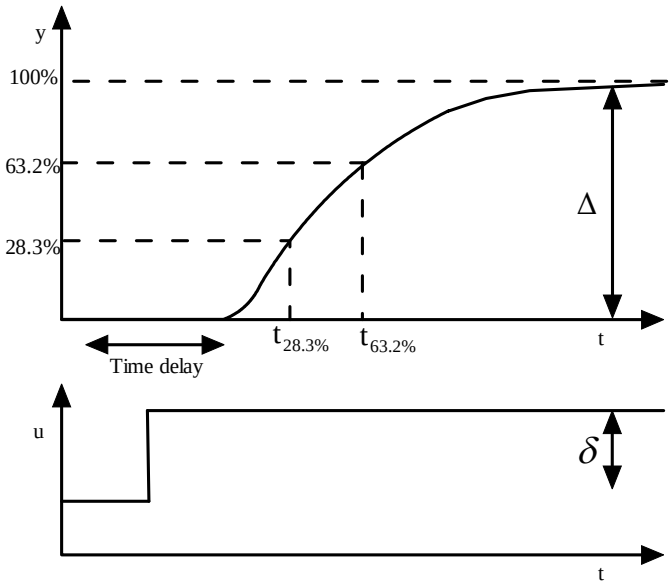

Figure-2: Two point method for estimating the process parameters

IV. OPEN LOOP MODELS FOR SPHERICAL TANK SYSTEM

The proposed works objective is to find the three different models at various operating regions. In the spherical tank process, the model has been taken at three different operating points of level around 10 %, 50% and 66% at lower, middle and upper level of the tank. At a fixed inlet flow rate, outlet flow rate, the system is allowed to reach the steady state. After that a step increment in the input flow rate is given, and various readings are noted till the process becomes stable in the spherical tank. The experimental data are approximated to be a FOPDT model. The open loop response of spherical tank process around operating point of 10%, 50%, 66% are taken in real time and parameters obtained reported in Table 1.

Table-1: Process parameters at three different operating points

Level	K	τ	θ
10 %	4.5	440	120
50 %	6	1200	130
66 %	2.75	1050	150

IV. DESIGN METHODS FOR TUNING CONTROLLER PARAMETERS

Although PID controllers are widely used in industry, the tuning of these parameters can be very challenging [2]. Tuning of a PID controller refers to the tuning of its various parameters (KP, KI and KD) to achieve an optimized value of the desired response. The basic requirements of the output will be the stability, desired rise time, peak time and overshoot. Different processes have different requirements of these parameters which can be achieved by meaningful tuning of the PID parameters [5].

When a mathematical model of a system is available, the parameters of the controller can be explicitly determined. However, when a mathematical model is unavailable, the parameters must be determined experimentally. Types of controller tuning methods include the trial and error method, and process reaction curve methods. The most common classical controller tuning methods are the Ziegler-Nichols and Cohen-Coon methods. The Ziegler-Nichols method can be used for both closed and open loop systems, while Cohen-Coon is typically used for open loop systems. Ziegler and Nichols present tuning rules based on process models that have been obtained through the open loop step tests. In this work Ziegler and Nichols tuning method is used to determine the controller parameters of spherical tank system. Ziegler and Nichols [1] proposed tuning parameters for a process that has been identified as first order with dead time based on open loop step response. Their recommended tuning parameters are shown in Table 2. It should be noted that using the model parameters, PI controller parameters are obtained at three different operating point are reported in Table 3.

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Table-2: Ziegler –Nichols open loop tuning parameters

Controller type	K_c	τ_I	τ_D
P- only	$\frac{\tau_p}{k_p\theta}$		
PI	$\frac{0.9\,\tau_p}{k_p\theta}$	3.3θ	
PID	$\frac{1.2\,\tau_p}{k_p\theta}$	$2\,\theta$	0.5θ

Table-3: PI controller parameters at different operating points

Level	Transfer Function model	Controller gain K_P	Integral gain K_I
10 %	$G(s)=\frac{4.5e^{-120s}}{440s+1}$	0.7330	0.0018
50 %	$G(s)=\frac{6e^{-130s}}{1200s+1}$	1.3846	0.0032
66 %	$G(s)=\frac{2.75e^{-150s}}{1050s+1}$	2.2900	0.0046

V. GENETIC ALGORITHMS

Genetic Algorithms (GA) are a stochastic global search method that mimics the process of natural evolution [6]. It is one of the methods used for optimization. GA belonging to the family of evolutionary computational algorithms has been widely used in many control engineering applications. It is implemented as a computer simulation in which a population of abstract representations, called chromosomes or the genotype or the genome, of candidate solutions, creatures, or phenotypes, to an optimization problem evolves towards better solutions [7]. The continuing performance improvement of computational systems has made them attractive for some types of optimization. It finds the optimal solution through cooperation and competition among the potential solutions. These algorithms are highly relevant for industrial applications, because they are capable of handling problems with non-linear constraints, multiple objectives, and dynamic components properties that frequently appear in real-world problems [8]. The GA starts with no knowledge of the correct solution and depends entirely on responses from its environment and evolution operators such as reproduction, crossover and mutation to arrive at the best solution. By starting at several independent points and searching in parallel, the algorithm avoids local minima and converges to sub optimal solutions [9].

VI. CHARACTERISTICS OF GENETIC ALGORITHM

Genetic Algorithms (GAs) are adaptive heuristic search algorithms that follow the Darwinian principle of "survival of the fittest". They are based on the evolutionary ideas of natural selection and genetic inheritance [8]. GA involves a population of individuals, referred to as chromosomes, and each chromosome consists of a string of cells called genes. Chromosomes undergo selection in the presence of variation inducing operators such as crossover and mutation. Crossover in GAs occurs with a user specified probability called the "crossover probability" and is problem dependant. The mutation operator is considered to be a background operator that is mainly used to explore new areas within the search space and to add diversity to the population of chromosomes in order to prevent them from being trapped within a local optimum. Mutation is applied to the offspring chromosomes after crossover is performed [11]. A selection operator selects chromosomes for mating in order to generate offspring. The selection process is usually biased toward fitter chromosomes. GA manipulates not just one potential solution to a problem but a collection of potential solutions. This is known as population. Each chromosome represents a binary string. However an individual chromosome performs a task which is measured and assessed by the objective function. The objective function assigns each individual a corresponding number called its fitness. The fitness of each chromosome is assessed and a survival of the fittest strategy is applied [12]. In this work, the magnitude of the error will be used to assess the fitness of each chromosome.

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A. Population Size

Determining the number of population is one of the important steps in GA. There is no fast and thumb rule for determining the population size. For a long time the decision on the population size is based on trial and error [13].It is suggested that the safe population size is from 30 to 100.

B. Reproduction

During the reproduction phase the fitness value of each chromosome is assessed. This value is used in the selection process to provide bias towards fitter individuals. Just like in natural evolution, a fit chromosome has a higher probability of being selected for reproduction [14]. An example of a common selection technique is the Roulette Wheel selection method. Each individual in the population is allocated a section of a roulette wheel. The size of the section is proportional to the fitness of the individual. A pointer is spun and the individual to whom it points is selected. This continues until the selection criterion has been met. The probability of an individual being selected is thus related to its fitness, ensuring that fitter individuals are more likely to leave offspring. Multiple copies of the same string may be selected for reproduction and the fitter strings should begin to dominate. Due to the complexities of the other methods, the Roulette Wheel method is preferred in this paper.

C. Crossover

Once the selection process is completed, the crossover process is initiated. The crossover operation swaps certain parts of the two selected strings in a bid to capture the good parts of old chromosomes and create better new ones. The crossover probability indicates how often crossover is performed [55]. A probability of 0% means that the offspring will be exact replicas of their parents and a probability of 100% means that each generation will be composed of entirely new offspring. The simplest crossover technique is the single point crossover. There are two stages involved in single point crossover:

1. Members of the newly reproduced strings in the mating pool are mated (paired) at random.
2. Each pair of strings undergoes a crossover as follows: An integer k is randomly selected between one and the length of the string less one, [1, L-1]. Swapping all the characters between positions k+1 and L inclusively creates two new strings.

More complex crossover techniques exist in the form of multi-point and uniform crossover Algorithms. In Multi-point crossover, it is an extension of the single point crossover algorithm and operates on the principle that the parts of a chromosome that contribute most to its fitness might not be adjacent [14]. In uniform crossover, a random mask of ones and zeros of the same length as the parent strings is used. Uniform crossover is the most disruptive of the crossover algorithms and has the capability to completely dismantle a fit string, rendering it useless in the next generation. Because of this, uniform crossover will not be used in this paper work and multi-point crossover is the preferred choice.

D. Mutation

Using selection process and crossover on their own will generate a large amount of different strings. However there are two main problems with this:

1. Depending on the initial population chosen, there may not be enough diversity in the initial strings to ensure that the GA searches the entire problem space.
2. The GA may converge on sub-optimum strings due to a bad choice of initial population.

These problems may be overcome by the introduction of a mutation operator into the GA. Mutation is the occasional random alteration of a value of a string position. It is considered a background operator in the GA [15]. The probability of mutation is normally low because a high mutation rate would destroy fit strings and degenerate the GA into a random search. Mutation probability values of around 0.1% or 0.01% are common, these values represent the probability that a certain string will be selected for mutation i.e. for a probability of 0.1%; one string in one thousand will be selected for mutation [15]. Once a string is selected for mutation, a randomly chosen element of the string is changed or mutated.

VII. STEPS TO IMPLEMENT GA

The steps involved in creating and implementing a genetic algorithm:

1. Generate an initial, random population of individuals for a fixed size.
2. Evaluate their fitness.
3. Select the fittest members of the population.

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4. Reproduce using a probabilistic method.
5. Implement crossover operation on the reproduced chromosomes
6. Execute mutation operation with low probability.
7. Repeat step 2 until a predefined convergence criterion is met.

The convergence criterion of a genetic algorithm is a user-specified condition for example the maximum number of generations or when the string fitness value exceeds a certain threshold.

VIII. ELITISM

In the process of the crossover and mutation taking place, there is high chance that the optimum solution could be lost. There is no guarantee that these operators will preserve the fittest string [13]. To avoid this, the elitist models are often used. In this model, the best individual from a population is saved before any of these operations take place. When a new population is formed and evaluated, this model will examine to see if this best structure has been preserved. If not the saved copy is reinserted into the population. The GA will then continue on as normal.

IX. OBJECTIVE FUNCTION OR FITNESS FUNCTION

The objective function is used to provide a measure of how individuals have performed in the problem domain. In the case of a minimization problem, the fit individuals will have the lowest numerical value of the associated objective function. This raw measure of fitness is usually only used as an intermediate stage in determining the relative performance of individuals in a GA.

X. DESIGNING OF PID USING GENETIC ALGORITHM

The optimal value of PID controller parameters KP, KI, KD is to be found using GA. All possible sets of controller parameter values are particles whose values are adjusted to minimize the objective function. An objective function is required to evaluate the best PID controller for the system. An objective function could be created to find a PID controller that gives the smallest overshoot, fastest rise time or quickest settling time. However in order to combine all of these objectives it was decided to design an objective function that will minimize the error of the controlled system instead. Each chromosome in the population is passed into the objective function one at a time. The chromosome is then evaluated and assigned a number to represent its fitness, the bigger its number the better its fitness. The GA uses the chromosome fitness value to create a new population consisting of the fittest members. Each chromosome consists of three separate strings constituting a P, I and D term, as defined by the 3-row 'bounds' declaration when creating the population. When the chromosome enters the evaluation function, it is split up into its three terms. The P, I and D parameters are used to create a PID controller according to the equation below

$$C_{PID}=\frac{K_D s^2+K_P s+K_I}{s} \qquad (4)$$

The newly formed PID controller is placed in a unity feedback loop with the system transfer function. The controlled system is then given a step input and the error is assessed using an error performance criterion such as ISE, IAE and ITAE. The chromosome is assigned an overall fitness value according to the magnitude of the error, the smaller the error the larger the fitness value.

XI. INITIALIZATION OF PARAMETERS

To start up with Genetic algorithm, certain parameters need to be defined. It includes the population size, bit length of chromosome, Number of iterations, Selection. Crossover and mutation types etc. In this work to tune the PI controller parameters for spherical tank system using GA, parameters are initialized as follows

- Population size =100
- Bit length of the considered chromosome: 6
- Number of generations: 100
- Selection method: Roulette Wheel method
- Cross over type: Multi point crossover
- Crossover probability: 0.8
- Mutation type: uniform mutation
- Mutation probability: 0.

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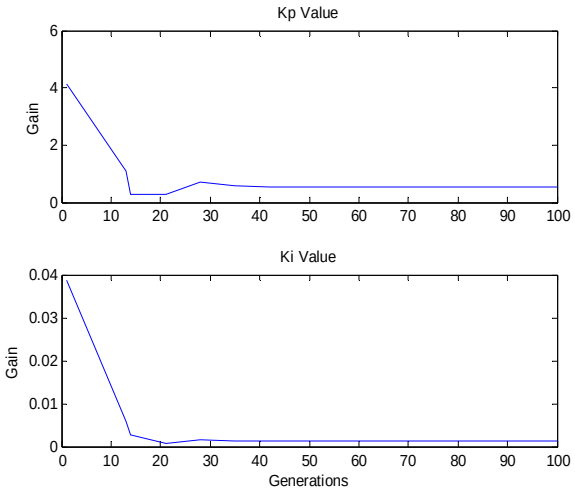

Figure-3: Best solutions of Kp and Ki to model 1 for 100 iterations (GA)

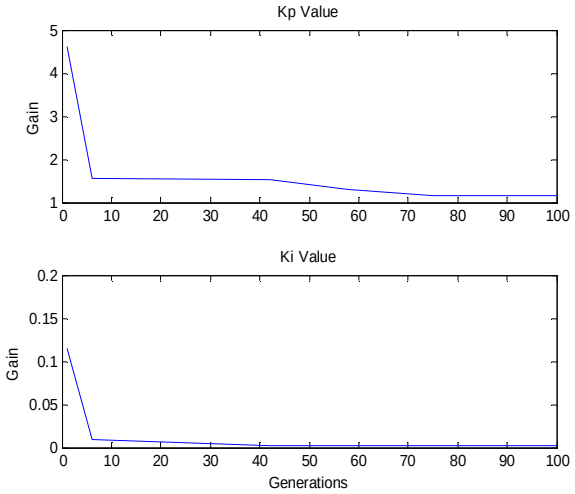

Figure-4: Best solutions of Kp and Ki to model 2 for 100 iterations (GA)

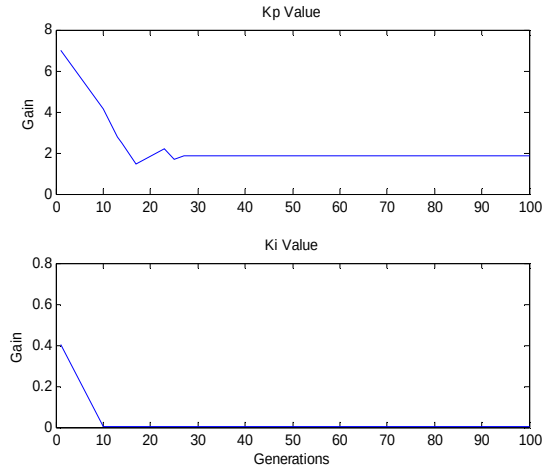

Figure-5: Best solutions of Kp and Ki to model 3 for 100 iterations (GA)

Table-4: PI parameters obtained from GA

Methods	Model 1		Model 2		Model 3	
	Kp	Ki	Kp	Ki	Kp	Ki
ZN	0.7333	0.0018	1.3846	0.0032	2.2900	0.0046
GA-ITAE	0.5235	0.0012	1.1528	0.0025	1.8586	0.0024
GA-IAE	0.6886	0.0013	1.1869	0.0033	1.9072	0.0034
GA-ISE	0.6669	0.0017	1.2488	0.0029	2.0237	0.0034

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XII. RESULTS AND DISCUSSION

The GA based controller with various cost functions are applied to three different models of Spherical tank process. The performances of the controllers with different controller parameters are evaluated through simulation. The unit step response of GA based PI controllers with ITAE, IAE and ISE as cost functions are shown in Figure 6 to Figure 8. The performance evaluation of GA based controller for model 1, model 2 and model 3 are presented in Table 5, Table 6 and Table 8 respectively. It found that GA tuned PI controller based on ITAE cost function gives better performance compared to IAE and ISE based controllers. Based on required performance we can select the controller parameters. It concluded that ITAE based controller gives better performance than other two.It is clear from the responses, GA based controller performs well when compared to PI-ZN controller.

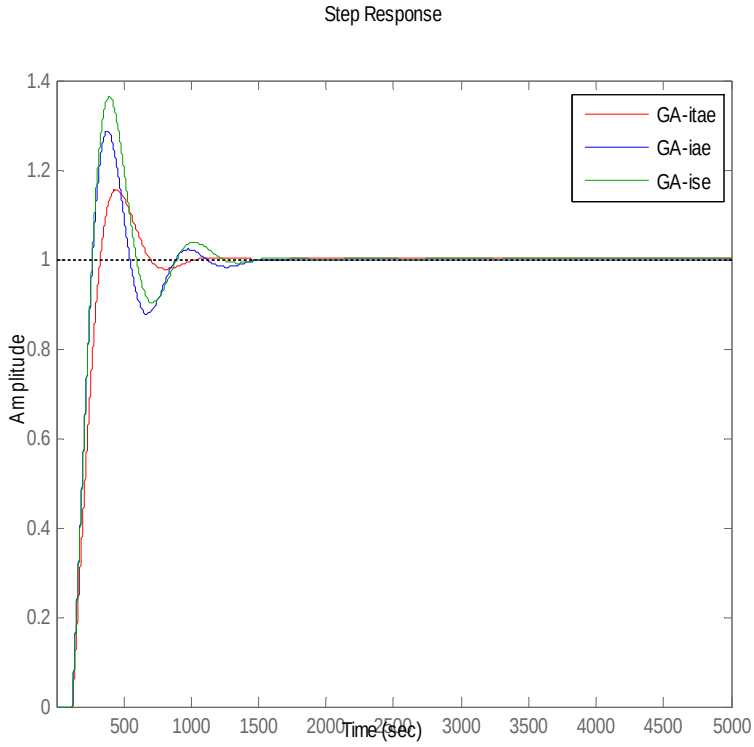
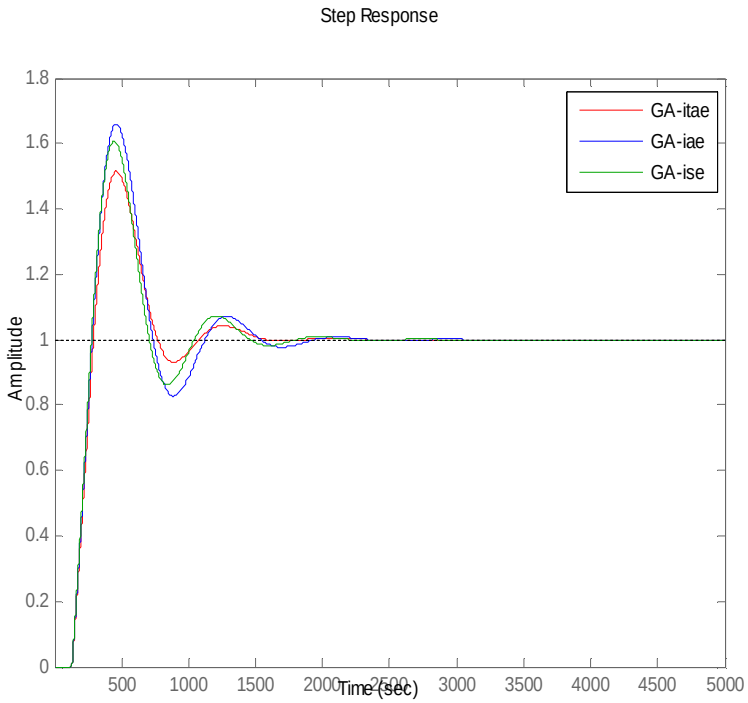


Figure-6: Step response for the closed loop system with GA based PI controller (model 1)



Figur-7: Step response for the closed loop system with GA based PI controller (model 2)

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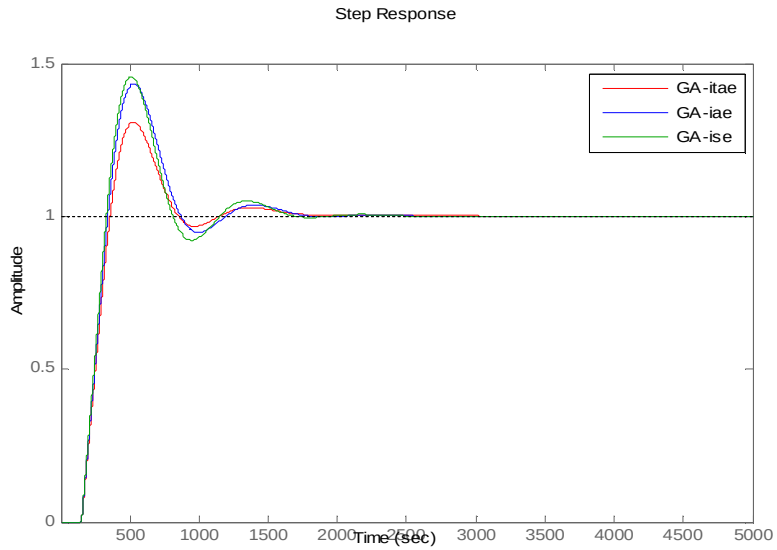

Figur-8: Step response for the closed loop system with GA based PI controller (model 3)

Table-5: Performance evaluation of spherical tank system with GA based controller and ACO based controller (model 1)

Methods	%Mp	Tp	ts	Tr	IAE	ISE	MSE	ITAE
ZN	42.9	376	1320	106	315.71	195.95	0.0392	$9.22x10^4$
GA-ITAE	16.1	448	849	157	256.64	187.37	0.0375	$4.72x10^4$
GA-IAE	28.0	370	989	108	276.57	181.56	0.0363	$7.03x10^4$
GA-ISE	36.3	393	1140	11	295.01	191.11	0.0382	$7.56x10^4$

Table-6: Performance evaluation of spherical tank system with GA based controller and ACO based controller (model 2)

Methods	%Mp	tp	ts	Tr	IAE	ISE	MSE	ITAE
ZN	69.8	425	1920	105	465.61	279.93	0.0560	$2.0565x10^5$
GA-ITAE	52.3	464	1440	120	388.66	246.06	0.0492	$1.3028x10^5$
GA-IAE	65.1	470	1750	122	454.97	280.66	0.0561	$1.8600x10^5$
GA-ISE	60.8	446	1400	128	420.10	260.00	0.0521	$1.5838x10^5$

Table-7: Performance evaluation of spherical tank system with GA based controller and ACO based controller (model 3)

Methods	%Mp	tp	ts	Tr	IAE	ISE	MSE	ITAE
ZN	63.7	486	2140	124	499.58	300.23	0.0600	$2.3669x10^5$
GA-ITAE	30.2	525	1530	160	361.09	238.41	0.0470	$1.1800x10^5$
GA-IAE	43.8	528	1610	150	408.08	261.23	0.0522	$1.4300x10^5$
GA-ISE	37.5	536	1560	140	408.28	258.89	0.0518	$1.4750x10^5$

ROBUSTNESS

Robustness of the controller is defined as its ability of tolerate a certain amount of changes in the process parameters without causing the feedback system to go unstable. In order to investigate the robustness of the proposed methods in the face model uncertainties, the model parameter namely process gain, time constant, delay time were altered (as shown in Table 8) from nominal values of.

Table-8: Changes in process parameters of original model

	K	τ	θ
Case 1	15 % increase	15 % increase	15 % increase
Case 2	10 % increase	10 % increase	15 % decrease
Case 3	25 % increase	No change	No change
Case 4	No change	25 % increase	No change
Case 5	No change	No change	25 % increase

The robustness of PI controller tuned with GA is evaluated and compared with other tuning methods as in Table 9. Thus GA tuned controller shows better result compared ZN based controller

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IX. CONCLUSION

In this paper, the concept of Genetic Algorithm based PI controller is described. The PID controller parameters are obtained using GA and compared with traditional tuning method. The obtained results which exhibit the effectiveness of the GA tuning technique. The results shown that there is a significant improvement in the time domain specification in terms of lesser rise time and settling time with the application GA based PID settings. GA-PI with different objective functions were used to tune PI parameters. According to this, ITAE cost function gives a better performance. Secondly, GA–ITAE and ZN are compared. Then, the performance of optimal tuning methods for tuning PI controllers was tested (by changes time constant, process gain, delay time) for robustness. The controller tuned with GA-ITAE showed high robustness in all cases compared to other methods (GA-ITAE, ZN)

Table-9: Performance indices of various controllers for altered models based on GA and ZN for

Case 1																		
Methods	**Model 1**						**Model 2**						**Model 3**					
	Kp	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**
ZN	0.7333	0.0018	33.5	347	1000	105	1.3846	0.0032	53.8	390	1230	105	2.29	0.0046	49.6	448	1390	123
GA	0.5235	0.0012	11.7	439	729	162	1.1528	0.0025	39.5	437	1230	128	1.8586	0.0024	33.9	509	1350	155
Case 2																		
Methods	**Model 1**						**Model 2**						**Model 3**					
	Kp	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**
ZN	0.7333	0.0018	36.9	356	1040	105	1.3846	0.0032	59.4	402	1260	105	2.29	0.0046	52.9	464	1440	125
GA	0.5235	0.0012	13.4	433	668	157	1.1528	0.0025	43.8	545	1330	127	1.8586	0.0024	36.2	524	950	157
Case 3																		
Methods	**Model 1**						**Model 2**						**Model 3**					
	Kp	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**
ZN	0.7333	0.0018	65.7	348	2050	84	1.3846	0.0032	93.9	391	3560	85.7	2.29	0.0046	85.2	450	3400	102
GA	0.5235	0.0012	30.8	393	1100	120	1.1528	0.0025	70.7	416	1900	102	1.8586	0.0024	60.4	485	1800	125
Case 4																		
Methods	**Model 1**						**Model 2**						**Model 3**					
	Kp	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**
ZN	0.7333	0.0018	36.7	401	1170	118	1.3846	0.0032	55.6	478	1500	128	2.29	0.0046	49.3	554	1680	153
GA	0.5235	0.0012	13.4	499	809	181	1.1528	0.0025	42	539	1110	156	1.8586	0.0024	34.8	638	1240	194
Case 5																		
Methods	**Model 1**						**Model 2**						**Model 3**					
	Kp	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**	**Kp**	**Ki**	**%Mp**	**tp**	**Ts**	**tr**
ZN	0.7333	0.0018	20.5	326	648	109	1.3846	0.0032	40.8	370	1140	107	2.29	0.0046	35.2	428	1270	129
GA	0.5235	0.0012	3.19	450	550	182	1.1528	0.0025	29.3	424	1170	133	1.8586	0.0024	22.9	505	1034	186

robustness investigation

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SOFT MULTI-DIGRAPHS

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ABSTRACT
In this paper, soft multi-digraphs are introduced. In this connection some operations of soft multi-digraphs are defined. Also, the similarity measure and distance between two soft multi-digraphs are studied. Later on the relationship between soft multi-diagraph and matrices is defined. Finally an application of soft multi-digraphs is shown.

Keywords: Soft Set, Digraph, Soft Multisets.

1. INTRODUCTION

Multiset theory was introduced by N.G.Bruin [3]. These multisets are an important generalization of classical set theory. Molodtsov [13] introduced the theory of soft sets as a new mathematical tool to deal with the uncertain- ties present in our daily life. Now soft set theory is rapidly used in many fields like engineering, medical science, sociology, economics etc. to deal with the complexities of modeling with uncertain data. Many authors like Maji, Roy and Biswas [6, 7] have further studied the theory of soft sets and used this theory to solve some decision making problems. They have also introduced the concept of fuzzy soft set and intuitionistic fuzzy soft set [8, 9, 10], in a more generalized way. In 2009, Ali et al [1] has defined some new operations on soft sets.

Prof. Alkhazdeh studied the soft multi-set for the first time in his paper [2]. P. Majumdar reintroduced the soft multiset in [11]. In this paper we will introduce soft multi-digraph. Here we have tried to represent a soft multiset in the light of digraph theory. We will study the following: In Section 2, some preliminary definitions and example regarding soft set theory, soft digraph theory are given which will be used in the rest of the paper. In section 3, the definition of soft multi-digraph is given. Some operations of soft multi- digraph are discussed in section 4. Section 5 is devoted for some terminologies of soft multi-digraph. Finally in the last section i.e. section 6, an application using soft multi-digraphs is discussed.

2. PRELIMINARIES

Prof. S. Miyamoto introduced the concept of multiset theory with the help counting function in [12]. On the other hand, Prof. P. Majumdar redefined the concept of Soft Multiset theory which is a combination of soft set theory and multiset theory in his paper [11]. However for the benefit of the readers of this article, it is requested to follow the papers [13, 10, 12, and 11] for conceptual development regarding soft set, multiset and soft multiset theory.

Example-2.1: Suppose the universal set and the parameter set be as follows: Consider $U = \{h_1, h_2, h_3, h_4\}$ and $E = \{e_1, e_2, e_3\}$. Define a mapping $F: E \rightarrow P^*(U)$ as follows:

$$F(e_1) = \left\{\frac{1}{h_1}, \frac{2}{h_2}, \frac{2}{h_3}, \frac{3}{h_4}\right\}$$
$$F(e_2) = \left\{\frac{3}{h_1}, \frac{1}{h_2}, \frac{2}{h_4}\right\}$$
$$F(e_3) = \left\{\frac{1}{h_1}, \frac{1}{h_2}, \frac{2}{h_3}\right\}$$

Then (F, E, C_F) is a soft multiset where the soft count function C_F is given by the parameterized count functions C^{e1} , C^{e2} , C^{e3} : $U \rightarrow J$,which are define as follows:

$$c^{e1}_F(h_1) = 1,\ c^{e1}_F(h_2) = 2,\ c^{e1}_F(h_3) = 2,\ c^{e1}_F(h_4) = 3,$$

$$c^{e2}_F(h_1) = 3,\ c^{e2}_F(h_2) = 1,\ c^{e2}_F(h_4) = 2,$$

$$c^{e3}_F(h_1) = 1,\ c^{e3}_F(h_2) = 1,\ c^{e3}_F(h_3) = 2.$$

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Now digraph theory is one of the famous branch in Mathematics. It is rapidly used in solving many mathematical problems. For terminologies regarding graph theory, any standard reference, say [5] or [4] can be seen. We have introduced the soft digraph corresponding to a soft set (F, E) in our paper [15]. For sake of simplicity, we assume that the universal set and the parameter set to be finite throughout the paper. In this paper, we will introduce Soft Multi-digraph corresponding to a soft multiset.

3. SOFT MULTI-DIGRAPH

Recall that U = {hi, i = 1, 2, . . . , n} be an initial finite universal set and let E = {ei; i = 1, . . . , n} be a finite set of parameters. Suppose J be the set of all nonnegative integers and $P*(U)$ be the collection of all crisp multisets defined in U. Then a soft multiset which is a triple (F, E, C_F) with its soft count function $CF : E \to J^U$ is defined in [12]. Now we associate a digraph corresponding to every soft multiset, called soft multidigraph as follows:

Definition-3.1. Suppose (F, E, C_F) be a soft multiset over an universal set U. Consider a digraph $D = (V_D, A_D)$ with vertex set V_D and arc set A_D as follows:

$V_D = E \cup \{e_a\}$

$A_D = \{(ei, ej): hj \in F(e_i) \text{ and } j \leq |E|\} \cup \{(e_i, e_a): hj \in F(e_i) \text{ and } j > |E|\}$, where ea is a dummy parameter with $F(e_a) = \varphi$.

Now we associate a count function C^D_F which is a real valued function defined on A_D of D. In that case, corresponding to each $h_j \in F(ei)$, every arc (e_i, e_j) or (e_i, e_a) occurs exactly $C^D_F(h_j) = c^{ei}(h_j)$ times in A_D. Then the triplet $D = (V_D, A_D, C^D)$ is called a soft multi digraph corresponding to the soft multiset (F, E, C_F). The vertex e_a is called the universal vertex of the soft multi-digraph D.

Example-3.2. Consider the digraph D corresponding to the soft multiset (F, E, C_F) which is given as follows: Suppose the universal set and the parameter set be as follows: Consider $U = \{h_1, h_2, h_3, h_4\}$ and $E = \{e_1, e_2, e_3\}$. Define a mapping $F: E \to P*(U)$ as follows:

$$F(e_1) = \left\{ \frac{1}{h_1}, \frac{2}{h_2}, \frac{2}{h_3}, \frac{3}{h_4} \right\}$$

$$F(e_2) = \left\{ \frac{3}{h_1}, \frac{1}{h_2}, \frac{2}{h_4} \right\}$$

$$F(e_3) = \left\{ \frac{1}{h_1}, \frac{1}{h_2}, \frac{2}{h_3} \right\}$$

Then (F, E, C_F) is a soft multiset where the soft count function C_F is given by the parameterized count functions $C^{e1}, C^{e2}, C^{e3}: U \to J$, which are defined as follows:

$$c^{e1}_F(h_1) = 1,\ c^{e1}_F(h_2) = 2,\ c^{e1}_F(h_3) = 2,\ c^{e1}_F(h_4) = 3,$$

$$c^{e2}_F(h_1) = 3,\ c^{e2}_F(h_2) = 1,\ c^{e2}_F(h_4) = 2,$$

$$c^{e3}_F(h_1) = 1,\ c^{e3}_F(h_2) = 1,\ c^{e3}_F(h_3) = 2.$$

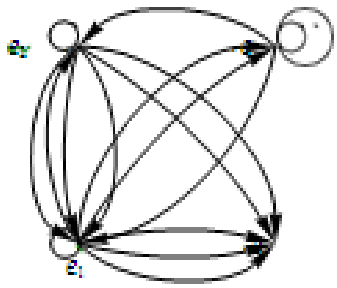

Figure-1: The soft multi-digraph D

It is clear that D is a soft multi-digraph by Definition 3.1.

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4. OPERATIONS ON SOFT MULTI-DIGRAPH

In this section we define some basic operations on soft multi-digraph.

Definition-4.1. Suppose D = (V_D, A_D, $C^D{}_F$) and H = (V_H, A_H, $C^H{}_G$) be any two soft multi-digraph corresponding to the two soft multi-set (F, A, C_F) and (G, B, C_G) respectively over the same universal set U. Then $V_D = A \cup \{e_a\}$ and $V_H = B \cup \{e_a\}$. Then D is a soft multi-subdigraph of H if $V_D \subseteq V_H$, $A_D \subseteq A_H$ and $C^D{}_G(h_j) \leq C^H{}_G(h_j)$, $\forall (e_i, e_j)$ (or (e_i, e_a)) $\in A_D \cap A_H$.

Note that $V_D \subseteq V_H$ implies $A \subseteq B$ and $A_D \subseteq A_H$ implies $\forall e \in A$, $F(e) \subseteq G(e)$. Also $C_D(h_j) \leq C^H(h_j)$, $\forall (e_i, e_j)$ (or (e_i, e_a)) $\in A_D \cap A_H$ implies that $C_F{}^e F(x) \leq C^G{}_e(x)$ $\forall x \in U$, $e \in A \cap B$. Thus, if H is a soft multi-subdigraph of D, then (F, A, C_F) is a soft multi-subset of (G, B, C_G).

Definition-4.2. Suppose D = (V_D, A=, $C^D{}_F$) and H = (V_H, A_H, $C^H{}_G$) be any two soft multi-digraph corresponding to the two soft multi-set (F, A, C_F) and (G, B, C_G) respectively over the same universal set U. Then $V_D = A \cup \{e_a\}$ and $V_H = B \cup \{e_a\}$. Then D and H are said to be equal soft multi-digraph.

If $V_D = V_H$, $A_D = A_H$ and $C^D{}_F(h_j) = C^H{}_G(h_j)$, $\forall (e_i, e_j)$ (or (e_i, e_a)) $\in A_D = A_H$.

In this case, we see that A = B and $c^e F(x) = c^e{}_G(x)$ $\forall x \in U$, $e \in A = B$.

Definition-4.3. Suppose H_1 = (V_{H1}, A_{H1}, $C^F{}_{H1}$) and H_2 = (V_{H2}, A_{H2}, $C^G{}_{H2}$) be any two soft multi-digraph corresponding to the two soft multi-set (F, A, C_F) and (G, B, C_G) respectively over the same universal set U. Then $V_{H1} = A \cup \{e_a\}$ and $V_{H2} = B \cup \{e_a\}$. Then the union of two soft multidigraph H_1 and H_2 i.e. $D_1 = H_1 \cup H_2$ is defined as follows: $V_{D1} = V_{H1} \cup V_{H2}$, $A_{D1} = A_{H1} \cup A_{H2}$ and $C_{D1}(h_j) = C^F{}_{H1}(h_j) \vee C^G{}_{H2}(h_j)$, $\forall (e_i, e_j)$ (or (e_i, e_a)) $\in A_{H1} \cup A_{H2}$. In this case also, we see that the soft multi-digraph D_1 represents the union of two soft multisets (F, A, C_F) and (G, B, C_G).

In a similar way we can define the intersection of two soft multi-digraph.

Definition-4.4. Suppose H_1 = (V_{H1}, A_{H1}, $C^F{}_{H1}$) and H_2 = (V_{H2}, A_{H2},$C^G{}_{H2}$) be any two soft multi-digraph corresponding to the two soft multi-set (F, A, C_F) and (G, B, C_G) respectively over the same universal set U. Then $V_{H1} = A \cup \{e_a\}$ and $V_{H2} = B \cup \{e_a\}$. Then the intersection of two soft multi-digraph H_1 and H_2 i.e. $D_1 = H_1 \cap H_2$ is defined as follows: $V_{D1} = V_{H1} \cup V_{H2}$, $A_{D1} = A_{H1} \cup A_H$ and $C^F{}_{D1}(h_j) = C^F{}_{H1}(h_j) \wedge C^G{}_{H2}(h_j)$, $\forall (e_i, e_j)$ (or (e_i, e_a)) $\in A_{H1} \cap A_{H2}$. Clearly the soft multi-digraph D_1 represents the intersection of two soft multisets (F, A, C_F) and (G, B, C_G).

5. DIFFERENT TERMINOLOGIES REGARDING SOFT MULTI-DIGRAPH

5.1. Cardinality of Soft Multi-digraph

Definition-5.1. Suppose (F, E, C_F) be a soft multiset over an universal set U = {h_1, h_2. . . h_r} with soft count function C_F and $C_F(e) = c^e{}_F$, $e \in E$ and D = (V_D, A_D, $C_F{}^D$) be the soft multi-digraph corresponding to the soft-multiset (F, E, C_F). Then the number of arcs present in the soft-multidigraph D i.e.

$|A_D|$ is said to be the cardinality of the soft multidigraph D. In other words,

$$Card\ (D) = |A_D| = \sum_{e \in E} \sum_{h_i \in U} C^D{}_F\ (h_j)$$

Example-5.2. The cardinality of the soft multi-digraph D in 1 is 18. It can be easily seen that there are 18 arcs are present in the soft multidigraph D.

5.2. Matrix representation of a soft multi-digraph

P. Majumdar showed the tabular representation in his paper [11]. In this paper, we will made a similar tabular representation of soft multi- digraph. Suppose D = (V_D, A_D, $C_F{}^D$) be the soft multi-digraph corresponding to the soft-multiset (F, E, C_F), which is defined over an universal set U = {h_1, h_2. . . h_r}. We say that an n × n matrix $M_D = [b_{ij}]$ specifies a soft multi-digraph D = (V_D, A_D, $C_F{}^D$) of order n if D = (V_D, A_D) with $|V_D| = n$, and for $1 \leq i, j \leq n$, $(i, j) \in A_D$ if and only if the entry bij of M_D is specified. In this case, we write,

$$bij = \begin{cases} C_F{}^D(h_{ij}), & \text{if } (i, j) \in A_D \\ 0, & \text{if } (i, j) \notin A_D. \end{cases}$$

In other words, if D is a soft multi-digraph then bij, the (i, j)-th entry of M_D is the number of parallel arcs between the vertex i and vertex j.

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Example-5.3 Consider a matrix $M_D = [b_{ij}]$ specifying the soft multi-digraph D of Figure 1 as follows

$$M_D = \begin{pmatrix} 1 & 2 & 2 & 3 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & 2 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Here, we take the first rows as $\{e_1, e_2 \ldots e_a\}$ and columns as $\{e_1, e_2, \ldots, e_a\}$. one can easily verify that B is the matrix representation of the soft multi- digraph .

5.3. Distance between two multi-digraphs

Definition-5.4. Suppose $H_1 = (V_{H1}, A_{H1}, C_F^{H1})$ and $H_2 = (V_{H2}, A_{H2}, C_G^{H2})$ be any two soft multi-digraph with $|V_{H1}| = |V_{H2}| = n$ corresponding to the two soft multi-set (F, A, C_F) and (G, B, C_G) respectively over the same universal set U. Let $M_D^1 = [a_{ij}]$ and $M_D^2 = [bij]$ are the matrix representation of the soft multi-digraphs H_1 and H_2 respectively. Then the distance between the two soft multi-digraph H_1 and H_2 is given by:

$$d(H_1, H_2) = \sum\sum_{i,j} |a_{ij} - b_{ij}| \quad \forall\, i, j.$$

We can also calculate the distance between two soft multi-digraphs H and K according to the following formula:

$$d(H_1, H_2) = |A_{H_1 \cup H_2} - A_{H_1 \cap H_2}|.$$

Example-5.5. Consider two soft multi-digraphs $H = (V_H, A_H, C^F_D)$ and $K = (V_K, A_K, C^K_G)$ with their matrix representation as follows:

$$M_H = \begin{pmatrix} 3 & 0 & 1 \\ 1 & 4 & 1 \\ 0 & 0 & 0 \end{pmatrix}$$

$$M_K = \begin{pmatrix} 4 & 1 & 1 \\ 3 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

Then the distance between two soft multi-digraphs H and K is $d(H, K) = 8$.

5.4. Similarity between two soft multi-digraph

Suppose $D = (V_D, A_D, C^D_F)$ and $H = (V_H, A_H, C^H_G)$ be any two soft multi-digraph corresponding to the two soft multi-set (F, A, C_F) and (G, B, C_G)

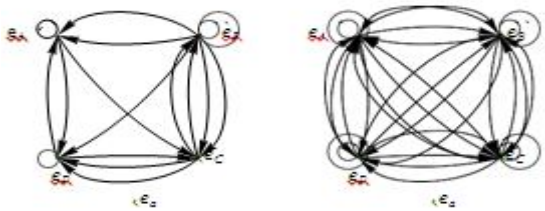

Figure-2: The soft multi-digraph D_1 and D_2

Respectively over the same universal set U. Let M_D and M_H are the matrix representation of the two soft multidigraph D and H respectively. Then the similarity between the two multi-digraphs are defined by

$$S(D, H) = \frac{1}{1 + d(D, H)}$$

Example-5.6. The similarity between two soft multi-digraphs H and K in Example 5.5 is as following

$$S(H, K) = \frac{1}{1+8} = \frac{1}{9}.$$

Please note that the criterion for significantly similarity of two soft multisets H and K is S (H, K) < 1.

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6. APPLICATIONS OF SOFT MULTI-DIGRAPHS

Soft multi-digraphs can be used in decision making problems. We will solve a decision making problem using soft multidigraph. Suppose an engineer wants to evaluate a resident complex with five towers say A, B, C, D, and E. The towers are tested according to the 'security', 'Fire safety', 'building plan', 'parking facility'. Their performance in each category is either 0 or 1 or 2. We now draw the soft multi-digraph D_1 of the engineer's evaluation and the model soft multi-digraph D_2 about the five towers based on the parameter set E = {A, B, C, D} and U = {h_1, h_2, h_3}. Here D_2 in Figure 2 is the model soft multi-digraph of a residing complex with five towers. Each vertex of D_2 has out degree 8 (including loops). Now the distance between two soft multi-digraphs D_1 and D_2 is d (D_1, D_2) = $|A_{D1} \cup_{D2} - A_{D1} \cap_{D2}|$ = 16. Hence the similarity measure between two digraphs D_1 and D_2 is s (F, G) =1/17< 1. Hence the residing complex which the engineer visited is almost in a good condition.

7. CONCLUSION

Molodtstov introduced the soft set theory in his paper [13] to deal with the uncertainties in real life problems. Later on soft multiset is studied by [2, 11]. We have introduced the soft multi-digraph which corresponds to a soft multi-set. In that paper we have defined the soft multidigraph and its operations. We also defined some terminologies regarding soft multi-digraph like distance between soft multi-digraphs, matrix representation, similarity etc. We have solved a practical problem in the light of soft multi-digraph theory. In future one can find the properties of soft multi-digraphs.

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A STUDY ON FACTORS CAUSING OBSTACLES IN LEARNING AMONG HIGHER SECONDARY STUDENTS IN COIMBATORE DISTRICT

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ABSTRACT
Leaning has a very significant position in schools and without learning; all kinds of efforts of students and teachers are becoming useless and waste. Learning enlarges the probabilities of adaptive behaviour of students and it makes changes among them. At the same time, students are also facing numerous obstacles in learning in both school and home environments. Personal, contextual, teacher and parental factors are the factors that cause obstacles in learning among higher secondary students. Significant difference exits between profile of higher secondary students and factors that cause obstacles in learning among them. Personal factors, teacher factors, contextual factors and parental factors have significant and negative influence on academic achievement of higher secondary students. In order to remove or reduce the obstacles in learning among higher secondary students, teachers and parents must encourage and motivate them for effective learning and they should remove the fear of failure in examinations. Both teachers and parents must provide pleasant and peaceful environment for leaning and parents should keep their children' health at good level for better learning.

Keywords: Learning, Obstacles, Students

1. INTRODUCTION

Learning is a continuous and development practice that is taking place over the periods of time. There is substantiation that learners require sufficient time to understand process of learning and subjects and it has to be individualized (Azevedo, 2005). Students may create cognitive talents without many difficulties on and are capable of planning and monitoring their achievement in learning and rectify their mistakes whenever and wherever necessary (Bransford et al, 2000). Therefore, learning is the modified form of behaviour through experiences and it is the attainment of behaviour pattern and also interaction between environment and individual students (Chen et al, 2015).

Leaning has a very significant position in schools and without learning; all kinds of efforts of students and teachers are becoming useless and waste. Learning enlarges the probabilities of adaptive behaviour of students and it makes changes among them (Lee et al, 2005). It also involves in maintaining relation between teachers and students, among students and developing healthy habits among students and it also helps to develop right attitudes and managing emotions among both teachers and students.

Successful learning needs that students have to be motivated to attain their aspirated learning objectives (Lee and Hao, 2015). Nevertheless, not entire students may create an efficient passageway that is benefit to learning on their own efforts (Trespalacios and Rand, 2015). Thus, learning environment have be to created to promote intensive learning to motivate students and concentrate on abilities of students to identify and use knowledge (Klette,2007), but every learning circumstance is a newer one and this can create fatigue and reduce learning interest among students. In addition, students are also facing numerous obstacles in learning in both school and home environments. Thus, it is imperative to understand factors causing obstacles in learning among higher secondary students in Coimbatore district.

2. METHODOLOGY

The present study is done in Coimbatore district. 150 higher secondary students are chosen for the present study by using random sampling method. The percentages are calculated to examine profile of higher secondary students. An exploratory factor analysis is carried out to discover the factors causing obstacles in learning among higher secondary students. The t-test and F-test are used to check difference in factors causing obstacles in learning among profile of higher secondary students. The multiple regression analysis is done to analyze the influence of factors causing obstacles in learning on academic achievement of higher secondary students.

3. RESULTS AND DISCUSSION

3.1. Profile of Higher Secondary Students

The profile of higher secondary students is shown in Table-1. The findings explain that 59.33 per cent of higher secondary students are boys, while, 40.67 per cent of them are girls and 46.00 per cent of higher

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secondary students are studying in private schools, while, 20.67 per cent of them are studying in Government aided schools and 33.33 per cent of them are studying in Government schools.

The findings disclose that 38.66 per cent of higher secondary students' mothers have higher secondary, while, 28.67 per cent of them have graduation and 32.67 per cent of them have secondary education and 52.67 per cent of higher secondary students are studying schools located in rural areas, while, 47.33 per cent of them studying schools located in urban areas.

Table-1: Profile of Higher Secondary Students

Profile	Number of Higher Secondary Students (N = 150)	Percentage
Gender		
Boys	89	59.33
Girls	61	40.67
Type of Management		
Government	50	33.33
Aided	31	20.67
Private	69	46.00
Mother's Education		
Secondary	49	32.67
Higher Secondary	58	38.66
Graduation	43	28.67
Locality of School		
Urban	71	47.33
Rural	79	52.67

3.2. Factors Causing Obstacles in Learning Among Higher Secondary Students

To discover the factors causing obstacles in learning among higher secondary students, an exploratory factor analysis is done and the results are shown in Table-2. Kaiser-Meyer-Olkin value for sampling adequacy is 0.834 and Chi-square value for Bartlett test for Sphericity is 0.0021 that is significant at one per cent level and these are disclosing the method is apt.

Four factors attained have 73.44 per cent of variations on all variables and variation of each factor is 22.96 per cent, 20.53 per cent, 18.25 per cent and 11.70 per cent in the array of derivation.

Table-2: Factors Causing Obstacles in Learning among Higher Secondary Students

Factor	Variable	Rotated Factor Loadings	Eigen Value	% of Variation	Factor Name
I	Lack of emotional stability	0.68	3.05	22.96	**Personal Factors**
	Low economic status	0.65			
	Poor health	0.69			
	Fear of failure	0.64			
	Wrong learning plan	0.67			
	Unpleasant towards learning	0.66			
	Poor learning atmosphere	0.62			
II	Inadequate facilities	0.66	2.48	20.53	**Contextual Factors**
	High degree of competition	0.69			
	Poor school climate	0.67			
	Poor interaction between teachers and students	0.62			
	Poor relation among students	0.63			
	Inadequate support from peers	0.64			
III	Behaviour of teachers	0.69	1.31	18.25	**Teacher Factors**
	Ability of teachers	0.65			
	Ineffective teaching methods	0.67			
	Low competency of teacher	0.64			
	Low level of motivation from teachers	0.62			
IV	Lack of support from parents	0.65	1.02	11.70	**Parental**

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	Lack of motivation from parents	0.67			**Factors**
	Compulsion from parents	0.60			
	Poor interaction of parents	0.61			
	Cumulative % of Variation	-	-	73.44	-
	Cronbach's Alpha	-	-	-	0.89

Principal Component Analysis.

Varimax Rotation

Rotation converged in 10^{th} iterations.

Factor – I has lack of emotional stability, low economic status, poor health, fear of failure, wrong learning plan, unpleasant towards learning and poor learning atmosphere. Thus, this is called as **Personal Factors.**

Factor – II has inadequate facilities, high degree of competition, poor school climate, poor interaction between teachers and students, poor relation among students and inadequate support from peers. Hence, this is described as **Contextual Factors.**

Factor – III has behaviour of teachers, ability of teachers, ineffective teaching methods, low competency of teacher and low level of motivation from teachers. So, this is expressed as **Teacher Factors.**

Factor – IV has lack of support from parents, lack of motivation from parents, compulsion from parents and poor interaction of parents. Therefore, this is termed as **Parental Factors.**

The value of Cronbach's Alpha is 0.89 that displaying the internal consistency of all the measures is at acceptable level. Personal, contextual, teacher and parental factors are the factors causing obstacles in learning among higher secondary students.

3.3. Profile of Higher Secondary Students and Factors Causing Obstacles in Learning Among Them

To dissect difference in factors causing obstacles in learning among profile of higher secondary students, t-test and Analysis of Variance test are carried out and the results are shown in Table-3.

Table-3: Difference in Factors Causing Obstacles in Learning among Profile of Higher Secondary Students

Particulars	t- Value / F-Value	Sig.
Gender and Factors Causing Obstacles in Learning	6.196^{**} (t-value)	.000
Type of Management and Factors Causing Obstacles in Learning	9.270^{**} (F-value)	.000
Mother's Education and Factors Causing Obstacles in Learning	8.742^{**} (F-value)	.000
Locality of School and Factors Causing Obstacles in Learning	5.854^{**} (t-value)	.000

** Significant at one per cent level

The t-values and F-value are significant at one per cent level elucidating that there is significant difference in factors causing obstacles in learning among profile of higher secondary students. As a result, the null hypothesis is rejected.

3.4. Influence of Factors Causing Obstacles in Learning on Academic Achievement of Higher Secondary Students

To analyze the influence of factors causing obstacles in learning on academic achievement of higher secondary students, the multiple regression is used and the results are shown in Table-4. The R^2 is 0.63 and adjusted R^2 is 0.61 illustrating the regression model is good fit. It means that 61.00 per cent of the variation in dependent variable is shared by the independent variables. The F-value of 19.430 is significant at one per cent level demonstrating the model is significant.

Table-4: Influence of Factors Causing Obstacles in Learning on Academic Achievement of Higher Secondary Students

Factors Causing Obstacles in Learning	Regression Co-efficients	t-value	Sig.
Intercept	1.102^{**}	9.545	.000
Personal (X_1)	$-.217^{**}$	6.542	.000
Contextual (X_2)	$-.161^{**}$	5.834	.000
Teacher (X_3)	$-.193^{**}$	6.110	.000
Parental (X_4)	$-.134^{**}$	5.656	.000
R^2	0.63	-	-
Adjusted R^2	0.61	-	-
F	19.430	-	.000

** Significant at one per cent level

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Personal factors, teacher factors, contextual factors and parental factors are significantly and negatively influencing academic achievement of higher secondary students at one per cent level. As the outcome, the null hypothesis is rejected.

4. CONCLUSION

The findings reveal personal, contextual, teacher and parental factors are the factors that cause obstacles in learning among higher secondary students. Significant difference prevails between profile of higher secondary students and factors causing obstacles in learning among them. Personal factors, teacher factors, contextual factors and parental factors have significant and negative influence on academic achievement of higher secondary students.

In order to remove or reduce the obstacles in learning among higher secondary students, teachers and parents must encourage and motivate them for effective learning and they should remove the fear of failure in examinations. Both teachers and parents must provide pleasant and peaceful environment for leaning and parents should keep their children' health at good level for better learning. Besides, schools must provide all the amenities and good climate for students for their effectual learning. Teachers should interact with their students on regular basis in order to understand their problems and solve them in peaceful manners. In addition, teachers must improve their abilities and competencies for interesting and efficient teaching through innovative teaching methods for improving leaning behaviour of higher secondary students. Both teachers and parents should help higher secondary students for improving their learning skills and attitudes.

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ESTABLISHING THE RANKING AMONG THE DIVISIONS OF THE TEXTILE ENTERPRISES OF PUNJAB (INDIA) EFFECTED BY THE DIFFERENT TYPE OF POWER SYSTEM RELIABILITY ISSUES

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ABSTRACT
The purpose of the conducted research was to identify the effect of different type of power system reliability issues on the separate departments of the textile enterprises of Punjab (India). From April 2015 to April 2017, a successful response from 148 enterprises was obtained from the high concentration areas- Central, North and South Punjab, asking respondents to focus a time period from 2010 to 2014 and up to the survey performing time, using a questionnaire schedule by conducting the interviews and leaving the schedules with the interested firms for a specified period of time. Both the reliability measures- Krippendorff's alpha and Cronbach alpha, were found in the acceptance zones. A related samples statistical tests- Friedman and Kendall's level of concordance were applied to identify the difference among the considered dependent variables under separate sections and the level of unanimity among the responses, respectively. The departments of the Production, Sales and Marketing, Administration and Customer service, and Material Procurement were found extremely important for the respondents. The outcomes revealed that almost all the departments of the textile enterprises were highly effected by the unplanned outages followed by load shedding and planned outages. The utility maintenance issues, ageing of the equipment birds/animals/insects and manufacture installation were found the prominent causes of power outages which is questioning the standing of the sole public utility company of the state.

Keywords: departments, power system reliability issues, questionnaire schedule, textile enterprises.

1. INTRODUCTION

Electricity is vital for the economic growth and development of any nation. A broadly categorized sectors such as residential, commercial, agricultural and industrial sectors, have been utilizing the electric power for their expediency since decades, however, the surge of an increasing population and the cut throat competition have exponentially triggered the demand of electric power which is putting the burden on the existing power systems. Power system networks are working very near to their bounds. With the continuous increase in the load, the frequency of the system goes on decreasing and it reaches to its minimum allowable value after the further increase in load will result in more frequent drop resulting in the need of load shedding [10]. In order to avert cascaded failures and eventually blackouts, load shedding is used as a means. The outcome of this situation results in load shedding or power rationing, which has become so common in the underdeveloped and developing countries in order to balance the demand among the different sectors or geographical locations by providing the electric power to the priority sectors and stopping the supply to other sectors at some particular time for a fixed duration. In this situation, the effected sectors or areas become handicapped and are directed by the utilities not to engage their connected loads for that fixed duration. There are two alternatives left for an industry, either to bear the loss because of the downtime resulting from the load shedding or to run their production systems on their backup units with increased overall costs. It is understood that the large or medium industries can cope up with this situation to a large extent with the help of backup generators because of their large revenues but the situation is not the same with the micro and small industries which cannot afford the extra costs resulting from the use of backup units. It seems that the regimes in power are not much concerned about the investment in the planning of power systems, otherwise the issue could has been addressed much before, as the progressive development is seen in many other sectors at the same time. The present industries are still dependent on the age old power systems which results in the failure of components and line maintenance, seems to be the major causes of unplanned and planned outages, respectively. As per the IEEE definitions, the intentional disabling of a component's capability to deliver power, done at a pre-selected time, usually for the purposes of construction, preventative maintenance, or repair, leads to the occurrence of planned electric power outages. The loss of electric power to one or more customers that does not result from a planned outage is called unplanned outage [5]. One of the study conducted in Capetown, South Africa revealed that only one-third of the respondents shown satisfaction with the electric utility service [2]. Another study emphasized that unannounced power outages can led to equipment damage that can eventually disturb the quality of the products. It has also been seen that the expenses incurred in repairing equipment, the postponements or terminations in the distribution of orders were tolerated by the small and medium scale enterprises (SMEs) that rises the process and maintenance costs. Author concluded that higher the power interruptions are, the lower

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would be the Return on Investment (ROI) of SMEs [3]. In 2009, Zimbabwe imported about fifty percent of its electric power needs, with overall standing demand of over 2100MW associated to existing capacity from internal sources of 1100MW. The electric power utility company, ZESA (Zimbabwe Electricity Supply Authority), switched-off some load in order to balance supply and demand in the occurrence of loss of internal generation or electricity imports [6]. One more research highlighted a structure for power system design necessities in the electric power utility service as per the customer needs. A seven common lacking items related to electric power supply common to all the four categories of the participants (i.e., domestic, agricultural, industrial, and public organization customers) were identified and need considerable enhancement for providing the electric power service quality in Indian electricity industry. Those lacking seven items were the quality of electric power supplied, method of payment of electricity bills, process of registering the consumer complaints, new connection of electricity, display of electricity safety lessons, voltage fluctuations and, waiting period in the line for the payment of electricity bills [9]. A small and medium enterprises (SMEs) in Tanzania faced many challenges in their courses containing electric power fluctuations and load shedding that in return lead to decreased production, underprivileged delivery of services and low incomes. A successions of rolling blackouts was experienced in 2012 as per the TANESCO (Tanzania Electric Supply Company Limited) statistics of November 2013. The results of the study exposed that the majority of the respondents (64.3%) stated that over the past two years load shedding has happened more than 31 times. This was due to the shortage of water in the dams for power generation and hence there was load shedding in order to avoid the problem of complete blackout in the region [7]. Electric power interruption variables (estimated using hours per day without electricity and percentage of output gone due to electric power outages) had a negative and significant effect on the productivity, mainly on the smaller firms [8]. The social and economic development of Africa rests typically on the activities of the small and medium scale firms. The monthly average number of electric power interruptions faced was nearly 24 that had an unwanted effect on the production efficiency of the firms, demanded the vast investment projects in the new generation capacity so as to reduce the negative outcome of the electric power shortages on the production process of firms in Africa [1].The power outages primarily results in lost wage/salary cost, lost revenue, corrective costs (e.g. subsequent overtime, repairs, etc.) and damages/penalties to the businesses. However, the mentioned reasons are not the only one which results in the outages causing the downtime. There are many other reasons of outages such as natural calamities, accidental damages, vandalism, preventive maintenance of the power systems etc., which can result in the substantial downtime based on its origin or nature. The effort was made to identify level of effect by the outages of different types on the areas and operations of the textile industries. The research also addressed the level of occurrence of the power outages based on their origin.

2. METHODOLOGY

The frequent use of customer surveys by the researchers as compared to the other methods for assessing the impact of power outages on different sectors is evident from the literature review and give the indication that the customers themselves are the best source of information for estimating the cost of power outages for different type and length of outages. However, these studies demand a lot of calculations from the consumer perspective which considerably wastes the time of targeted enterprises. Moreover, majority of the enterprises are not much concerned about maintaining the databases of power outages accurately. In order to accurately calculate the cost of power outages to different sectors, a existence of robust databases of power outages is needed, which unfortunately is absent in even some developed countries. Generally, majority of the data of power outages depicting its cause, type and length is being maintained at the grid/substations level in the hard and/or soft form but the data that is being further forwarded to the central offices of the utilities ignores the anatomy, portraying only the total length of all the outages in order to calculate the reliability of the power systems of the utilities which can be acceptable from the power system reliability aspect but in order to accurately assess the cost of power outages in different sectors, both type and length of the power outage is needed. There is no robust liaison between the consumers and the utilities as far as the maintaining of the data is concerned. A restructuring in the method of maintaining the data at central level can results in very fruitful results, useful for the planning of power systems at the reginal and national level. It is not easy for any researcher to target the industries and the regional substations at the same time, for conducting the study. With a combined effort of utility and their consumers, the reliability of the power systems should be calculated separately for the different type of industrial and other consumers considering the effect of cause, type and length of power outage in order to show the realistic measure of reliability. Presently, the data that is being maintained at the central offices of the utility is not research friendly and in the broad aggregate form ignoring the anatomy of power outage i.e. planned or unplanned or load shedding, portraying the reliability of the utility positively which seems to be not that bright. The success of any utility depends on the opinion and judgment of its different customers towards the performance of the power systems. Seeing the scenario, the decision was

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made to adopt a simple approach to conduct a study considering the textile customers of Punjab (India) and record their judgements on the different aspects of power system reliability and its impact on their industrial processes. Rather than focussing on the quantitative reliability measurement of the power systems which involves cumbersome calculations, the opinion of the textile consumers towards the reliability of power systems were taken which portrays the similar results, can be helpful in making decisions by the utility and government on the planning of power systems at regional levels. In order to accomplish this task, from a specially prepared population list of 1163 registered textile enterprises of Punjab using the databases of micro, small and medium enterprises (MSME) and ministry of corporate affairs (MCA), a random sample of 400 industries was obtained by using a simple random sampling approach. Over a duration of two years from April 2015 to April 2017, 169 responses focusing the time period 2010 to 2014, were recorded on a questionnaire schedule designed using seven point ordinal scale Likert items, primarily by conducting the interviews and leaving the schedules at their premises for a stipulated period of time. Finally, 148 responses were found valid after discarding the 21 invalid questionnaire schedules, indicating nearly a survey response rate of 40%. A final population list consisted the textiles enterprises from the districts with high concentration such as Ludhiana (Central Zone), Amritsar and Jalandhar (North Zone) and Patiala and Mohali (South Zone). During the survey, it was found that the frequency of medium and large enterprises was markedly limited as compared to the micro and small scale enterprises and also the response of these enterprises was very poor. Therefore, decision was taken not to target further these industries for conducting the study. A research was conducted at regional level focussing one specific category of industrial sector i.e. textile enterprises of Punjab (India) and their connected power systems of the public utility company Punjab State Power Corporation Limited (PSPCL).

3. RESULTS AND DISCUSSIONS

Two software packages, SPSS 24 and Microsoft Excel were used for the statistical analysis and the data visualization in the form of tables including the figures, respectively.

Table-3.1: Interater Reliability of the Survey

Interrater Reliability	**Krippendorff's Alpha (K-Alpha)**				**Kendall's Coefficient of Concordance (Kendall's W)**			
	C		G		C		G	
Values	0.779		0.766		0.803		0.799	
Interrater Reliability	Krippendorff's Alpha (K-Alpha) | Kendall's Coefficient of Concordance (Kendall's W)							
	G1i G1ii G1iii	G2i G2ii G2iii	G3i G3ii G3iii	G4i G4ii G4iii	G5i G5ii G5iii	G6i G6ii G6iii	G7i G7ii G7iii	G8i G8ii G8iii	G9i G9ii G9iii	G10iG10ii G10iii
Values	0.60|0.72	0.56|0.69	0.80|0.90	0.32|0.44	0.58|0.67	0.44|0.57	0.58|0.72	0.59|0.70	0.21|0.30	0.36|0.46

Survey Scale	1	2	3	4	5	6	7
Part C	Never	Rarely-in less than 10% of the chances when I could have	Occasionally-in about 30% of the chances when I could have	Sometimes-in about 50% of the chances when I could have	Frequently-in about 70% of the chances when I could have	Usually- in about 90% of the chances I could have	Every time
Part G and H	Not at all important	Slightly important	Somewhat important	Moderately important	Considerably important	Highly important	Extremely important
Part Gi, Gii & Giii and Part Hi, Hii & Hiii	Not at all effected	Slightly effected	Somewhat effected	Moderately effected	Considerably effected	Highly effected	Extremely effected

An interrater ordinal reliability measure- Krippendorff's Alpha (K-Alpha) for the different sections or parts of the questionnaire schedule mentioned in the Table 3.1 was calculated using the SPSS syntax developed by [4]. A Kendall's coefficient of concordance (Kendall's W) was also presented in the Table 3.1 which was obtained through the SPSS 24. All the reliability measures were found near 0.80 for all the sections of the study, indicating that the respondents have been agreed, and each respondent has allocated nearly the similar order to the variables under study. A Kendall's W (Coefficient of concordance) test have the power to reveal the agreement between subjects and presents a value which ranges between 0 (No agreement) and 1 (Full Agreement). An anatomy of seven point Likert scale items for the different sections of the study are shown in the Table 3.1. A Friedman test was conducted to determine whether respondents had a differential rank ordered preference for the various dependent variables under different sections of the questionnaire schedule measured on seven point Likert type items. The null hypothesis for the Friedman test states that there are no differences between the variables. If the calculated probability is small (P less than the selected significance level of 0.05) the null-hypothesis is rejected and it can be concluded that at least two of the variables are significantly

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different from each other. Further, after obtaining the statistical significant results from the Friedman's Statistics, pairwise comparisons were performed (SPSS 24) with a Dunn's Bonferroni correction for multiple comparisons to identify the statistically significant differences between all the possible combination of pairs formed by the dependent variables i.e. which of the variables is significantly different from which other variables. Further, in order to have closer look on the results, descriptive statistics was also provided which included median, percentiles, mean and standard deviation for each variable. Moreover, in order to visualize the data effectively, data bars for the measures, mean rank and percentage distribution were shown within the contingency tables for the different sections of the research study.

Table 3.2 mentioned below shows the results obtained by performing Friedman test, a non-parametric repeated measure ANOVA, including descriptive statistics and cross tabulation. The variables shown in this table are arranged in their descending order based on the mean rank. A Friedman test was run to determine if there were differences in the frequency of occurrence scores obtained on seven-point scale among the dependent variables under the section "level of frequency of occurrence of power outages based on the origin or causes". Pairwise comparisons were performed (SPSS 24) with a Dunn's Bonferroni correction for multiple comparisons. Level of frequency of occurrence scores was found statistically significantly different among the variables under consideration, Friedman's Q or $\chi^2(11) = 1307.939, p = 0.000$, means at least two of the variables are significantly different from each other. As shown in Table 3.3, a post hoc analysis exposed statistically significant differences among the pairs of the variables and no statistical significant difference was seen between the

Table-3.2: Statistical Analysis- Level of Occurrence of the Power Outages Based on the Origin or Causes

Test Statistics- Friedman's Q | Chi-Square= 1307.939				Kendal's W= 0.803 N= 148, Degree of Freedom= 11						Asymp. Sig. (p-Value)= 0.000				
Dependent Variables	Mean Rank	Visual Mean Rank	Percentiles 25th	50th (Median)	75th	Mean	Std. Dev.	Never	Rarely	Ocassionally	Sometimes	Frequently	Usually	Everytime	Visual Percentage Distribution
C10 Utility Maintenance issues	11.29		6.00	6.00	7.00	6.28	0.449	0%	0%	0%	0%	0%	72%	28%	
C8 Age/wear of electrical equipment	10.61		6.00	6.00	6.00	5.93	0.438	0%	0%	0%	0%	14%	80%	6%	
C3 Animal, birds and insects	10.58		6.00	6.00	6.00	5.89	0.360	0%	0%	0%	0%	13%	86%	1%	
C12 Manufacture installation	7.54		5.00	5.00	5.00	4.88	0.494	0%	0%	0%	19%	74%	7%	0%	
C2 High winds and storms	6.92		4.00	5.00	5.00	4.70	0.490	0%	0%	1%	30%	69%	1%	0%	
C7 Accidental damage	6.33		4.00	5.00	5.00	4.54	0.513	0%	0%	0%	47%	53%	1%	0%	
C11 Protection including settings	5.89		4.00	4.00	5.00	4.43	0.511	0%	0%	0%	57%	42%	1%	0%	
C4 Falling trees	5.37		4.00	4.00	5.00	4.27	0.578	0%	0%	7%	59%	34%	0%	0%	
C9 Safety issues	4.78		4.00	4.00	4.00	4.11	0.515	0%	0%	8%	72%	20%	0%	0%	
C5 Rain & flooding	3.95		4.00	4.00	4.00	3.89	0.378	0%	0%	14%	84%	2%	0%	0%	
C6 Willful damage	2.95		3.00	4.00	4.00	3.55	0.551	0%	1%	45%	52%	2%	0%	0%	
C1 Lightning strikes	1.78		3.00	3.00	3.00	3.10	0.477	0%	7%	76%	17%	0%	0%	0%	

pairs C1- C6, C2-C12, C3-C8, C3-C10, C4-C11, C4-C7, C5-C9, C5-C4, C6-C5, C7-C2, C7-C12, C8- C10, C9-C4, C9-C11, C11-C7 and C11-C2. A Kendall's W of value 0.803 indicates that all subjects ranked the twelve variables in the same way and hence they were in high agreement. It is clear from the Table 3.2 that the variables C10 (mean rank = 11.29), C8 (mean rank = 10.61) and C3 (mean rank = 10.58) with median values equal to six, were ranked higher on the seven-point Likert item scale which portrays that the occurrence of power outages was mainly due to the utility maintenance issues, ageing of the equipment and birds/animals/insects. For the variables C12 (mean rank = 7.54), C2 (mean rank = 6.92) and C7 (mean rank =

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6.33), median value of five was obtained which depicted that the manufacture installation, high winds and storms and accidental damage were also ranked sizably high on seven-point scale, indicating these also as the known causes of power outages. Further, a median value of four was obtained for the variables protection including settings-C11 (mean rank = 5.89), falling trees-C4 (mean rank = 5.37), safety issues-C9 (mean rank = 4.78), rain and flooding-C5 (mean rank = 3.95) and wilful damage-C6 (mean rank = 2.95), indicating a medium level ranking. Finally, a variable C1 (mean rank = 1.78) with median value of three was ranked lower among all the variables representing the occurrence of outage due to lightning strikes was minimal.

Table-3.3: Test Statistics- Dunn's Bonferroni Post Hoc Analysis for Part C

Pairwise Comparisons	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]	Pairwise Comparisons	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
C1-C6	-1.172	0.419	-2.797	0.005	*0.340*	C9-C2	2.132	0.419	5.086	0.000	0.000
C1-C5	-2.172	0.419	-5.183	0.000	0.000	C9-C12	-2.760	0.419	-6.585	0.000	0.000
C1-C9	-3.003	0.419	-7.166	0.000	0.000	C9-C3	5.797	0.419	13.832	0.000	0.000
C1-C4	-3.591	0.419	-8.568	0.000	0.000	C9-C8	5.824	0.419	13.896	0.000	0.000
C1-C11	-4.108	0.419	-9.801	0.000	0.000	C9-C10	-6.510	0.419	-15.532	0.000	0.000
C1-C7	-4.547	0.419	-10.849	0.000	0.000	C4-C11	-0.517	0.419	-1.233	0.217	*1.000*
C1-C2	-5.135	0.419	-12.252	0.000	0.000	C4-C7	-0.956	0.419	-2.281	0.023	*1.000*
C1-C12	-5.764	0.419	-13.751	0.000	0.000	C4-C2	1.544	0.419	3.684	0.000	*0.015*
C1-C3	-8.801	0.419	-20.997	0.000	0.000	C4-C12	-2.172	0.419	-5.183	0.000	0.000
C1-C8	-8.828	0.419	-21.062	0.000	0.000	C4-C3	5.209	0.419	12.429	0.000	0.000
C1-C10	-9.514	0.419	-22.698	0.000	0.000	C4-C8	-5.236	0.419	-12.494	0.000	0.000
C6-C5	1.000	0.419	2.386	0.017	*1.000*	C4-C10	-5.922	0.419	-14.130	0.000	0.000
C6-C9	-1.831	0.419	-4.369	0.000	0.001	C11-C7	0.439	0.419	1.048	0.295	*1.000*
C6-C4	2.419	0.419	5.771	0.000	0.000	C11-C2	1.027	0.419	2.450	0.014	*0.942*
C6-C11	-2.936	0.419	-7.004	0.000	0.000	C11-C12	-1.655	0.419	-3.950	0.000	*0.005*
C6-C7	-3.375	0.419	-8.052	0.000	0.000	C11-C3	4.693	0.419	11.196	0.000	0.000
C6-C2	3.963	0.419	9.455	0.000	0.000	C11-C8	4.720	0.419	11.260	0.000	0.000
C6-C12	-4.591	0.419	-10.954	0.000	0.000	C11-C10	5.405	0.419	12.897	0.000	0.000
C6-C3	7.628	0.419	18.200	0.000	0.000	C7-C2	0.588	0.419	1.402	0.161	*1.000*
C6-C8	-7.655	0.419	-18.265	0.000	0.000	C7-C12	-1.216	0.419	-2.902	0.004	*0.245*
C6-C10	-8.341	0.419	-19.901	0.000	0.000	C7-C3	4.253	0.419	10.148	0.000	0.000
C5-C9	-0.831	0.419	-1.983	0.047	*1.000*	C7-C8	-4.280	0.419	-10.212	0.000	0.000
C5-C4	1.419	0.419	3.385	0.001	0.047	C7-C10	-4.966	0.419	-11.849	0.000	0.000
C5-C11	-1.936	0.419	-4.619	0.000	0.000	C2-C12	-0.628	0.419	-1.499	0.134	*1.000*
C5-C7	-2.375	0.419	-5.666	0.000	0.000	C2-C3	-3.666	0.419	-8.745	0.000	0.000
C5-C2	2.963	0.419	7.069	0.000	0.000	C2-C8	-3.693	0.419	-8.810	0.000	0.000
C5-C12	-3.591	0.419	-8.568	0.000	0.000	C2-C10	-4.378	0.419	-10.446	0.000	0.000
C5-C3	6.628	0.419	15.814	0.000	0.000	C12-C3	3.037	0.419	7.246	0.000	0.000
C5-C8	-6.655	0.419	-15.879	0.000	0.000	C12-C8	3.064	0.419	7.311	0.000	0.000
C5-C10	-7.341	0.419	-17.515	0.000	0.000	C12-C10	3.750	0.419	8.947	0.000	0.000
C9-C4	0.588	0.419	1.402	0.161	*1.000*	C3-C8	-0.027	0.419	-0.064	0.949	*1.000*
C9-C11	-1.105	0.419	-2.636	0.008	*0.554*	C3-C10	-0.713	0.419	-1.701	0.089	*1.000*
C9-C7	1.544	0.419	3.684	0.000	*0.015*	C8-C10	-0.686	0.419	-1.636	0.102	*1.000*

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.
Rows in grey have insignificant p-values for pairs.

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Table 3.4 shows the outcomes attained by running a Friedman test including descriptive statistics and cross tabulation for the section "level of importance towards the different areas/departments of the firms". The variables shown in the Table 3.4 are arranged in their descending order based on their mean ranks. A Friedman test was applied to determine if there were differences in the level of importance scores amongst the variables. Level of importance scores measured on seven-point scale was found statistically significantly different among the variables under consideration, Friedman's Q or $\chi^2(9) = 1064.302$, $p = 0.000$. As shown in the Table 3.5, a Dunn's Bonferroni post hoc analysis exposed statistically significant differences among the pairs of the variables and no statistical significant difference was seen between the pairs G2-G4, G4-G1, G3-G5, G4-G1, G5-G2, G6-G9, G7-G6, G7-G9, G9-G3 and G10-G8. A Kendall's W value of 0.799 depicts fairly good level of agreement among the respondents. It

Table-3.4: Statistical Analysis- Level of Importance Towards the Different Areas/Departments of the Firms

Test Statistics- Friedman's Q | Chi-Square= 1064.302						Kendal's W= 0.799 N= 148, Degree of Freedom= 09							Asymp. Sig. (p-Value)= 0.000			
Dependent Variables	Mean Rank	Visual Mean Rank	Percentiles			Mean	Std. Dev.	Not at all important	Slightly important	Somewhat important	Moderately important	Considerably important	Highly important	Extremely important	Visual Percentage Distribution
			25th	50th (Median)	75th										
G1 Production	8.75		6.00	6.00	7.00	6.45	0.499	0%	0%	0%	0%	0%	55%	45%	
G4 Sales & Marketing	8.00		6.00	6.00	6.00	6.16	0.453	0%	0%	0%	0%	3%	77%	20%	
G2 Administration	7.89		6.00	6.00	6.00	6.11	0.389	0%	0%	0%	0%	3%	84%	14%	
G5 Customer Service	6.78		5.00	6.00	6.00	5.76	0.490	0%	0%	0%	0%	27%	70%	3%	
G3 Material Procurement	6.11		5.00	6.00	6.00	5.55	0.499	0%	0%	0%	0%	45%	55%	0%	
G9 Budgetary Control & Financial Management	5.18		5.00	5.00	6.00	5.23	0.596	0%	0%	0%	8%	61%	30%	1%	
G6 Consumer Relationships	4.95		5.00	5.00	5.00	5.17	0.527	0%	0%	0%	7%	70%	24%	0%	
G7 Product Design and Development	4.25		4.25	5.00	5.00	4.87	0.598	0%	0%	0%	25%	63%	12%	0%	
G8 Human Resource Management	1.57		3.00	3.00	3.00	3.22	0.429	0%	1%	77%	22%	0%	0%	0%	
G10 Social & Organizational Promotion	1.51		3.00	3.00	3.00	3.17	0.427	0%	2%	79%	19%	0%	0%	0%	

is evident from the Table 3.4 that the variables G1 (mean rank = 8.75), G4 (mean rank = 8.00) and G2 (mean rank = 7.89) having median values of six, were scored higher on the seven-point level of importance Likert item scale which depicts that the departments of production, sales and marketing, and administration are highly important to the firms. The variables G5 (mean rank = 6.78) and G3 (mean rank = 6.11) with high median value of again six depicted that customer service and material procurement are also noticeably important. Further, a median value of five was attained for the variables budgetary control and financial management-G9 (mean rank = 5.18), consumer relationships-G6 (mean rank = 4.95) and product design and development-G7 (mean rank = 4.25), representing an intermediate level score. Lastly, the variables G8 (mean rank = 1.57) and G10 (mean rank = 1.51) with median values of three were scored lower amongst all the variables pointing that the departments of human resource management, and social and organizational promotion. During the interview process, respondents were asked to score all the variables from G1-G10 based on the downtime caused by the power outages or load shedding. Almost all the variables were scored above three (somewhat important) on seven-point scale by the respondents.

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Table-3.5: Test Statistics- Dunn's Bonferroni Post Hoc Analysis for Part G

Pairwise Comparisons	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]	Pairwise Comparisons	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
G10-G8	0.068	0.352	0.192	0.848	*1.000*	G7-G1	4.500	0.352	12.786	0.000	0.000
G10-G7	2.747	0.352	7.804	0.000	0.000	G6-G9	-0.230	0.352	-0.653	0.514	*1.000*
G10-G6	3.439	0.352	9.772	0.000	0.000	G6-G3	1.169	0.352	3.321	0.001	*0.040*
G10-G9	3.669	0.352	10.424	0.000	0.000	G6-G5	1.834	0.352	5.212	0.000	0.000
G10-G3	4.608	0.352	13.093	0.000	0.000	G6-G2	2.946	0.352	8.370	0.000	0.000
G10-G5	5.274	0.352	14.984	0.000	0.000	G6-G4	3.057	0.352	8.687	0.000	0.000
G10-G2	6.385	0.352	18.142	0.000	0.000	G6-G1	3.807	0.352	10.818	0.000	0.000
G10-G4	6.497	0.352	18.459	0.000	0.000	G9-G3	0.939	0.352	2.668	0.008	*0.343*
G10-G1	7.247	0.352	20.589	0.000	0.000	G9-G5	1.605	0.352	4.559	0.000	0.000
G8-G7	2.679	0.352	7.612	0.000	0.000	G9-G2	2.716	0.352	7.717	0.000	0.000
G8-G6	3.372	0.352	9.580	0.000	0.000	G9-G4	2.828	0.352	8.034	0.000	0.000
G8-G9	-3.601	0.352	-10.232	0.000	0.000	G9-G1	3.578	0.352	10.165	0.000	0.000
G8-G3	4.541	0.352	12.901	0.000	0.000	G3-G5	-0.666	0.352	-1.891	0.059	*1.000*
G8-G5	5.206	0.352	14.792	0.000	0.000	G3-G2	1.777	0.352	5.049	0.000	0.000
G8-G2	6.318	0.352	17.950	0.000	0.000	G3-G4	-1.889	0.352	-5.366	0.000	0.000
G8-G4	6.429	0.352	18.267	0.000	0.000	G3-G1	2.639	0.352	7.497	0.000	0.000
G8-G1	7.179	0.352	20.398	0.000	0.000	G5-G2	1.111	0.352	3.158	0.002	*0.071*
G7-G6	0.693	0.352	1.968	0.049	*1.000*	G5-G4	1.223	0.352	3.475	0.001	*0.023*
G7-G9	-0.922	0.352	-2.620	0.009	*0.395*	G5-G1	1.973	0.352	5.606	0.000	0.000
G7-G3	1.861	0.352	5.289	0.000	0.000	G2-G4	-0.111	0.352	-0.317	0.751	*1.000*
G7-G5	2.527	0.352	7.180	0.000	0.000	G2-G1	0.861	0.352	2.448	0.014	*0.647*
G7-G2	3.639	0.352	10.338	0.000	0.000	G4-G1	0.750	0.352	2.131	0.033	*1.000*
G7-G4	3.750	0.352	10.655	0.000	0.000	Rows in grey have insignificant p-values for pairs.					

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 3.6 displays the statistical outcomes achieved by running a Friedman test along with Dunn's Bonferroni post hoc for the section "level of effect caused by reliability issues on the separate areas/departments of the firm". A Friedman test was applied to determine if there were differences in the level of effect scores measured on seven-point scale amongst the variables depicting the different departments of the firm each for three types of reliability issues- Gi-planned outages, Gii-load shedding and Giii-unplanned outages. Level of effect scores was found statistically significantly different among the three categories of reliability issues for each dependent variable showing the departments of the firm , Friedman's Q or $\chi^2(2)$ with p-values and Kendall's W for the different departments are shown in the brackets as follows- Production (Q=214.082, p=0.000, W=0.723), Administration (Q=203.276, p=0.000, W=0.687), Material and Procurement (Q=267.360, p=0.000, W=0.903), Sales and Marketing (Q=128.954, p=0.000, W=0.436), Customer Service (Q=202.971, p=0.000, W=0.686), Consumer Relationships (Q=168.765, p=0.000, W=0.570), Product Design and Development (Q=212.968, p=0.000, W=0.719), Human Resource Management (Q=202.029, p=0.000, W=0.696), Budgetary Control & Financial Management (Q=87.726, p=0.000, W=0.296), Social & Organizational Promotion (Q=136.886, p=0.000, W=0.462). The mean ranks along with visualization for all the departments except the departments of Human Resource Management and Budgetary Control & Financial Management, as shown in the Table 3.6 and Table 3.7, revealed that the respondents scored high towards the unplanned outages followed by load shedding and planned outages on seven-point Likert scale item scale, respectively, indicating that the different departments of the firm were considerably effected by all the three categories of power system reliability issues. However, the department of Human Resource Management was scored higher on load shedding followed by the unplanned and planned outages. A Dunn's Bonferroni post hoc analysis uncovered statistically significant differences among all the pairs of the variables formed by the three levels of reliability issues except for the pair 2-3 (load shedding and unplanned outages) for the department of Budgetary Control & Financial Management. A Kendall's W values which predicts the level of agreement among the respondents is also shown in the Table 3.6.

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Table-3.6: Statistical Analysis- Level of Effect Caused by Reliability Issues on the Separate areas of the firm

Dependent Variables	Type of Outages/ Reliability Issues	Median	F-Q Mean Rank	Visual Mean Rank	Bonferroni Dunn's Post Hoc					
					Group Pairs	Test Statistics	Standard Error	Test Std. Statistcs	p-value	Adjusted p-value
Production	1- G1i Planned	5.00	1.19		1-2	-0.953	0.116	-8.195	0.000	0.000
	2- G1ii Load Shedding	6.00	2.14		2-3	-1.490	0.116	-12.816	0.000	0.000
	3- G1iii Unplanned	7.00	2.68		3-1	-1.490	0.116	-12.816	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 214.082 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.723 |					
Administration	1- G2i Planned	5.00	1.23		1-2	-0.889	0.116	-7.643	0.000	0.000
	2- G2ii Load Shedding	6.00	2.12		2-3	-0.534	0.116	-4.592	0.000	0.000
	3- G2iii Unplanned	6.00	2.65		3-1	-1.422	0.116	-12.235	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 203.276 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.687 |					
Material Procurement	1- G3i Planned	4.00	1.02		1-2	-1.216	0.116	-10.462	0.000	0.000
	2- G3ii Load Shedding	6.00	2.24		2-3	-0.497	0.116	-4.272	0.000	0.000
	3- G3iii Unplanned	6.00	2.74		3-1	-1.713	0.116	-14.734	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 267.360 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.903 |					
Sales & Marketing	1- G4i Planned	6.00	1.48		1-2	-0.564	0.116	-4.853	0.000	0.000
	2- G4ii Load Shedding	6.00	2.04		2-3	-0.443	0.116	-3.807	0.000	0.000
	3- G4iii Unplanned	6.00	2.48		3-1	-1.007	0.116	-8.660	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 128.954 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.436 |					
Customer Service	1- G5i Planned	5.00	1.21		1-2	-0.936	0.116	-8.050	0.000	0.000
	2- G5ii Load Shedding	6.00	2.15		2-3	-0.490	0.116	-4.214	0.000	0.000
	3- G5iii Unplanned	6.00	2.64		3-1	-1.426	0.116	-12.264	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 202.971 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.686 |					
Consumer Relationships	1- G6i Planned	4.00	1.36		1-2	-0.611	0.116	-5.260	0.000	0.000
	2- G6ii Load Shedding	5.00	1.97		2-3	-0.693	0.116	-5.958	0.000	0.000
	3- G6iii Unplanned	5.00	2.67		3-1	-1.304	0.116	-11.218	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 168.765 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.570 |					
Product Design & Development	1- G7i Planned	4.00	1.31		1-2	-0.557	0.116	-4.795	0.000	0.000
	2- G7ii Load Shedding	4.00	1.87		2-3	-0.943	0.116	-8.108	0.000	0.000
	3- G7iii Unplanned	5.00	2.81		3-1	-1.500	0.116	-12.903	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 212.968 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.719 |					
Human Resource Management	1- G8i Planned	3.00	1.26		1-2	-1.507	0.116	-12.962	0.000	0.000
	2- G8ii Load Shedding	5.00	2.76		2-3	0.784	0.116	6.742	0.000	0.000
	3- G8iii Unplanned	4.00	1.98		3-1	-0.723	0.116	-6.219	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 206.029 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.696 |					
Budgetary Control & Financial Management	1- G9i Planned	4.00	1.49		1-2	-0.757	0.116	-6.510	0.000	0.000
	2- G9ii Load Shedding	5.00	2.25		2-3	-0.017	0.116	-0.145	*0.884*	*1.000*
	3- G9iii Unplanned	5.00	2.26		3-1	-0.774	0.116	-6.655	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 87.726, df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.296 |					
Social & Organizational Promotion	1- G10i Planned	3.00	1.52		1-2	-0.378	0.116	-3.255	0.001	*0.003*
	2- G10ii Load Shedding	3.00	1.90		2-3	-0.682	0.116	-5.871	0.000	0.000
	3- G10iii Unplanned	4.00	2.58		3-1	-1.061	0.116	-9.125	0.000	0.000
	| p = 0.000 | Friedman's Stat., Q = 136.886 , df = 2 |				| Kendall's Cofficient of Concordance Stat., W= 0.462 |					

A crosstabulation shown in Table 3.7 revealed that most of the scores on seven-point scale were equal to or above four (moderately effected), indicating that effect of power system reliability issues on the different departments were considerably high. Moreover, the mean rank, median, percentiles, mean and standard deviation as descriptive statistics measures are also shown in the Table 3.7.

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Table-3.7: Descriptive Statistics and Cross Tabulation for the Parts Gi-Giii showing levels of reliability issues

Dependent Variables	Type of Outages/ Reliability Issues	Mean Rank	Visual Mean Rank	Percentiles			Mean	Std. Dev.	1	2	3	4	5	6	7	Visual Percentage Distribution
				25th	50th (Median)	75th			Not at all effected	Slightly effected	Somewhat effected	Moderately effected	Considerably effected	Highly effected	Extremely effected	
Production	1- G1i Planned	1.19		5.00	5.00	6.00	5.22	0.502	0%	0%	0%	4%	70%	26%	0%	
	2- G1ii Load Shedding	2.14		6.00	6.00	6.00	6.09	0.403	0%	0%	0%	0%	4%	83%	13%	
	3- G1iii Unplanned	2.68		6.00	7.00	7.00	6.58	0.495	0%	0%	0%	0%	0%	42%	58%	
Administration	1- G2i Planned	1.23		5.00	5.00	5.00	4.97	0.521	0%	0%	0%	15%	73%	12%	0%	
	2- G2ii Load Shedding	2.12		5.00	6.00	6.00	5.76	0.513	0%	0%	0%	0%	28%	68%	4%	
	3- G2iii Unplanned	2.65		6.00	6.00	6.00	6.23	0.438	0%	0%	0%	0%	1%	76%	24%	
Material Procurement	1- G3i Planned	1.02		4.00	4.00	4.00	4.05	0.433	0%	0%	7%	81%	12%	0%	0%	
	2- G3ii Load Shedding	2.24		5.00	6.00	6.00	5.61	0.488	0%	0%	0%	0%	39%	61%	0%	
	3- G3iii Unplanned	2.74		6.00	6.00	6.00	6.14	0.369	0%	0%	0%	0%	1%	84%	15%	
Sales & Marketing	1- G4i Planned	1.48		5.00	6.00	6.00	5.65	0.507	0%	0%	0%	0%	36%	62%	1%	
	2- G4ii Load Shedding	2.04		6.00	6.00	6.00	6.10	0.416	0%	0%	0%	0%	4%	82%	14%	
	3- G4iii Unplanned	2.48		6.00	6.00	7.00	6.45	0.499	0%	0%	0%	0%	0%	55%	45%	
Customer Service	1- G5i Planned	1.21		5.00	5.00	5.00	5.07	0.468	0%	0%	0%	7%	78%	15%	0%	
	2- G5ii Load Shedding	2.15		6.00	6.00	6.00	5.85	0.426	0%	0%	0%	0%	18%	80%	3%	
	3- G5iii Unplanned	2.64		6.00	6.00	7.00	6.28	0.464	0%	0%	0%	0%	1%	71%	28%	
Consumer Relationships	1- G6i Planned	1.36		4.00	4.00	5.00	4.19	0.564	0%	0%	8%	65%	27%	0%	0%	
	2- G6ii Load Shedding	1.97		4.00	5.00	5.00	4.71	0.525	0%	0%	0%	32%	64%	3%	0%	
	3- G6iii Unplanned	2.67		5.00	5.00	6.00	5.32	0.498	0%	0%	0%	1%	65%	34%	0%	
Product Design & Development	1- G7i Planned	1.31		3.00	4.00	4.00	3.72	0.545	0%	0%	32%	63%	5%	0%	0%	
	2- G7ii Load Shedding	1.87		4.00	4.00	5.00	4.26	0.500	0%	0%	3%	68%	29%	0%	0%	
	3- G7iii Unplanned	2.81		5.00	5.00	6.00	5.20	0.571	0%	0%	0%	8%	64%	28%	0%	
Human Resource Management	1- G8i Planned	1.26		3.00	3.00	4.00	3.16	0.572	0%	9%	65%	26%	0%	0%	0%	
	2- G8ii Load Shedding	2.76		4.00	5.00	5.00	4.73	0.554	0%	0%	1%	30%	64%	5%	0%	
	3- G8iii Unplanned	1.98		4.00	4.00	4.00	3.93	0.523	0%	0%	18%	72%	10%	0%	0%	
Budgetary Control & Financial Management	1- G9i Planned	1.49		4.00	4.00	4.00	3.93	0.555	0%	0%	19%	69%	12%	0%	0%	
	2- G9ii Load Shedding	2.25		4.00	5.00	5.00	4.57	0.561	0%	0%	0%	47%	50%	3%	0%	
	3- G9iii Unplanned	2.26		4.00	5.00	5.00	4.55	0.587	0%	0%	4%	38%	57%	1%	0%	
Social & Organizational Promotion	1- G10i Planned	1.52		3.00	3.00	3.00	2.85	0.442	0%	18%	78%	3%	0%	0%	0%	
	2- G10ii Load Shedding	1.90		3.00	3.00	3.00	3.16	0.437	0%	3%	78%	19%	0%	0%	0%	
	3- G10iii Unplanned	2.58		3.00	4.00	4.00	3.69	0.533	0%	0%	34%	62%	3%	0%	0%	

4. CONCLUSION

The calculation of interrater reliability for the related sample design sections C and G was 0.78 and 0.77, respectively, which revealed that there was fairly good level of agreement among the respondents while rating the variables and hence gave almost the similar order to the variables under study. The variables C10 “utility maintenance issues” (mean rank = 11.29), C8 “ageing of the equipment” (mean rank = 10.61) and C3 “birds/animals/insects” (mean rank = 10.58) with median values equal to six, were scored higher on the seven-point Likert item scale, revealing the primary causes or origin of power outages. The variables willful damage and lightning strikes with means ranks of 2.95 and 1.78 having median values equal to four and three,

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respectively, were found the least known causes of power outages. Further, the variables G1 "production", G4 "sales and marketing" and G2 "administration" with means ranks of 8.75, 8.00 and 7.89, respectively, and median values of six, were scored higher on the seven-point level of importance Likert item scale, exposing the highly important departments of the firms. The variables G8 "human resource management" and G10 "social and organizational promotions" having mean ranks of 1.57 and 1.51, respectively, with median values of three were rated very low, showing the minimal importance of these areas to the firm as far as the effect of power outages is concerned. Finally, with a related sample design, all the departments/areas of the firm were rated on seven-point scale at three levels of power system reliability issues i.e. planned outages, load shedding and unplanned outages by the respondents. The results indicated that almost for all the variables, the effect of the unplanned outages on the different departments of the firm was found dominant over the load shedding followed by the planned outages. The existence of load shedding is indicating that the enterprises were also faced the occurrence of power rationing, questioning the generating capacity of the utility. The present research provided the approach which is useful to know the standing of the utility company from the consumer's perspective without the use of calculations which demands significant time of the consumers. The research focused the one type of the industrial sector which can be extended by considering the opinion of other sectors. The data related to the power outages with the cause, length and type should be maintained at the central locations instead of the substations of the utility company in order to get the sector wise reliability accurately rather than merely calculating the reliability of the power systems. This approach not only saves the time but also can depict the clear picture of the utility company.

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HYDROLOGICAL CHARACTERIZATION THROUGH MORPHOMETRIC ANALYSIS OF CHURU WATERSHED, RAJASTHAN USING GEOSPATIAL TECHNIQUES

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ABSTRACT
Morphometric analysis covers the linear, areal and relief aspects of the watershed which helps in characterization of the terrain in terms of vulnerability to surface runoff, erosion, floods or drought. In the present study, the morphometric analysis of the Churusub basin, located in the Thar desert, has been done using GIS techniques.Various linear, areal, relief morphometric parameters of Churu watershed were computed using formulas suggested by Horton (1945), Strahler (1964) and Schumn (1956).The analysis has revealed that the region has dominance of 1st and 2ndorder streams. Low drainage density, permeable top subsoil, scrub jungle vegetation cover, high erodibility of soil, low relief etc. has been indicated through calculation of drainage density, bifurcation ratio, infiltration number etc.The elongated shape of basin is indicated by values of form factor, circulatory ratio and elongation ratio.

Churu district is a part of the arid Rajasthan Plain known as Rajasthan Bagar area. It is a sandy desert area with dunes which are of shiftingnature.It is now believed that this area was encroached upon by sea in the Eocene age followedby the process of sedimentation of sand stones.

The Morphometric analysisbased on remote sensing and GIS techniques is very useful to understand the prevailinghydrological characteristics for watershed Management and planning.

The results of this analysis would be useful in determining the effect of catchment characteristics such as size, shape, slope of the catchment on runoff vis-a-vis the hydrological characterization.

Keywords: Watershed, Morphometry, Hydrological Characteristics

1. INTRODUCTION
Morphometric analysis of river basin is useful for understanding the behavior of river basin. It is the quantitative description and analysis of landforms that may be applied particularly to drainage basin. Variousstudies have been conducted on morphometric analysis across the world and found the linear, areal and relief aspects for different drainage basins. Morphometric analysis is widely used to assess the drainage characteristics of the river basins and inputs for watershed development (Rao and Babu1995; Pakhmode et al. 2003; Sreedevi et al. 2005;Manu and Anirudhan2008; Magesh et al. 2011).

Remote sensing and geographical information system (RS-GIS) techniques are in vogue for assessing various morphometric and hypsometric parameters of the drainage basin/watershed (Gangalakunta2004; Grohmann et al. 2007; Korkalainen et al. 2007; Yu and Wei 2008; Hlaing et al. 2008; Javed et al. 2009;Umrikar 2016).As each watershed has its own unique characteristics, so a method having capability of quantification, correlation and analysis of several geomorphometric parameters, should be involved in the process of watershed development and management.

Groundwater recharge is a key component in the assessment of groundwater systems. Keeping in view all these facts the authorshave taken up the computation of morphometric parameters on the basis of watershed to understand the geomorphological characteristics and hydrological set up of the Churu watershed.

2. STUDY AREA
The district of Churu(Fig 1) is situated in the northern part of the state of Rajasthan of India. It covers a total geographical area of 13,85,889 hectares. Precisely, it is located between73º51'49" to 75º01' east longitudes and between 27º24'39" to 28º19' north latitudes.According to the 2011 census the total population of the district is 2,041,171.This small population is distributed into 7 sub administrative levels (tehsils) towns and 990 villages. Sandy arid plains are stretched throughout the area. Undulating sandy plains traversed with longitudinal dunes, with height ranging from 6 to 50 meters above mean ground level treading north east to south west, are well marked in the topography of the area. The terrain slopes from south to north east. The area has altitudes which vary from 199 to 472 meters above Mean Sea Level. Only some hillocks are present in the area and no big hills. There is absence of any perennial river or stream in the district. The principal supply of water is obtained from wells and ponds. The area is characterized by light brown sandy soil plains with scattered dunes. The soil is sandy to loamy fine sandy, very deep, non-calcareous and well drained surface horizon, a slightly calcareous,

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loamy fine sandy B horizon followed by a zone of lime accumulation, partly as concretion (CAZRI, 1990). The aridity index of the area is relatively high, ranging from 75% to 83% and therefore the area falls in arid climatic zone. The district of Churu which is located in the arid western Rajasthan, faces extreme climatic conditions and drought compared to the other arid regions of the country. There is a huge variation in temperature and the climate is dry desert type. Temperature range is from -2 to 50 º C. Relative humidity is generally below 30% except during brief south east monsoon period when the same rises up to 60%.Rainy season starts from July to mid- September and normal rainfall is only 328mm.The cropped area is estimated to be around 11.4 lakh ha, out of which 5.1% is under irrigation.

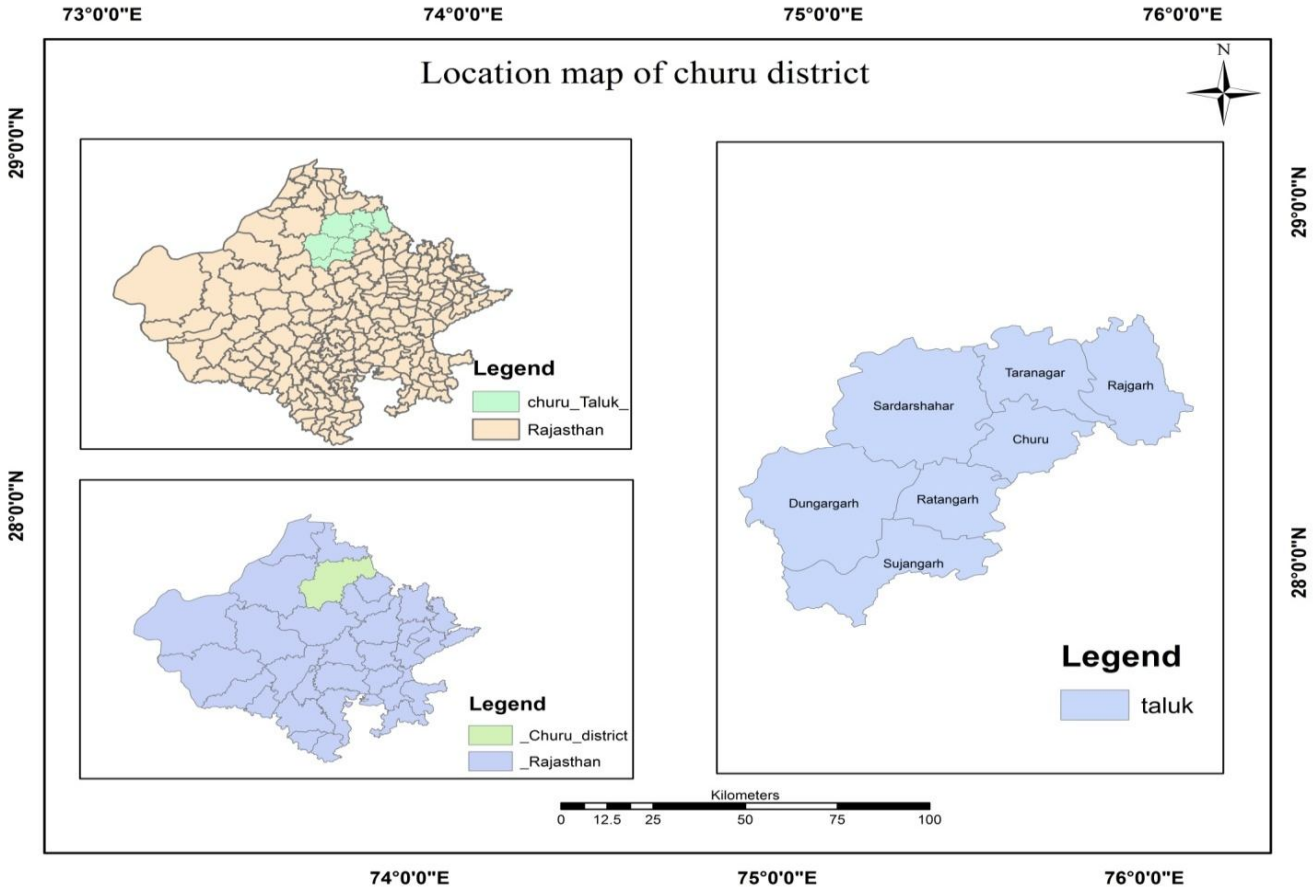

Fig-1: Study area

3. METHODOLOGY

The study area of Churu sub basin situated in sandy landscape of flat desert terrain has very few non perennial seasonal streams.The delineation of the Churu watershed has been carriedfrom theDEM data.First, depression less DEM was created by removing errors through sink and fill process. DEM Sink represents a cell surrounded by cells with relatively higher elevations. After that the flow direction and flow accumulation was calculated for stream channels.

ASTER data have been used for generating DEM and slope map. Spatial analysis ofbasin morphometry, base map and thematic maps have been carried out using the ArcGIS and ERDAS Imagine. The orders were designated to each stream following Strahler (Strahler AN, 1964) stream ordering technique. The stream numbers of various orders were counted, while the stream length, basin length, basin area, and perimeter of the basin were measured. The attributes were assigned to create the digital data base for drainage layer of the river basin. Various linear, areal, relief morphometric parameters of Churu watershed were computed using formulas suggested by Horton (1945), Strahler (1964) and Schumn (1956).

DRAINAGE NETWORK

The study area doesn't have any rivers flowing through it. It has non perennial short and intermittent inland streams flowing over short distances during the monsoonal season. From the drainage map it is evident that dendritic pattern is followed by majority of the streams (Fig. 2). Dendritic type indicates erosional streams. This pattern is found in the higher order streams revealing the homogeneity in texture and lack of structural control.Most of the streams are of the 1st and 2nd order indicating no major flows and lack of water.

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3.1. LINEAR ASPECTS

The linear aspects of morphometric analysis of basin include stream order, stream length, stream length ratio and bifurcation ratio, which explain the role of basaltic terrain in stream network generation. The bifurcation ratio and mean bifurcation ratio explain the significance of basaltic terrain and structural control on the drainage pattern (Kale and Gupta 2001).

3.1 a) Stream Order (u): There are four different system of ordering streams that are available Horton(1945),Strahler(1952) and Schidegger(1970).Strahler's system which is an upgraded version of Horton's system has been followed. According to this system the smallest, un-branched fingertip streams are designated as 1st order, when two or more 1st order channels meet they form the 2nd order, when two 2nd order streams join it forms a 3rd order and so on.When two channel of different order join then the higher order is maintained.In the study region the 1st and 2nd order streams mostly dominate the basin (75%) as is evident from Figure 2.Table 1 indicates the stream order counts.

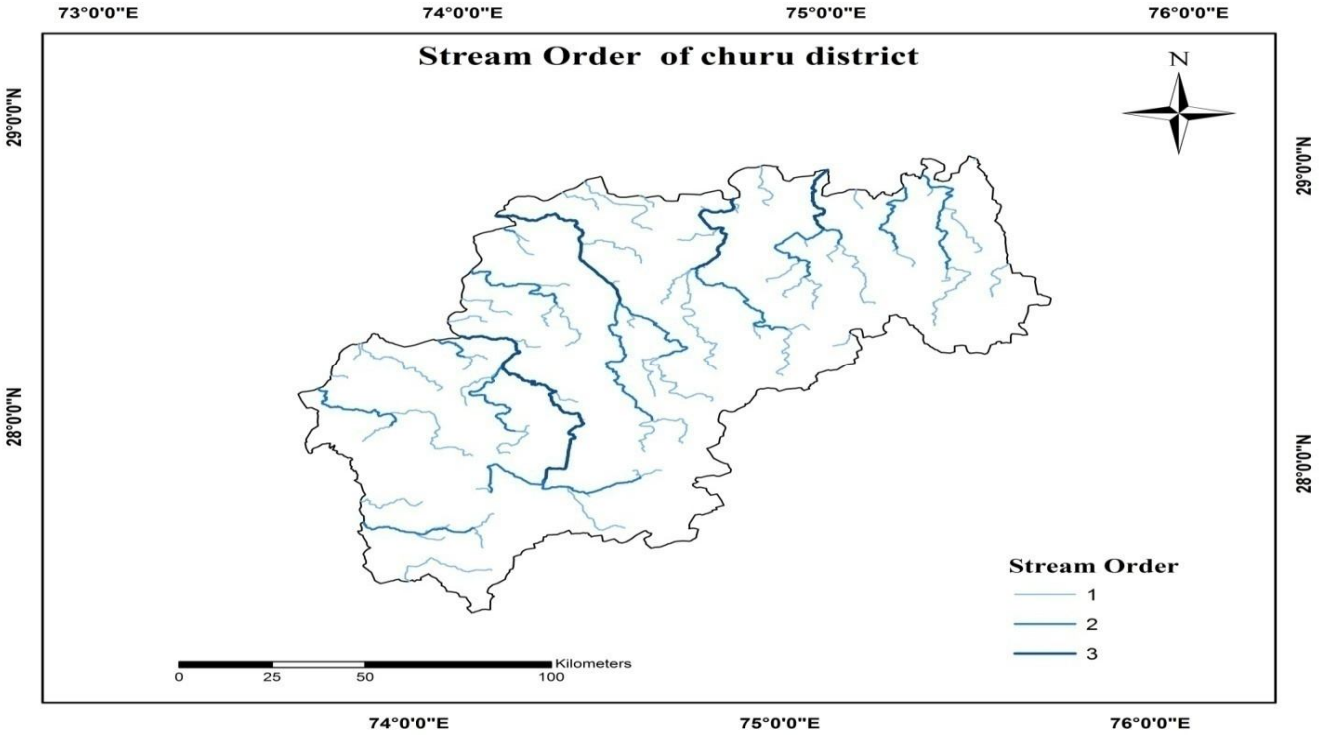

Fig-2: Stream Order of Churu district

3.1 b) Stream Length (Lu): The stream length was calculatedaccording to Horton's law. Stream length is an important hydrological features which explains the surface runoff characteristics. Generally, the total of stream segments is maximum in first order stream and decreases as stream order increases as is evident in Figure 3. The stream length for Churu watershed for the stream of first order is 1043.64km with mean stream length of 1.31 km and for the third order stream length is 244.19km having mean stream length of 1.15 (Table 1). The stream length along with Msl is quite low suggesting the arid climate and sandy to loamy soil which hinders the length of streams.

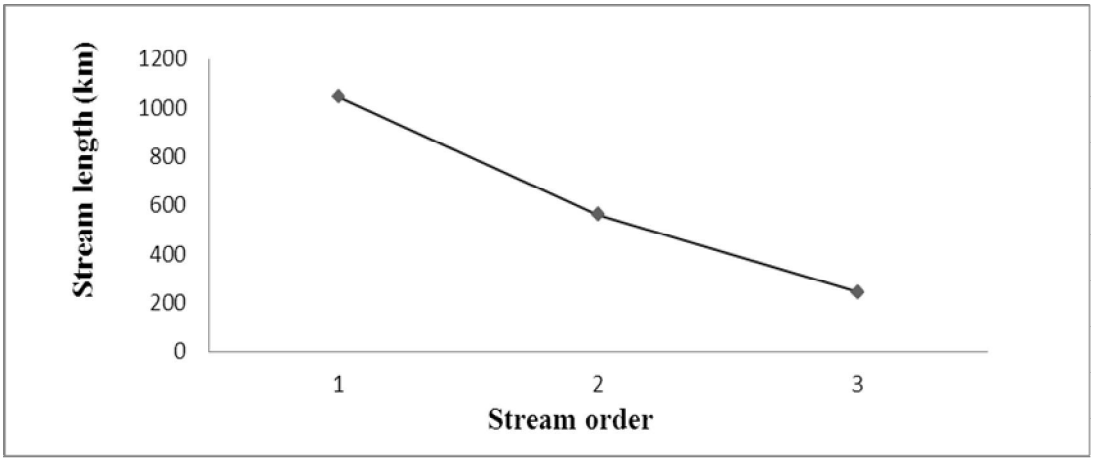

Fig-3: Relationship of Stream Order and Stream length of the study area

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3.1 c) Stream Length Ratio (RL): The stream length ratio can be defined as the ratio of the mean stream length of a given order to the main stream length of next lower order and has an important relationship with surface flow and discharge (Horton, 1932). An increasing trend in the stream length ratio from lower order to higher order indicates their mature geomorphic stage (Vinthula et al, 2014). RL of Churu watershed varies between 1.86 and 2.29.

3.1 d) Stream number (Nu): Stream number is the number of streams in each order for a given drainage basin.For Churu watershed number of stream in first order is 797 which goes on decreasing with stream order (Table 1).According to Horton (1945) the numbers of stream segments of each order form an inverse geometric sequence with order number. In Churu watershed, stream number (Nu) supports Horton's law. Moderate to loweramount of stream number indicates greater permeability and infiltration. The analysis is also supported by the soil texture of the study region which has a high sand and loam content enabling infiltration. It is directly proportional to size of the contributing watersheds and to channel dimensions.

Order No.	Order Count	Rb	Stream length in Km	Mean Stream Length	Stream Length Ratio(Rl)	Basin Perimeter
1	797		1043.64	1.31		
2	431	1.8	560.11	1.3	1.86	
3	212	2.03	244.19	1.15	2.29	891.19
Total	**342**	**3.88**	**1847.95**		**4.15**	
Mean		**1.94**				

Table-1: Linear parameters of Churu Watershed

3.1 e) Bifurcation Ratio (Rb): Bifurcation ratio is considered (Horton,1945)as an index of relief and dissection. Strahler (1956) established that the bifurcation ratio exhibits a small range of variation for varied regions or environmental circumstances, expect where the geology dominates. Bifurcation ratiois the number of one order to the number of next higher order.For Churu watershed the minimum and maximum value of Rb is 1.84 and 2.03 which can be termed as moderate. Average bifurcation ratio is 1.94 (Table 1). Greater is the bifurcation ratio higher is the chance of flooding. Thus the study area does not stand any major chance of flooding. Lower structural disturbance coupled with lower distortion of drainage pattern is signified when bifurcation ration is low (Strahler 1964). Thus the region has low structural disturbance with mature topography with the geological structure having no control over thedevelopment of drainage pattern.

On the other hand, complexity in landform, low permeability (Ket-Ord et al. 2013) and mature topography is indicated by high value of bifurcation ratio.

3.2 AREAL ASPECTS

It deals with the total area projected upon a horizontal plane contributing overland flow to the channel segment of the given order and includes all tributaries of lower order. It comprises of drainage density, drainage texture, stream frequency, form factor, circularity ratio, elongation ratio and length of overland flow.

3.2 a) Drainage Density (Dd): Drainage density, according to Horton (1932), is defined as the length of streams per unit area. It expresses the closeness of spacing of channel. Ddof any area depends on lithology, relief, vegetation cover, porosity, climate etc. A low drainage density indicates permeable sub-surface strata, arid climatic condition and has a characteristic feature of coarse drainage, whichgenerally shows values less than 1. Strahler (1964) notedthat low drainage density is favored where basin relief is low and vice versa.The Dd value of present study area is quite low at 0.107, which indicates that the region has paucity of water/surface drainage along with arid condition, low to moderate relief and a porous surface.The detailed drainage density map of the study area is given in Figure 4.

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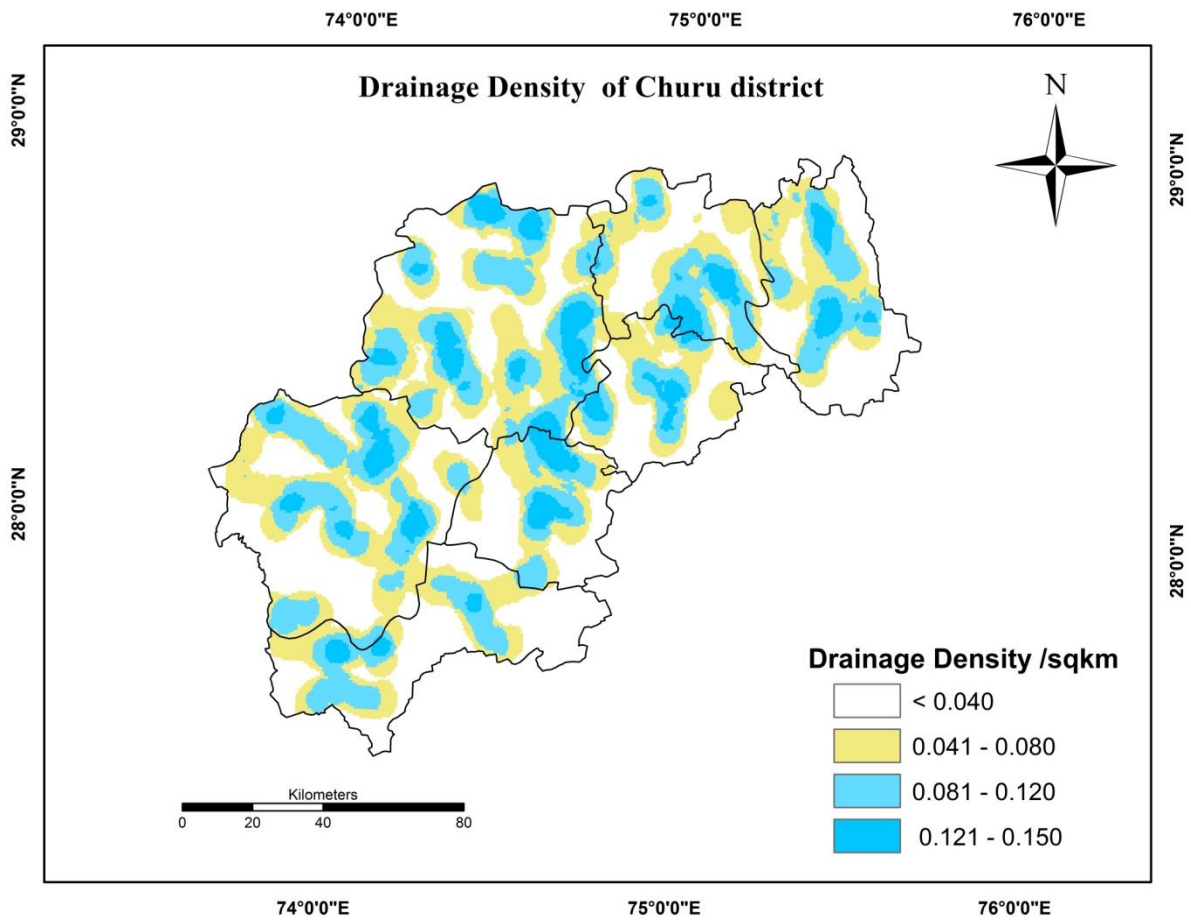

Fig.-4: Drainage map of Churu district

3.2 b) Drainage Texture(Rt): The drainage texture of a region is directly related to Dd and Fs of that region and is expressed as the product of them. An essential geomorphic concept about the drainage pattern is the drainage texture by which one means proportionate inter drainage spacing. Drainage texture is commonly expressed as fine, medium or coarse. Climate affects the drainage texture both directly and indirectly. The drainage texture depends upon a number of natural factors such as climate, rainfall, vegetation, lithology,slope, infiltration capacity, and stage ofdevelopment (Smith1950).The Rt value of the present study area is very low at1.61,indicating the relative inordinate high inter drainage spacing, semi-arid climate with coarse drainage.

3.2 c) Stream Frequency (Fs): It is defined as the number of stream segments per unit area. Higher stream frequency in one area indicates the development of new channels or extending of the existing streams. Stream frequency is affected by the structure of underlying rocks, intensity of slope, soil texture, surface material permeability etc. Stream frequency of Churu watershed is quite low at 0.08. This indicates permeable surface material and low relief.

3.2 d) Form Factor (Ff) : Horton (1945) defined form factor as the ratio of basin area to square of the basin length. Form factor value ranges from 0 - 1; the more the value approaches 1 means the basin is circular and 0 indicates absolutely elongated basin. F= 1 also signifies that the basin is characterized by nearly homogeneous structural pattern, morphogenetic characteristics and morphological process. But exceedingly elongated basin implies greater structure-topographical command over the river pattern.Elongated watersheds have an extended low peak flow.The present study area has Ff value 0.86, which indicates moderately elongated basin with homogeneous topography and channel morphology with more run off during the short intermittent showers.

3.2 e) Circulatory Ratio (Rc): The low, medium and high value of Rc are indicators of the youth, mature and old stage of the life cycle of the tributaries of a basin. The Rc value of Churu watershed is 0.27 which indicates the dendritic stage of the tributaries of this basin. This Rc value also indicates that the drainage system of the present study area is structurally controlled and the area has moderate relief. Miller described the basin of the circularity ratios range 0.4 to 0.5 which indicates strongly elongated and highly permeable homogenous geologic materials. The circularity ratio value (0.27) of the basin substantiates Miller's range which indicate that Churu watershed is moderately elongated in shape, low discharge of runoff and high permeability of the subsoil condition. Generally watersheds tend to become elongated as it attends mature stage.

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3.2 f) Elongation ratio (Re): According to Schumm (1956), the elongation ratio is defined as the ratio between the diameter of the circle of thesame area as the drainage basin and the maximum length ofthe basin (Table 1). It is found that a circular basin is efficient enough to discharge the runoff than an elongate done (Singh and Singh 1997).Basins with very low relief have values close to 1.0, whereas basins with high relief and steep slope have values rangesbetween 0.6 and 0.8 (Strahler 1964). These values can begrouped into three categories, namely (a) circular (>0.9), (b)oval (0.9–0.8), and (c) less elongated (<0.8), elongated (0.5-0.7), and more elongated (< 0.5). The 'Re' value of the study area is 0.525, which indicates that the study area is elongated with low relief and slope.

3.2 g) Length of Overland Flow(Lg): Length of overland flow is the length of flow of the rain water over the ground prior to its accumulation in definite stream channels (Horton, 1945). It is a critical measure of erodibility affecting hydrologic response and physiographic development of watershed (Horton, 1945). Smaller the value of length of overland flow, quicker is the surface runoff and lesser erosion and vice-versa. This factor depends on the rock type, permeability, climatic regime, vegetation cover and relief as well as duration of erosion (Schumm, 1956). The observed value of overland flow is 4.65 which is excessively high indicating longer flow path, gentler slopes, lower vegetation cover and greater erosion.

3.2 h) Infiltration number *(In)*: It depends on the drainage density and stream frequency of the region. Drainage density, drainage frequency, existing geology, soil formation, texture and degree of slope are the main factors for infiltration. The lower the In, higher is the infiltration and vice versa. The study region has a very low infiltration number of 0.008. This indicates high infiltration. This can be corroborated by the fact that the region has loamy sand to fine sand soil aiding infiltration.

3.2 i) Constant of Channel Maintenance(C): The constant of channel maintenance indicates the relative size of landform units in a drainage basin and has a specific genetic connotation (Strahler, 1957). The drainage basins having greatervalues of this parameter, will have decreased value of drainage density. Piedmont area basins show comparatively higher value of constant of channel maintenance. Higher value of constant of channel maintenance confirms steady curb of lithology with a surface of high permeability. Alluvial basin of plain and piedmont zone shows highest value, as the permeability in this zone is high. The study area has a very high C of 9.31 which indicates piedmont zone of high permeability having very low drainage density.

3.3 RELIEF ASPECT

Difference in the elevation between the highest point of a watershed and the lowest point on the valley floor is known as the relief difference of the river basin.

3.3 a) Slope: Slope plays a dominant controlling factor for regional planning of any region. Slope map of the Churu watershed was prepared from DEM data. The degree of slope in the study area ranges between 20 to 80°(Fig-5).There is relatively higher slope gradient in the north eastern part. Overall the region has moderate to low slope indicating piedmont plain and an enhanced scope of permeability. The land has a gentle slope towards the north-east having a disturbed drainage.

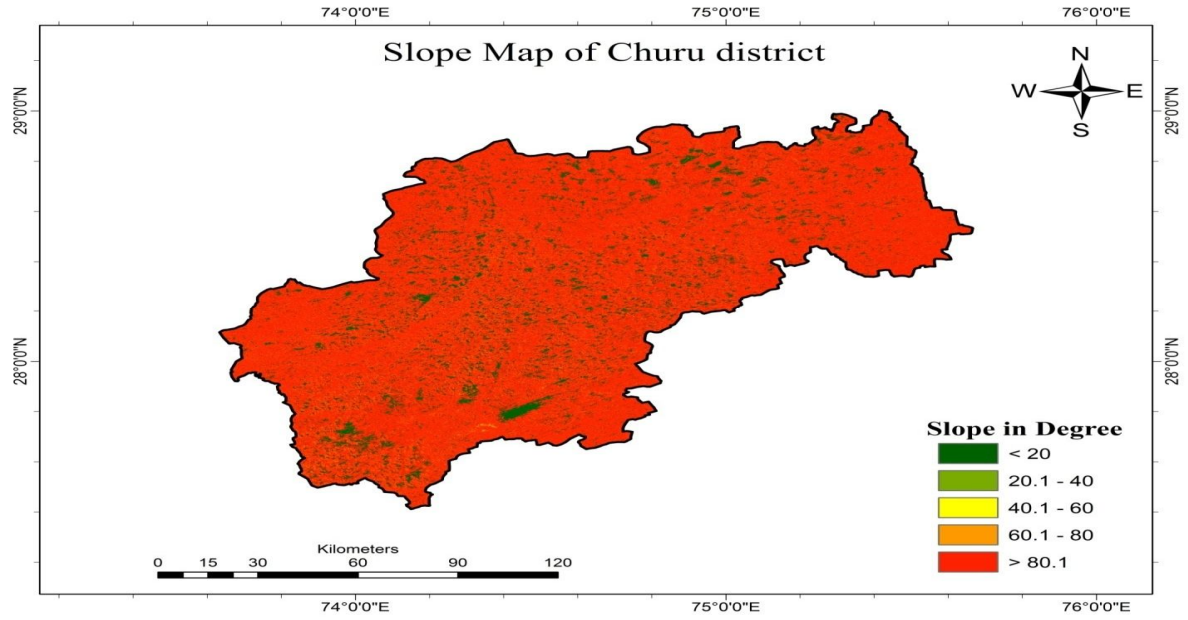

Fig-5: Slope map of Churu district

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3.3 b) Basin Relief(Bh) /(H): Basin relief is defined as vertical distance between the lowest and highest points of basin.The maximum and minimum relief of the study area are 472m and 199m respectively. Therefore, the basin relief of this region is 273m.The north eastern part of the study area has comparatively more relief, although the entire region is an undulating plain.

3.3 c)Relief Ratio (Rh):The altitudinaldiscrepancyof the watershed is its total relief, although the ratio of total relief to horizontal distance along the longest dimension of the basin parallel to the principal drainage line is Relief ratio (Rh) (Schumn, 1956). The relief ratio of the present study area is 1.93 which proves that the study area has low relief.

3.3 d) Ruggedness number (Rn):It is the product of maximum basin relief (H) and drainage density (Dd), where both parameters are in the same unit. The value of ruggedness number in present basin is quite high at 29.32 which indicates high erosional susceptibility.

3.3 e) Gradient ratio (Rg): The channel slope can be determined by Gradient ratio. It also enables to assess the runoff volume (Sreedevi, 2004. Smith, G.H 1939,1950). The present study area has an Rg of 1.93 which is too low indicating low slope and almost undulating plain.

CONCLUSION

Remote sensing and GIS techniques are convenient tools for morphometric analysis. GIS techniques, characterized by high accuracy of mapping and measurement, prove to be a competent tool in morphometric analysis. Detailed morphometric study of the Churu basin represents dendritic to sub-dendritic drainage pattern with 3rdorder drainage. The larger number of first order streams indicate uniform lithology and gentle slope gradient. Drainage texture is commonly expressed as fine, medium or coarse. The average bifurcation ratio of 1.94 indicates that the basin is normal and geological structure has no dominant control over thedevelopment of drainage pattern. In the study region the 1st and 2nd order streams mostly dominate the basin. The stream length along with Msl is quite low suggesting the arid climate and sandy to loamy soil which hinders the length of streams. The low average value of Ddand stream order wise drainage density suggests that the region has paucity of water/surface drainage along with arid condition, sparse vegetative cover and low to moderate relief and a porous surface. Circularity and elongation ratio shows that the basin has elongated shaped with low relief and slope. Hence, from the study it can be said that ASTER (DEM) data along with geospatial techniques is a competent tool in morphometric analysis.

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KNOWING WATER GOVERNANCE: - LOCAL SOCIAL INSTITUTIONS IN INDIAN WATER SECTOR

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ABSTRACT
Having its different types, Governance of water can be governed through bureaucracy, through economic instruments, through technology and with user participation. In India, Due to Water scarcity, it is considered that community involvement in water management is one of the most beneficial weapons for long term sustainability. Precisely, Water governance can be defined in two forms i.e. formal and informal. A formal side of water institution included the role of watershed approaches and participatory irrigation management approach. The success of these approaches depends upon on the involvement of community and social capital. Similarly, functioning of water market and groundwater market called informal water sharing arrangements within community for sustainable use of water. So this thematic article emphasis on the contribution of farmer's or community water institutions in the use of water resources.

Keywords: Water Governance, Watershed Management, Canal Water User Associations, water market

INTRODUCTION
Water is a flowing resource which is constantly in motion via the hydrological cycle and have different perspectives used at international and national level. Water is perceived by different people or same people in different context in different ways; as a commodity, as a commons, as a basic right and as a sacred resource or divinity (Iyer, 2003). So sometime, water becomes the reason of conflict at various levels i.e. Industrial, agricultural, and domestic. For the management or govern this resource, here is basic need of institutions or institutional arrangement. Study of Shah (2005) stated that Institutional Economy of Indian water economy consist two type of Institutions i.e. formal and informal form. Study revealed that government agencies, International agencies, governments water policy, water related laws, groundwater markets, tube-well co-operatives, water user associations are included in institutions or institutional arrangements.

In India, water is a state subject, Constitutional and legal provision deals with water sector. Most of the water policies had made within existing institutional framework. Presently, population growth, climate change, over-exploitation, industrialization and urbanization had affected water availability and lead to chronic water shortages in a growing number of regions. So, State has faced burning challenge to preserve the quality and its availability. This Challenge has led to Public, Private and community partnership in water sector.

Analyses of this paper will emphasis on the main Question: - How the formal and informal institutional arrangements within community contribute towards sustaining water resources in Indian water sector? For this, paper divides into two parts: - first part deals with the understanding of water governance and second part will address the role of social institutions in water resources. Understanding of water governance will reveal that water governance has its various forms, but this article will put more emphasis on those institutional aspects in which community engagement has worked.

UNDERSTANDING OF WATER GOVERNANCE
The water crisis of the 21st century is in many ways a crisis of governance in other words a crisis of the failure of institutions to manage the resources for the well-being of humans and ecosystems. Roger and Hall (2003) defined the concept of Governance that It is about effectively implementing socially acceptable allocation and regulation and is thus intensely political. Governance is a more inclusive concept than government *per se*; it embraces the relationship between a society and its government. Governance generally involves mediating behavior via values, norms, and, where possible, through laws. The concept of governance of course encompasses laws, regulations, and institutions but it also relates to government policies and actions, to domestic activities, and to networks of influence, including international market forces, the private sector and civil society.

Thus above stated definition reiterates that governance of water is more inclusive term than government and it contains values, norms, laws and regulations. The concept of water governance also relates to government policies, national and international market forces and civil society. Further their study stated These in turn are affected by the political systems within which they function. National sovereignty, social values or political ideology may have a strong impact on attempts to change governance arrangements related to the water sector, as is the case for example, with land and water rights or corruption (Roger and Hall 2003).

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There is a difference between water management, integrated water resource management and water governance. Water management is about achieving goals, preferably in a functionally and socially responsive and efficient manner, with given means, and largely within given conditions and constraints. Water governance is about identifying, choosing or adhering to the values and translating these values water, safety, agriculture, urban space, beauty or artistic design into goals, standards and institutional structures and processes. These are achieved in a context of public external accountability (Proceeding of UNESCO, 2011).

It is noted that here is need of water governance due to various reasons. Pressure on water ecosystems and other natural resources has increased due to rapid economic development and societal change. Water has a social, economic and institutional context but mostly governed by the technical factors. Water scarcity and water pollution has also put a challenge for better governance. So, water becomes social issue and its scarcity will not be challenge for that person who are able to pay but becomes challenge for those who have not economic resource. (http://pubs.iied.org/pdfs/G02523.pdf).

Secondly, Water has also its economic aspect and counted a key input for India's sustained growth. The agriculture sector is a major consumer of water in India that accounts for 85 percent of India's water consumption. Well developed irrigation infrastructure allows the country to be self sufficient in food grain production. Uttar Pradesh, Punjab, Madhya Pradesh, West Bengal, and Haryana became home to major water basins and counted in the chief producers of food grains. These states known for their Intensive irrigation and have already exceeded their surface irrigation potential. Further it is also seen that farmers of these states have turned to groundwater for irrigation. This trend has increased the numbers of groundwater pump sets in the country. Consequently, it is noticed that many of these regions have been categorized as water-stressed zones due to excessive groundwater use (Prabhu, Suresh P, 2014).

However Water resources arise in diverse ways and have different perspectives i.e. Riparian, Federal, formal Laws, civil Society, participatory, environmental and economic. But social and economic aspects of water use became the major reason for proper water governance. Water resource is governed by constitutional framework**,** Entry 17of the State List and Entry 56 in the Union List and Article 262 of the Constitution that gives the right to state and center to extent the regulation and development for the public interest. The relevant provisions are reiterated below:

Entry 17 of List II in the Seventh Schedule (State List)
Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List I.

Entry 56 of List I in the Seventh Schedule (Union List)
Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.(Planning Commission Report 2007)

Similarly, Article 246 of the Constitution of India deals with the subject matter of laws to be made by Parliament and by the Legislature of States, which is reiterated below:

1. Notwithstanding anything in clauses (2) and (3), Parliament has exclusive power to make laws with respect to any of the matters enumerated in List I in the Seventh Schedule (in this Constitution referred to as the "Union List")".
2. Notwithstanding anything in clause (3), Parliament, and, subject to clause (1), the Legislature of any State also, have power to make laws with respect to any of the matters enumerated in List III in the Seventh Schedule (in this Constitution referred to as the "Concurrent List").
3. Subject to clause (1) and (2), the Legislature of any State has exclusive power to make laws for such State or any part thereof with respect to any of the matters enumerated in List II in the Seventh Schedule (in this Constitution referred to as the "State List).
4. Parliament has power to make laws with respect to any matter for any part of the territory of India not included (in a State) notwithstanding that such matter is a matter enumerated in the State List.(Planning Commission Report 2007)

The parliament passed the inter-state water dispute Act in 1956 under Article 262 and with the 73rd and 74th constitutional amendment; the local bodies had got the constitutional right in water management (Ray, 2008).The adoption of the National Water Policy (NWP) of 1987, 2002 and 2012 are based on this constitutional basis. However, a national water policy has no legal status. Thus, water is primarily a State

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subject. The States have the competence to make laws, formulate and implement plans and schemes for development of water resources for water supply, irrigation, hydropower etc. However, several States of India have enacted different laws but most of these laws do not address the present concerns in the water resources sector with in a holistic manner.

SOCIAL INSTITUTIONS AND THEIR ADAPTION IN WATER SECTOR

Many researcher have emphasized that community ought to organize and manage water resources which would reduce the subsidies and financial burden of government. Their studies also have highlighted that natural resources cannot be managed and preserved properly without involving the rural communities that derive their sustenance from natural resources (Mishra, Nayak, Ghate and Mukhopadhyay 2008). Firstly, I will discuss about the successful cases in watershed management of India. Among them, Sukhomajri was the best model for analyzing the community based watershed approach in India where the government had taken initiative steps of watershed management by involving the local community. In this model, common property water resources were transferred to village society and village society corporate water user cooperative society for management and distribution of water on equal right basis. In this village small dams were constructed and water was distributed to all on equality basis for irrigation (Chopra and Kadekodi, 1990).

Same happened in Ralegaon Siddhi (Ahmednagar) where Anna Hazare have seen the significance of water as the key to economic development and emphasized developing the rural economy on a watershed basis through community participation. He liked the idea of Vilas Saunke of water management and started following "*Pani Adva, Pani Jirwa*" means trapping the water where it falls (Rao, 2005). Similar, in Madhya Pradesh the Rajiv Gandhi mission on watershed management started by government in 1994 and made a paradigm shift against the crisis of environmental problem of livelihood security. Here people were made key actors through democratically elected watershed development committee for planning and implementation the government scheme.

Sexana (1998) has narrated *Jhaua* as a success story because in this story the low cost, wide use of indigenous technology such as gully plugs, check bunds, boulders have landmark of the programme. Now wells in this village have more water and migration rate has fallen. The *Pani Panchayats* model has been initiated by *Vilas Salunki* (an engineer) which has clearly demonstrated that the minor irrigation system based on watershed and lift irrigation system can be feasible. *Pani Panchayts model* was based on the equity and judicious management of the water resources with the suitable cropping pattern is backbone. In this scheme water was not distributed randomly and each is getting according to his landholding size. This experiment has proved that sustainable water management is the best for economic growth. In Rajasthan, Tarun Bharti Sanghis NGO based experiment which influenced by Gandhi and J.P. Naryana ideology. In this experiment, team of NGO's and local people started to construct *johads (Ponds)* by putting force labor for few months. In 1987, the local people started co-operating in the activities of *johads (ponds)* repairs, maintenance and construction. Local people were participating whole heartily in this scheme.

A Similar study is done by Kadekodi, Murty and Kumar (2002) in which they give an account of *Kumanons* (Uttarakhand) who efficiently managing the water distribution an effectively exercising their water rights even today. The experience of the village Ralegan Siddhi, under the leadership of Anna Hazare teaches that it is possible to break the nexus between dryland and dry life by the contribution of community whose life is going to be changed on account of such contribution.

Further, Singh and Firdausi (1991) described the working of traditional *phad* irrigation system in Maharasthra. It is system practiced since 16^{th} century for water harvesting and this system suggests the ground rules required for more fruitful relationship between the irrigation agency and water users in large irrigation projects. Deshpande and Reddy (1994) have studied the working of *pani panchayats* in Naygoan and neighboring villages of Purandar taluka of Maharashtra which provide framework to model group dynamics around resource sharing under own initiated collective action. The success of this system has been linked to group homogeneity, cost efficiency, commitment and equal distribution of water Second form of social institution of water sector is known as water user associations that are prevailing in Participatory Irrigation Management and known as Formal arrangements of community for water sharing.

The WUA provides the farmers a forum to come together and work. the functions of WUAs are-Distribution of water, maintenance and repairs, fixation and collection of water charges, punishing defaulters within the areas of the WUA and resolving disputes among water users in the area of operation. In 1961 Planning Commission has also recommended that maintenance of minor irrigation work should be entrusted to local bodies and Panchayats. The Ashok Mehta Committee Report also described the positive role of Mandal Panchayats in the working and shaping of water management (Upadhya, 2002).

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Ostrom also described the governance features in the institutional levels which are fully found in the governance of WUAs. These features are mentioned in the context of (i) Defined boundaries. In the case of WUAs, the membership would likely be all landowners that receive water from a main canal and the resource would be the flows (ii) Appropriation, rule, and local conditions congruence. Rules made by locals will inevitably make sense with local conditions.(iii)Collective-choice officials are elected to execute duties, the real authority rests with the general assembly of water users.(iv) Monitoring may take the form of water guards or more sophisticated gages.(v)Graduated sanctions. Penalties for those who are breaking the rules of the organization must be imposed by the elected members (VI) Conflict-resolution mechanisms. One of the beauties of WUAs is the ability to handle disputes on the local level. (Ostrom, 1990)

Report by Ministry of Water Resources, River Development and Ganga Rejuvenation highlighted that after the implementation of the water policy in 1987, the totally 56934 WUAs are formed at India level which are covering the total area of 13537.94 ha. The numbers and performance of WUAs is too successful in Andhra Pradesh, Maharashtra, Gujarat, Orissa and West Bengal. But still PIM act is fully successful only in 15 States not in whole Country.

Report chapter by planning commission of India stated that A few formal water users associations were also formed from time to time like the Vadakku Kodai Melazhahian Channel Land Holders Association in Tamilnadu in December 1959, Malinagar Irrigators Water Cooperative Society in Maharashtra in 1967, Vaishali Area Small Farmers Association in Bihar in 1971, Mohini Water Cooperative Society in Gujarat in 1978. Parthasarathy (2000) examined critically aspect of the Water Users Association (WUA) formed under the PIM programmes in Gujarat. Study found that people's participation, collection of contribution, fixing water rates higher than the government's, gender and equity concerns and conflict resolutions of the WUAs presented mixed results in Gujarat. He observed that these areas are successful in milk and other cooperatives, but the water users cooperatives seemed to lack of support and enthusiasm. There are areas that are not amenable to forming a WUA. Some WUAs are not following "the Societies Act" because they are not distributing the surplus income over and above sharing some fixed portion (12 or 15 per cent) as dividend among its members.

There are fewer cases where these Organizations are working in a successful way. Gujarat and Maharashtra with the proud record of the successful working of Panchayati Raj bodies and milk and sugar co-operatives but they did not provide a similar example in case of water users organization. The often cited cases of success are coming from the state of Andhra Pradesh, where credit goes to Syed Hashim Ali (Pant, 1986).

WUAs are successful only in those States where States Governments have taken initiative steps and passed the acts strictly. Governments of Punjab, Haryana and Manipur have still drafted their PIM bills which are in the process for enactment. Govt. of Haryana had agreed to implement PIM in the Water Resources Consolidation Project which was being implemented with the assistance of World Bank.

Narain (2003) had compared two water user associations function with Shejpali and Warabandi system in two states Maharashtra and Haryana. In Maharashtra, the IMT Model aims at changing control relations between the users and the bureaucracy. WUAs have been formed through the efforts of the Irrigation Department officers. These are in Aurangabad, Jalna, Parbhani and Nanded districts where NGOs and government officers to monitor the progress of water users associations. Gujarat, Maharashtra has successfully experimented with volumetric supply of water to user groups. However, with the slow and gradual pace of reform, both states are facing a problem of replication and expanding the scale of reform.

The government of Madhya Pradesh has passed a bill in 1999 which is known as "*Madhya Pradesh Sinchai Prabandhan Me Krishakon Ki Bhagidari Adhiniyam 1999"* .The objective was to transfer management of the irrigation system to water users' associations (WUAs) .The state of Chhattisgarh was constituted in November 2000, and was carved out from Madhya Pradesh. The new state has continued with the similar set up for the water resource department it inherited from Madhya Pradesh, including the new Participatory Irrigation Management Act. The Act is now known as Farmers' Participation in the Management of the Irrigation System in Chhattisgarh, CGFIMS Act 1999. In Chhattisgarh, a total of 942 WUAs have been constituted (Dinesh , 2005).

Similarly, everyone is aware about the fact that groundwater irrigation has played a crucial role in expanding agricultural production to meet the food security. But from last decades, groundwater has emerged as an indispensable resource for agricultural use in India especially in areas where there is scarcity of surface water. With the advent of Green Revolution technology in farming followed by the adoption of modern water extraction mechanisms, there has been a spurt in the extraction rate of groundwater to meet agricultural needs. This calls for a need to put in place innovative institutional arrangements to manage groundwater – a common property resource – especially in water scarce areas (Mukherjee, 2007).

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In several parts of India like north Gujarat, southern Rajasthan, Saurashtra, Coimbatore and Madurai districts of Tamil Nadu, Kolar district of Karnataka, parts of Andhra Pradesh, Punjab, Haryana and Uttar Pradesh are facing declining water levels are in the order of 1-2 m per year (Mukherjee,2007). In these states, groundwater market has emerged day by day but too much growth in Gujarat. In this institutional arrangement farmers buy and sell irrigation water for increasing access to and use of groundwater for irrigation Easter, Rosegrant, Dinar 1999: Shah 1993 describes that Informal water markets worked as "tit for tat" game-theory in which if farmers do not pay, their future supplies will cut down and if a seller does not deliver, the buyer can use another supplier.

They also stated that Informal water markets may be good alternative, particularly if water allocation at the local level is a problem and the transaction costs of establishing formal markets are high (meaning the costs of enacting legislation, establishing institutional and organizational arrangement for markets, implementing trade arrangements, and monitoring and enforcing trades). Besides allowing water to be sold to the most productive farmers, informal markets would give all farmers incentives to use their water more efficiently. (Easter, Rosegrant and Dinar 1999)

Groundwater market is not found in a uniform manner in India. While water markets are widespread in Punjab, Uttar Pradesh, Tamil Nadu, Andhra Pradesh and West Bengal, it is mostly developed in Gujarat (Mohanty and Gupta, 2002). Scholars like Shah (1993) and Bauer (1997) also examined that the water market existed in Gujarat in 1920s in an informal form, which was unregulated, localized, fragmented, impersonal and seasonal. They defined that water is sold to those who do not have their own pumping equipment. Further, Balasubramanian and Selvaraj (2003) explored that water markets worked efficiently where there are a large scale of pump ownership among farmers, so as to curb the monopolistic behavior in the market.

In water abundant states like West Bengal, water institutions at the local level have emerged not due to water scarcity but because of high tariffs over tube well extraction. Mukherji (2007) explored two types of informal groundwater institutions in West Bengal (a) first one being the kinship group- owned electric submersible tubewell (ESB) in a Dunipara village in Birbhum district (b) the other is private water market with price regulation by the Panchayat Samiti (PS) in Mohanpur village of Hugli district. Shah and Ballabh (1998) studied the functioning of field based water market in six villages of Bihar whose main concern was on "what makes a water market worthwhile as a socioeconomic institution?"

Another important study on informal water sharing institutions has been done by Tiwary (2010) in Bhajjal village, which is located in a Garhsankar block of Hoshiarpur district. This study described the principles, rules, sub-rules of shared tubewells which have been derived from the field observations, Interviews, focused group discussions. He further mentioned that the water right is connected with the right of land and when land sold the right of shared water is transferred to another farmer into the command area. The water rights are allocated among the shareholders according to the principle of "each according to its land". The discussions revealed that the shared groundwater irrigation is not necessarily fixed forever. Partners sometimes break away from the shared system. One partner may leave the systems particularly for setting up his own tube well.

Within water markets, the various scholars in Gujarat and Uttar Pradesh also study 'Rental Water Market'. They have focused on the management of water buying and selling by the local farmer's community within a fixed time-period of public tube wells. In India, public (government) tube wells were built with the intention of providing irrigation to all categories of farmers in a fair, equitable and affordable manner (Mukherjee and Kishore, 2003).

Groundwater market has also influenced the socio and economic status of farmers in some water scarce states or areas. Access to groundwater by different farmers have reduced poverty and ensured food security in Indian states. However due to depletion, it has created alarming challenges like socio-ecological and economic disparities. In some states like Gujarat and Tamil Nadu, over pumping and overuse of groundwater by these water institutions have created a situation of overexploitation of the aquifer which has created 'water lords' in rural Societies . In water scarce areas a few farmers have emerged with power to exercise control over the groundwater resources and extract surplus.

However, the well owners' extraction of monopoly rents from water sale is most likely to be problematic where the water markets are not competitive. Since topography and the distance between the source and field restrict water transactions, market competition is more difficult to achieve. Importantly, the availability of groundwater resources and alternative irrigation supplies can reduce the seller' monopoly power and hence the price of water (Janakarajan, 1994; Mukherjee, 2008).

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CONCLUDING POINTS AND WAY FORWARD

In concluding remark, it can be stated that Communities are part of good governance because they address certain problems that cannot be handled either by individuals or by markets and governments. This article gives a synoptic overview of the successful cases of three water institutions. Firstly, author can say that Watershed management programme has emerged as a holistic approach to achieve the goals of sustainable development like ecological, economic and social in rural areas of India. It is found that these programmes are not only run by the government agencies but also run and helped by the various NGO's in some states of India. This is helpful for the improvement of agricultural income, employment status and women condition in rural areas. But despite of this, these watershed programmes which involves the role of community is not fully initiated in some water scarce states i.e. Punjab and Haryana.

Similarly, role of water user association and functioning of Participatory Irrigation Management did not find equal in all states of India. On the other side, various studies described in this article stated that functions of Water user association can be helpful for creating economic sustainability and environment sustainability. Studies also revealed this point that People's participations through WUAs have been perceived as one the important means to ensure sustainable use of water. Here is need of decentralized approach with appropriate rules and responsibilities that proved helpful in the development of irrigation and the success of community in Participatory Irrigation Management in all states of India. Here is also need of strong political will in some states of India for the success of Participatory irrigation management that will be helpful for the success community's role in all the states of India.

Thirdly, functioning of water market also emphasized the role of community in sustainable use of groundwater in some states of India. These studies show that development of groundwater irrigation has not only helped the well owning farmers but also the non-well owners through the emergence of 'water markets'. But, lack of well defined property rights has made it vulnerable to over-exploitation in hard rock water scarce states. Lastly, it can be said that community based institution are proved successful in those areas where social norms, social values and political exists.

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MODELING DESIGN AND SIMULATION OF PHOTOVOLTAIC MODULE WITH TAGS USING SIMULINK

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ABSTRACT
Matlab is a general purpose scientific computing commercial software, its diverse environment including toolboxes and blocksets are prominent as leading simulation package in simulating, analyzing and optimizing the functioning of PV cell, module, and system. In present paper, Simulink models are deployed to realize the characteristics of PV module. The current I (V) and power P (V) characteristics of the PV array have been analyzed under influence of solar irradiance and temperature. The study includes usage of tags in simulink to implement the mathematical modeling of the PV module in the simulation environment. Mathematical modeling and electrical circuits of the PV cell and module are described. Moreover, the effect of series resistance and ideality factor on the characteristics of PV module is also described.

Keywords: Photovoltaic (PV) Cells, Module, Operating Temperature, Solar irradiations, Mathematical modeling, Matlab, Simulink

1. INTRODUCTION

Incrementing energy demands, an impact of greenhouse gasses (GHG), climate changes are ineluctably foreordained challenges in front of all over world community. One of the efficacious solutions to these difficulties is the adoption and development of renewable energies resources. Among all the available renewable energy sources (RES), green energy solar energy is most promising due to its availability in excess. Deployment of renewable energy can play a significant role in economic growth and enhancement in the quality of life.

PV systems are interface physical devices to convert solar energy to electrical energy without involving mechanical systems and their characteristics analysis provide optimum utilization of solar energy. Photovoltaic cells produce electricity directly from sunlight with the principle of the photovoltaic effect. The characteristics of the photoelectric cell such as current, voltage, power, and resistance change on the exposure of light. The PV modules are the structural development of horizontal and vertical combinations of the PV cells for the purpose of more voltage and power output.

The crucial usage of the PV modules includes the remote location such as mountains, satellites, deserts where electric grids are not available. Paramount utilization of photovoltaic systems in an efficient manner requires a careful learning of voltage current characteristic of photovoltaic modules.

Prominence development in technology, incentive policy formulation by regimes, degradation in environment and ecosystem due to thermal plants, decrement in fossil fuels and elevation in price are the main concern of focus for deployment of solar energy.

The significance of photovoltaic solar energy is its renewability and sustainability. The paramount deploy of solar energy is:

- Clean, green energy and liberate from sundry hazardous effects, reduce Green house gaseous.
- Reduce the conventional energy crisis and incrementing rate of environmental issues such as air pollution and ecumenical warming.
- Facilitate to all, since earth receives the gargantuan amount of solar energy from the sun.
- Increasing exponentially, by virtue of utilization of efficacious materials which increase in efficiency of solar cells.

The present investigation analyzes the characteristics of the PV cell, elongated to PV module. The single cell can produce the voltage in a range of 0.5 to 0.8V as per existing semiconductor and built-up technology which is profoundly low. The voltage and current can be incremented by connecting the cells in series and parallel. These modules are connected in series and parallel to compose a PV panel. When these panels are connected in series, the voltage will be integrated and the current will be same and when connected in parallel the voltage will be same and current will be integrated [1].

The focus of this paper is the realization of characteristics of the PV module with the help of Matlab software. There are various methods for the realization of characteristics of system in simulation. However, Matlab,

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general purpose scientific commercial software is very popular among searcher in all over globe. Moreover, in Matlab, multiple ways are available to analyze the characteristics of dynamic system viz. PV module. It includes Matlab script, Simulink, GUI, embedded functions, simscape, and Simelectronics.

In present paper, Simulink models with tags are deployed to realize the characteristics of PV module. The current $I(V)$ and power $P(V)$ characteristics of the PV array have been analyzed under influence of solar irradiance and temperature. Firstly, mathematical modeling and electrical circuits of the PV cell and arrays are described. To examine the characteristics of the PV modules, a literature survey of existing simulation in Matlab is depicted in Table 1. The adopting methods of Simulink using tags provide easy and understandable method of analyzing the characteristics of PV cells and modules in generic.

Table-1: Literature survey of existing PV simulation in Matlab

S. No.	Author and Year	Work Done	Observations
1.	Walker, 2001 and Gonzalez-Longatt, 2005[1]	A Matlab function script is developed to analyze the PV-characteristics by considering the data of solar irradiance, voltage, and temperature. In addition, the consequences of ideality factor and series resistance are illustrated.	A difficulty of this method is to require readers programming skills so it is not easy to follow.
2.	Gow and Manning, 1999	In this study, m-file and C-language has been used to compute the characteristics of PV module	Realization in C-Code is a cumbersome job.
3.	(Savita Nema and Agnihotri 2010), (Salmi et al. 2012), (Panwar and Saini 2012), and (Sudeepika and Khan 2014)	In these studies, the Simulink model with common blocks has been designed according to mathematical equations of PV cell or module to describe the PV characteristics under the influence of physical parameters and environmental conditions.	The simulation procedure used in this paper is not clear to understand and redesign by the searchers.
4.	Pandiarajan and Muthu 2011, Jena et al. 2014,	The simulation of PV models is implemented using subsystems in Simulink graphical environment. A step-wise procedure has been adopted to develop Simulink models based on mathematical equations of PV cell, modules.	This method does not consider the effect of partial shading on the operation of PV module.
5.	Banu and Istrate, 2012	The P-V and I-V Curve of the PV module are realized using empirical data and Lookup Table or Curve Fitting Tool.	The simulation of PV module is only realized if sufficient data is available from the experimental system
6.	Venkateswarlu Raju 2013 and Ibbini et al. 2014	The P-V and I-V characteristics of PV module have been demonstrated using the in-built solar cell block in Simscape.	Analysis of saturation current and effect of temperature have not included.
7.	Mohammed, 2011 et al.Varshney and Tariq 2014	The solar model developed with Tag tools in a Simulink environment is recorded in the research of this paper.	The steps of methodology are required.

2. ANALYTICAL MODELING EQUIVALENT CIRCUIT MODEL OF PV MODULE

In this section, different equivalent circuit models and mathematical modeling of PV cells are presented.

2.1. Electrical Equivalent Circuit Model of Ideal PV Cell

The ideal PV cell model of PV cell has a light generated current source in anti-parallel single diode. Ideal PV cell model is known as single mechanism three parameters (SMTP) which involve with ideality factor, photo current and saturation current. In Fig.1 the electric equivalent circuit of ideal PV cell is depicted. In this, the losses due to series resistance and shunt resistance are considered equal to zero. The output current of the PV cell is found using the Kirchhoff's current law and given by eq. (1)

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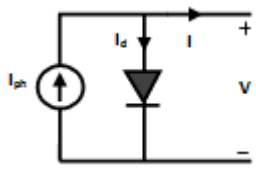

Figure-1: Ideal Equivalent Circuit PV Cell (Belia, 2014)

$$I=I_{ph}-I_d \quad (1)$$

I_{ph} : Photo current (A)

I_d : Current across diode (A)

Diode current is obtained by diode equation and given by eq. (2).

$$I_d=I_0\left[\exp\left(\frac{V}{AN_sV_T}\right)-1\right] \quad (2)$$

V : Load Voltage (V)

A: Ideality factor, which depends on the PV cell technology, and different ideality factor for different technology is depicted in Table 2

Table-2: Ideality factor (A) of different PV cell technologies (Huan-Liang et al., 2008)

S. No.	PV Cell Technology	Ideality Factor (A)
1.	Silicon (mono)	1.20
2.	Si-poly	1.30
3.	a-Si-H	1.80
4.	a-Si-H-tandem	3.30
5.	a-Si-H triple	5.00
6.	Cste	1.50

V_T : known as thermal voltage.

$$V_T=\frac{kT_c}{q} \quad (3)$$

Electron charge, $q=1.602\times10^{-19}$ C

Boltzmann's constant, $k=1.3805\times10^{-23}$ J/K

Reverse saturation current, I_0 (A)

Tc: Operating temperature (K)

Thermal Voltage: V_{Tc}=26 mV, at 300^0K for silicon cell

If V_T is multiplied with N_s and A , then

$$a=\frac{Ns.A.k.Tc}{q}=Ns.A.V_T \quad (4)$$

a: Modified ideality factor

2.2. Circuit Model of PV cell with R_s

Integration of a series resistance in the ideal PV model provides more precision. The electric scheme identically equivalent to this model adding up a series resistance R_s to single diode model is shown in Fig. 2. This model is known as simplified circuit model of PV cell, involves with four parameters –ideality factor, series resistance, saturation, and photo current. Due to this, the model is known as a single mechanism four parameters (SMFP).

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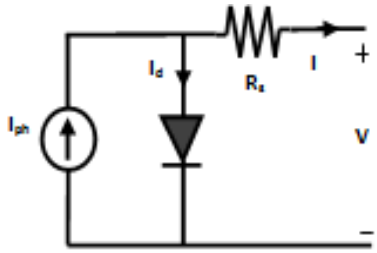

Figure-2: Simplified Circuit Model of PV Cell (Belia, 2014)

When R_s is taken into consideration then the diode current I_d is affected as given by eq. (5),

$$I_d = I_0 \left[\exp\left(\frac{V+IR_s}{AN_s V_T} \right) - 1 \right] \quad (5)$$

The PV cell circuit model with R_s depicted in Fig.2 is known as simplified form and widely used by the simulators.

2.3. Practical Model with Series Resistance R_s and Shunt Resistance R_{sh}

This practical model texture of a current source modeling the solar irradiations and two resistances for modeling the losses: series resistance Rs and shunt resistance Rp, as depicted in Fig.3. The model thus enfolds the following five unknown parameters: ideality factor, photocurrent, series resistance, shunt resistance and saturation current. Therefore, it is also known as SMFP (Single Mechanism, Five parameters) [4]. This practical model is so designed as by taking different properties of solar cell into consideration as:

- R_s have been employed in order to consider the internal losses and voltage drops due to a flow of current.
- R_{sh} expresses the losses in terms of leakage current to the ground when diode operates in reverse bias mode.

The output current is obtained by using the Kirchhoff's current law using equation 6:

$$I = I_{ph} - I_d - I_p \quad (6)$$

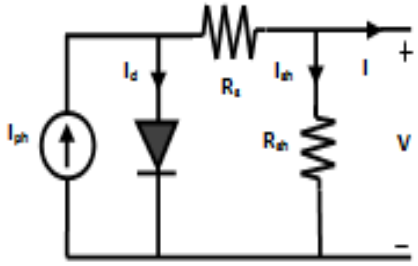

Figure-3: Equivalent Circuit of PV Cell (Salmi et al.2012)

The photo current is directly proportional to solar irradiations and temperature.

2.4. Photo-Current of PV Cell or Module (Iph)

The photo current of PV cell is obtained by using eq. (7) as:

$$Iph = \left[Isc + Ki\left(T - Tr\right) \right] G/1000 \quad (7)$$

Isc : Short circuit current (A) at STC;

Ki : Coefficient of short-circuit current of cell at STC (A/K)

T : Operating temperature in Kelvin;

Tr : Reference Temperature in Kelvin;

G : Solar irradiation in W/m^2;

The reverse saturation current across the diode, is depend on short circuit current, open circuit voltage, number of cells in series, ideality factor and operating temperature of the module. Mathematical it is calculated as below.

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2.5. Module Reverse Saturation Current (Irs)

The reverse saturation PV module has been determined as:

$$Irs = \frac{Isc}{\left[\exp\left(qV_{OC}/N_S kAT\right) - 1\right]} \quad (8)$$

Here,

q : Electron Charge ($1.6\times10^{-19}C$);

Voc : Open circuit voltage (V);

Ns : Number of PV cells connected in series;

k : Boltzmann's constant (1.3805×10^{-23} J/K)

A : Ideality factor of the diode;

The saturation current of diode in PV cell depend on reverse saturation current, operating temperature, band gap energy of diode. It is discussed below.

2.6. Saturation Current (Irs)

The module saturation current I_0 varies with the operating temperature of cell, which is given by

$$I_0 = Irs\left[\frac{T}{Tr}\right]^3 \exp\left[\frac{qE_{g0}}{kA}\left(\frac{1}{T} - \frac{1}{Tr}\right)\right] \quad (9)$$

Here,

Tr : Reference Temperature $(298.15\ K)$;

E_{g0} : Band gap energy of silicon $(1.1\ eV)$;

On computing the photo current, reverse saturation current and saturation current, the output current of PV module is computed. The mathematical relation of output current to above cited currents is given as:

2.7. Output current of PV module

Finally, the output current of PV module has been calculated as:

$$I = N_P I_{ph} - N_P I_0\left[\exp\left(\frac{V/N_S + IRs/N_P}{AVt}\right) - 1\right] - I_{sh} \quad (10)$$

With

$$Vt = \frac{kT}{q} \quad (11)$$

and

$$Ish = \left(\frac{VN_P}{N_S} + IR_S\right) / Rsh \quad (12)$$

Here:

Ns : Number of PV modules connected in parallel;

Rs : Series resistance (Ω);

Rsh : Shunt resistance (Ω);

Vt : Diode thermal voltage (V)

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The graphical representation of PV module using parallel and series cells depicted in Fig4.

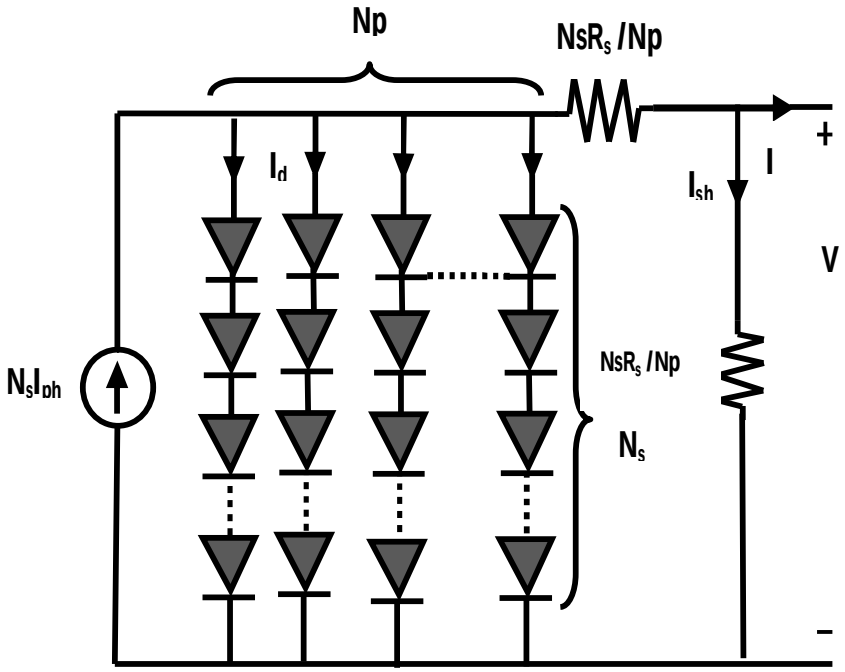

Figure-4: Equivalent Circuit of PV Array (Tu and Su 2008)

For single PV cell the output current is determined using eq. (13)

$$I = I_{ph} - I_0\left[\exp\left(\frac{V + I.R_s}{AN_sV_T}\right) - 1\right] - \frac{V + R_s.I}{R_p} \qquad (13)$$

In the present study, the 36 W Solar Power Module has been considered as reference model for performing the simulation. Further, the parameters of module are given in Table 3.

Table-3: Key specification of solkar 36 w PV modules (N.P. Rajan e.l)

S. No.	Parameters	Variables	Values of Solkar
1.	Rated power	Pr	37.08 W
2.	Maximum power	Pm	42.228 W
3.	Maximum voltage at maximum power	Vm	16.56 V
4.	Current at maximum power	Im	2.25 A
5.	Open circuit voltage	Voc	21.24 V
6.	Short circuit current	Isc	2.55 A
7.	Total number of cells in series	Ns	36
8.	Total number of cells in parallel	Np	1
9.	Ideality factor of diode	A	1.6
10.	Cell short circuit current temperature coefficient	Ki	0.00017
11.	Reference Temperature	Tr	25^0C
12.	Solar Irradiance	G	1000 w/m2 at STC

3. SIMULATION OF PV CELL MODULE

In Fig.5, the value of parameters of Solkar 36 W PV module is shown. These parameters values are fed to tag blocks and these are further used in other Simulink models. The blocks used contain constant blocks and tag GOTO blocks and these blocks are dragged from Simulink sub libraries commonly used library and signal. Simulink Model of photocurrent shown in Fig.6 is designed according to eq. (7). The current is dependent on temperature and solar irradiations. The model is developed in the same window of Simulink, in which parameters of PV module is defined for the purpose of a proper link between the GOTO blocks and FROM blocks. The saturation current in PV cell is given by eq. (9). The Simulink model of eq. (9) is shown in Fig.7. The parameters of the Solkar 36W PV module are given in Table 2. These parameters are used in Simulink models. The tags representation of these parameters is developed in Simulink environment and depicted in Fig.5. These tags are used to transfer of the values according to their compatible tags in the Simulink models.

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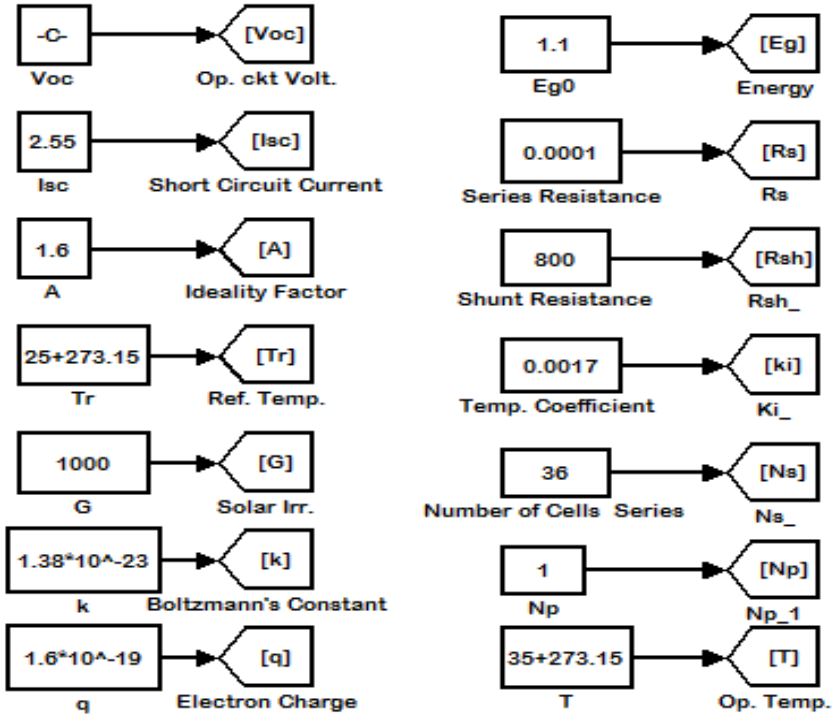

Figure-5: Parameters Values of SolKar 36 W PV Module

The PV cell behaves as the current source of exposure to solar irradiation. The photocurrent of the PV module is given by the eq. (7), and its Simulink model is depicted in Fig.6.

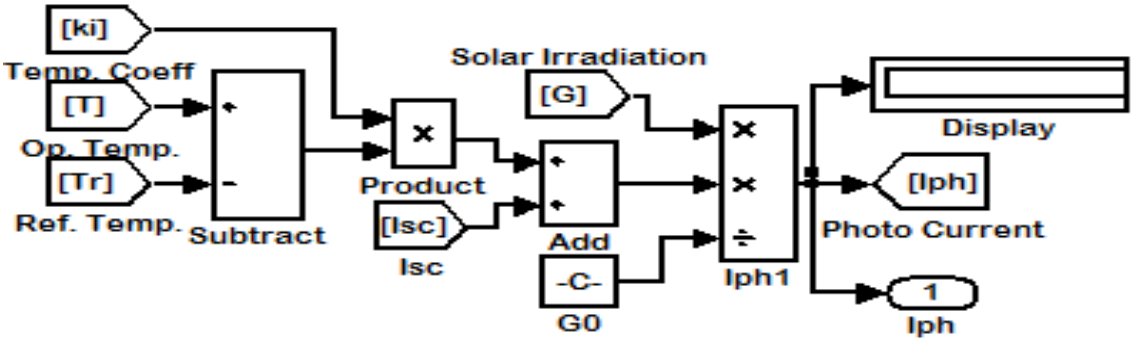

Figure-6: Simulation model of photo current (Iph)

In Fig.8, the Simulink model of the reverse saturation current is depicted. This model is designed on the basis of eq. (8). The saturation current of PV cell is given by eq. (9) and its Simulink model using tags is shown in Fig.8

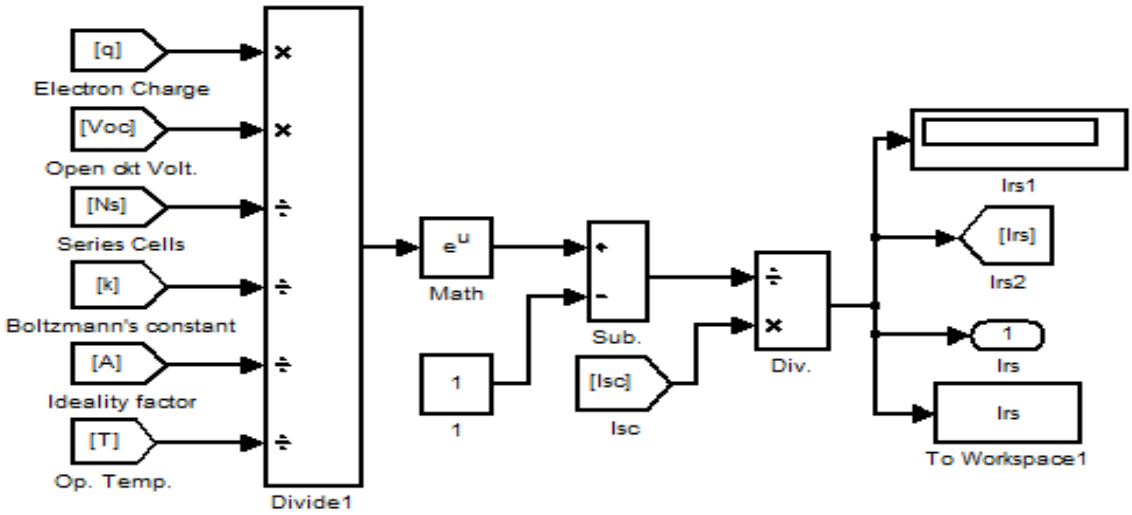

Figure-7: Simulation model of reverse saturation current (Irs)

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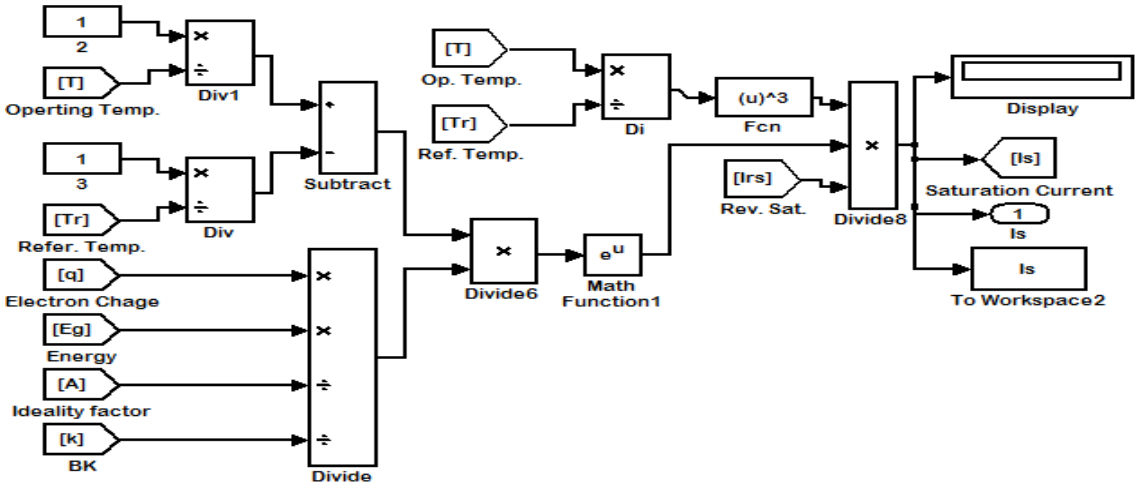

Figure-8: Simulation model of saturation current (Is)

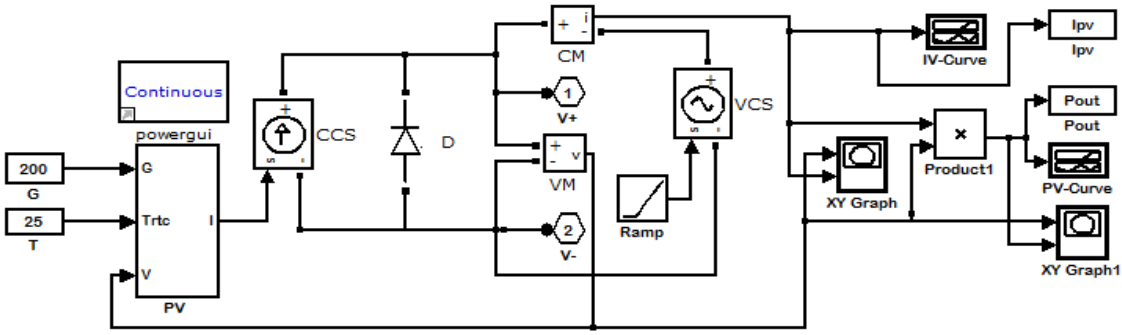

Figure-8: Simulation Model of PV Module

4. SIMULATION RESULT AND DISCUSSION

In this study, the effect of cell temperature and solar irradiance on the parameters values of PV module is analyzed. The experiment has been conducted by employing the tag based Simulink model with varying the temperature in the range of 15 to 50 ^{0}C at constant light intensity and the solar irradiations in the range of 100 W/m2 to 1000 W/m^2.

In Fig. 9, I-V curve of PV module with a variation of solar irradiation at constant temperature is depicted. It is noticed that short circuit current, open circuit voltage of the PV module has been increased with increased in solar irradiations. The effect of an increase in solar irradiations is more on short circuit current than the open circuit voltage.

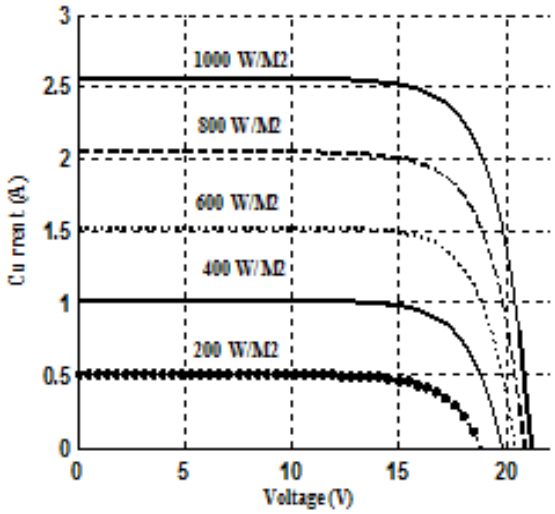

Figure-9: I-V Curve of PV Module (Solar Irradiations)

In addition, the simulation results in terms of P-V curve has been Fig. 10, it have been evident that maximum power of the PV module has been increased with increased in solar irradiations

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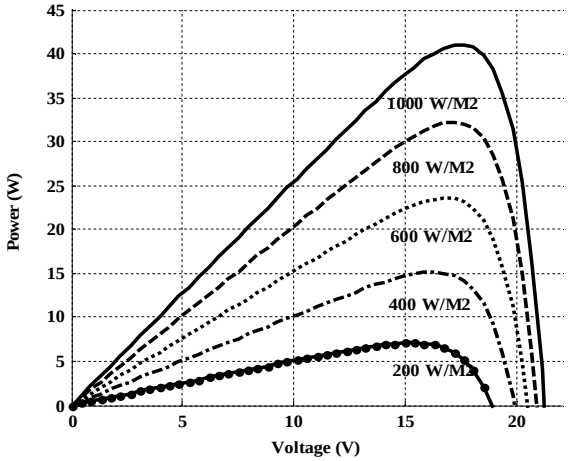

Figure-10: P-V Curve (Solar Irradiations)

Further, I-V and P-V curve have been obtained by varying the temperature at constant solar irradiation (1000W/m2) and shown in Fig.11-Fig.12.

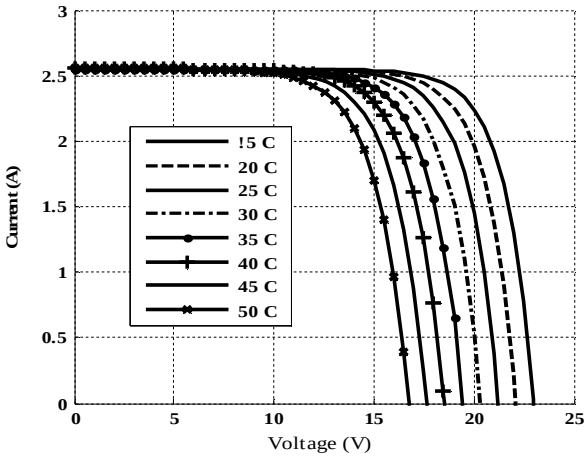

Figure-11: I-V Curve (Temperature)

From Fig.11, it has been revealed that, open circuit voltage decreases with increase in temperature. It has been observed from Fig.12, that maximum power is decreasing with increasing temperature. The result reveals that the cell temperature has a critical impact on the output parameters of the module and it controls the life, quality, and performance of the solar PV module.

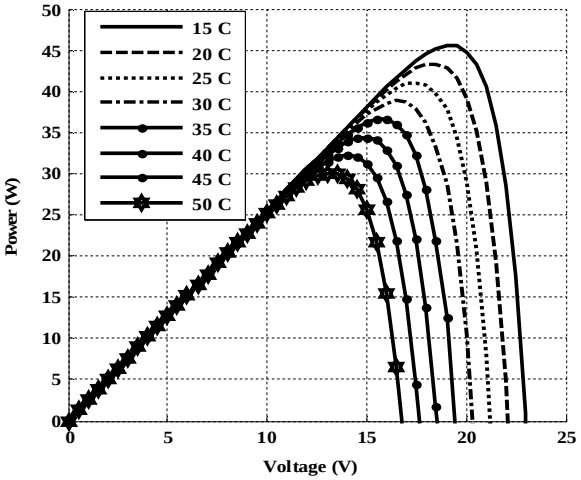

Figure-12: P-V Curve (Temperature)

The expansions in the operating temperature of the module downsize the efficiency, fill factor, maximum power, and open circuit voltage.

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4.1. Effect of Series Resistance: One of the noticeable effects of series resistance on I-V curve and the P-V curve is shown in Fig. 13 and Fig.14.

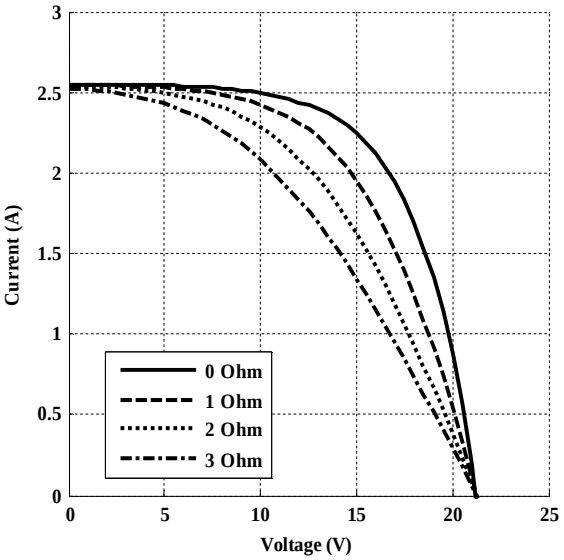

Figure-13: I-V Curve (Series Resistance)

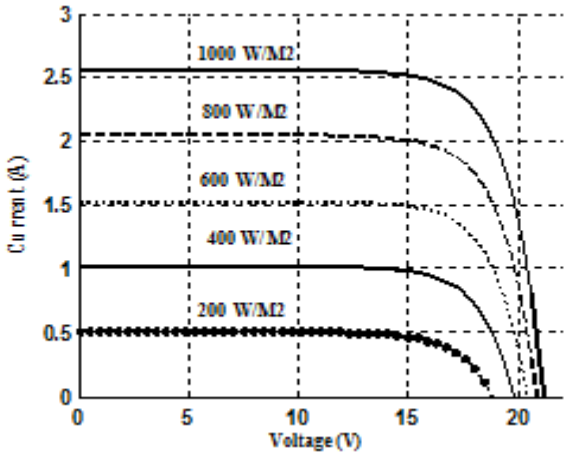

Figure-14: P-V Curve (Series Resistance)

4.2. Effect of Ideality Factor: The ideality factor is a physical parameter of the PV cell and it varies with materials. The effect of ideality factor using the simulation result on I-V curve and P-V curve is depicted in Fig. 15 and Fig.16 respectively.

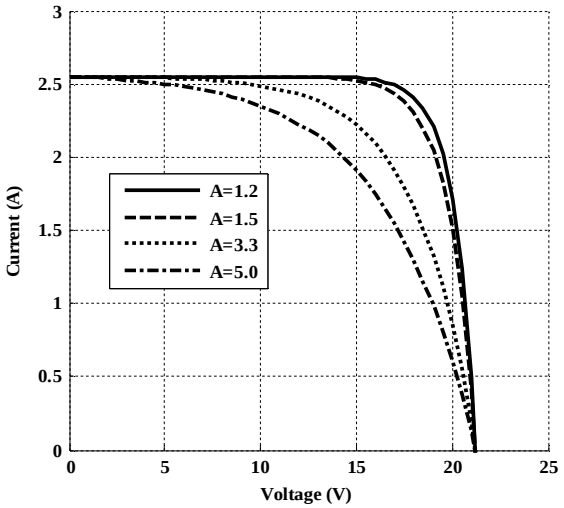

Figure-15: I-V Curve (Ideality Factor)

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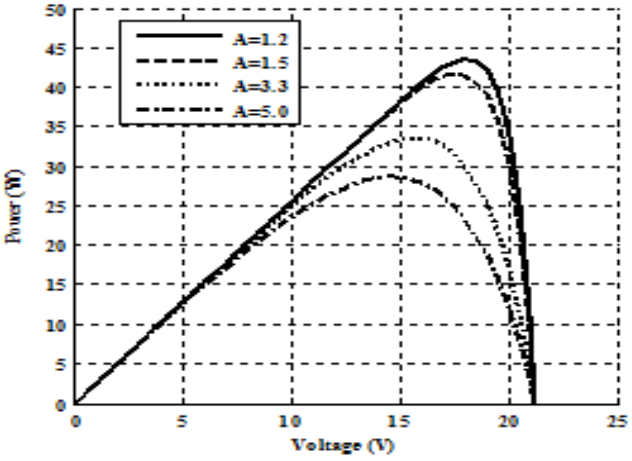

Figure-16: P-V Curve (Ideality Factor)

5. CONCLUSION

In the present study PV module has been developed in Matlab/Simulink using tags. Further, I-V and P-V characteristics of PV module have been obtained and analyzed at various solar irradiations and the temperature. Firstly, the simulation has been performed by varying solar irradiations from 100 W/m2 to 1000 W/m2 by keeping temperature constant at 25 ^{0}C. Then temperature has been varied from 15 ^{0}C to 50^{0}C at constant solar irradiation of 1000W/m2.

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NEUROCOGNITION IN EDUCATION: EMERGING PERSPECTIVES AND NEW CHALLENGES

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ABSTRACT
Neurocognition is associated with neural basis of thinking about thinking through the complex neuronal network taking place in our brain. Neurocognition is a sequence of cognitive processes such as the linking and appraising of information and incorporates speed of processing, attention, verbal and visual learning, problem-solving, working memory and reasoning abilities to enhance neurocognitive domain skills among the learners. Research on neurocognition had provided the various accounts in the intervention of novel strategies in teaching-learning processes. In this article, related literature, research on domain skills, components, strategies and importance in learning are described.

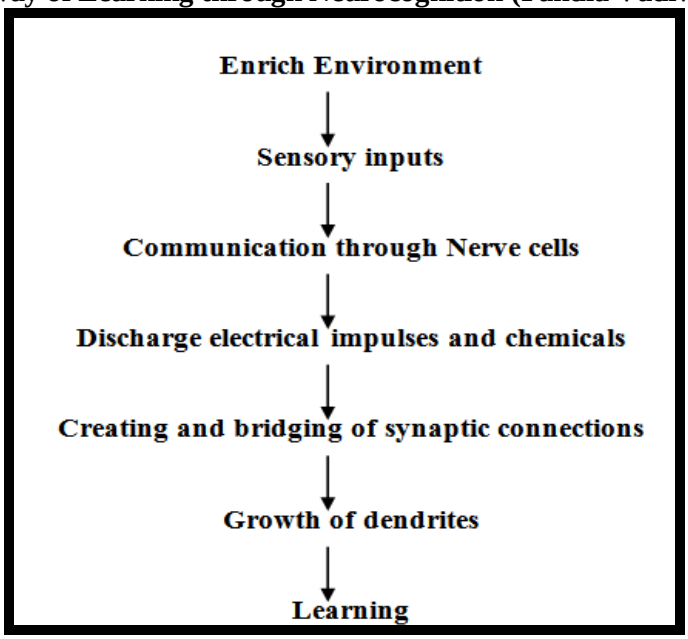
Keywords: Domain, Network, Neurocognition, Neuron, Strategies

I. BACKGROUND INFORMATION
The process of cognition associated with one or more specific areas of the brain is referred to as Neurocognition. It involves complex neural pathway in human. The basic anatomy and function of the brain and the learning process are the two important aspects of Neurocognition. **Richard Ridderinkhof et al. (2004)** had discussed Neurocognitive mechanisms of cognitive control and recent progress from cognitive neuroscience such as dynamic decision making, goal-directed action selection, response activation and inhibition, performance monitoring and reward-based learning in the main integral processes of cognitive control.

1.1. Structure and function of nerve cells
The structural and functional unit of the nervous system is known as a nerve cell or Neuron. The brain, spinal cord, and nerves are composed of a special type of tissue called nervous tissue and are mainly composed of the building block of many cells called nerve cells. Nervous tissue is made of neurons that receive and conduct impulses. The two most important functions every neuron plays in the body are (i) to monitor and relay information or messages from one neuron to another using a combination of what are called nervous impulses and neurotransmitters; and (ii) to 'learn', as it were, by forming sophisticated networks of neuronal patterns with other cells of its type as though they were simple mini-brains.

1.2. The scientific way of learning through Neurocognition
Rich sensory inputs enriched environment cause the nerve cells to get fired due to which they discharge electrical impulses and certain chemicals by creating and bridging synaptic connections: these cause dendrites to grow and create the capacity for new learning. The brief view on the scientific way of learning through neurocognition is shown in figure 1.

Figure-1: The Scientific way of Learning through Neurocognition (Pandia Vadivu & Sridhar, 2014)



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II. REVIEW OF RELATED LITERATURE

2.1. Review of Research on Neurocognition in Education conducted abroad

Hornquist, Anderson, Jansson & Nyberg (2017) made a study on "*Neural activations associated with feedback and retrieval success*". The authors investigated functional brain activity related to test-enhanced learning with feedback. Overall the study suggested that the beneficial effects of test-enhanced learning are regulated by feedback-induced updated memory representations, mediated via the striatum.

In the British Annual Conference paper present by **Lisle (2006)** entitled "*Cognitive neuroscience in education: Mapping neuro-cognitive process and structures to learning styles, can it be done?* The researcher studied the mapping of neurocognitive process and structures to learning styles with the help of principles of cognitive neuroscience in education and also outlined the mapping of neurophysiology to learning style as a unification of theory and practice, a synthesis that is essential for effective teaching.

In an innovative investigation by **Anderson (1992)**, some interrelationship between constructivist models of learning and current neurobiological theory, with implications for science education has discussed by the investigator. He elucidated how some fundamental mechanisms of nervous system activity can explain human information processing and the acquisition of knowledge. His findings were consistent with a cognitive view of the constructivist model of learning and provide additional theoretical support for constructivist applications to science education reform.

2.2. Review of Research on Neurocognition in Education conducted in India

Pandia Vadivu, Sridhar and Sundararasan (2018) conducted a pilot study for 106 respondents to standardize the constructed Neurocognitive Attitude Scale among science students in secondary level. The researchers performed inter-item correlation and covariance matrices to find its reliability score. Based on the Cronbach Alpha value (more than 0.7), out of 16 neurostatements, 15 were chosen for further investigation.

Ananda Kumar & Chellamani (2016) reviewed a trend analysis on educational research on Neurocognitive perspective. The educational research on neurocognition from the year 2006 to 2015 was analyzed of which, four experimental studies, ten surveys, and two interviews were analyzed. This review was insightful to find out the knowledge of neurocognition and application in classroom practices among teacher community.

Sasikumar, Parimala Fathima & Mohan (2016) examined the effect of neurocognitive intervention strategies on enchaining teaching competency in pre-service graduate teacher trainees. In this retrospective study, the investigator selected eight strategies (sensory association, information sequencing, visual recognition, auditory monitoring, scaffolding and decoding, emotional regulation, cognitive association and cognitive verbal articulation) on the concept of neurocognition. The single group pre-assessment treatment post- assessment design was followed in this experimental study. Overall the result revealed that the influence of Neurocognitive intervention strategies is found to be effective in enhancing competence in teaching science

Sridhar, Pandia Vadivu & Chandrakantha (2015) organized a study related to "*Modern Method of Teaching and Learning through Neurocognition: An Innovative Brain Based Strategy for Teachers and Learners*". The authors attempted to explore the recent approaches in teaching and learning process through Neurocognitive based teaching and learning and also discusses the significance of various types of nerve cell coordination in the process of learning and impact of the biology of learning through neurocognition. The neuronal network is a connection of many nerve cells. Neurocognition in education in mainly associated with one or more specific areas of the human brain with respect to the process of cognition in learning. Overall the thematic paper concluded that the futurological aspects of the application of recent strategy using biology of learning through neurocognition.

Pandia Vadivu & Sridhar (2014) conducted an innovative experimental study to examine the effectiveness of neurocognitive based concept mapping on students learning in a science course. A total of 32 students belonging to the ninth grade of the central board of secondary education school. The investigators adopted pretest-posttest experimental design to conduct their study. The control group was taught through routine conventional lecture method whereas the experimental group was instructed various strategies and steps used in neurocognitive based concept mapping. The findings revealed that the extremely statistically significant between pretest and posttest at 0.01 level of significance. Hence neurocognitive based concept mapping enhance the students the strategy can be implemented to various level of subjects as well as students.

Pandia Vadivu and Sridhar (2014) discussed in their thematic paper on *"Role of coding and decoding processes in learning through Neurocognitive Based Concept Mapping (NBCM)"*. The researchers discussed the coding and decoding process in learning through advanced concept mapping called Neurocognitive Based

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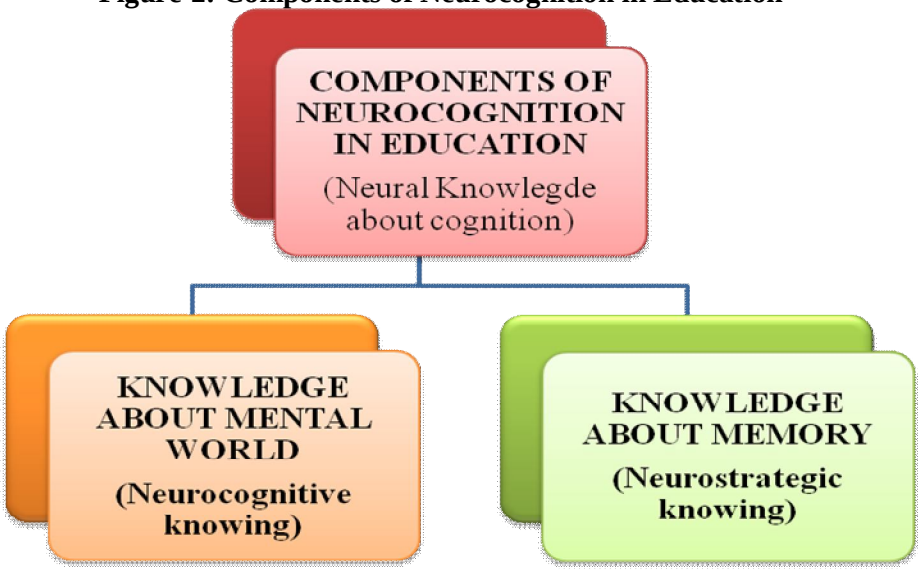
Concept Mapping. It includes information processing (coding and encoding processes) in the human brain. Advance organizer, graphical organizer, pictorial organizer, metacognitive based concept mapping, collaborative learning, Neurocognitive-Based Concept Mapping are the some of the types of advanced concept mapping and also explained human learning process, neurobiology of brain in relation to learning and significance of NBCM. Overall the results revealed that the implication of Neurocognition approaches to teacher education and developing instructional strategies for the furtherance of educational society.

III. COMPONENTS OF NEUROCOGNITION

The neural knowledge about cognition is basically called neurocognition. The term neuro represent the neural network in the brain which play important role in the memory function. The knowledge about the mental world and knowledge about memory are the main components of neurocognitive in education. The outline of the components of neurocognition in education id depicted in figure 2

Figure-2: Components of Neurocognition in Education



IV. THEORIES RELATED TO NEUROCOGNITION

Neurocognitive Learning Theory (Roger Anderson O, 2009)

In a retrospective study by **Anderson (2009)** propounded the Neurocognitive Learning Theory based on cognitive and neuroscientific theories and presented with particular attention to teaching and learning science. The author integrated the neurocognitive model of information processing with modern perspectives on how students think and learn scientific ideas and ways of knowing through inquiry. The author also listed four benchmarks of modern learning theory viz. Empiricism and behaviorist perspectives, early inquiry perspectives, constructivist theories and modern learning cycle approaches. The three important areas in the Neurocognitive Learning Theory are mentioned below,

a) **Neurophysiology**: which is related to the biological aspects of brain and neural activity

b) **Cognitive Science**: which is representing the information processing at the mental level

c) **Learning Theory**: explains the various strategies of learning principles and methodology

In 2009, **Brandoni and Anderson** in their research paper examined *"A New Neurocognitive Model for Assessing Divergent Thinking: Applicability, Evidence of Reliability, and Implications for Educational Theory and Practice"*. The researchers had presented a new neurocognitive model to access divergent thinking based on brain functional representations and cognitive dimensions derived from neuropsychology and cognitive science theory in the form of two- dimensional matric model. The model was given to 30 middle school students through an interview and think-aloud responses to questions. The auditory, verbal, psychomotor, spatial visual, visual, analytic reasoning alternatives, sensory, emotional and temporal/time were taken in the brain functional references dimension. On another hand, descriptive concrete, general interpretive concrete, concrete descriptive relationship, general interpretive relationship, memory-specific concrete, memory-specific relationship, memory-general acquired, memory-general personal, perspective situational and perspective personal are the area of cognitive dimension. The reliability was obtained by interobserver concordance and Cohen's Kappa coefficients were calculated for the cognitive and brain functional references dimensions (.90 and .91, respectively).

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Anderson (2013) made an investigation to examine "*Progress in the application of the neurosciences to an understanding of human learning: The challenge of finding a middle-ground Neuroeducational theory"*. The author has framed middle-ground Neuroeducational theory based on the brain-based theory of human learning

V. NEUROCOGNITIVE SKILLS & STRATEGIES

The neuropsychological domains describe the functional area of the human brain which includes attention, executive functions, language, memory, and intellect, emotions, visual-spatial and sensorimotor. The neurocognitive strategies such as reasoning and problem solving, principles of brain-based instructional strategy, processing speed, working memory, visual learning, higher order thinking skill, attention, hand-eye coordination (Motor skill), neural basis of coding and decoding, pattern recognition etc. will help the learners to enhance achieve high in their academics.

VI. CONCLUSION

This paper made an attempt to provide a brief overview of neurocognition by examining its background and summarizing the relevant literature. It has also outlined the theories, basic components, neurocognitive domain skills, strategies and importance in teaching-learning processes. Hence, the paper concludes futurological aspects of the application of recent strategy using brain-based learning through neurocognition. Therefore, neurocognition is a powerful educational tool in the present and future scenario.

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PHYSICAL PROPERTIES OF DIETHYLAMINE HYDROCHLORIDE AQUEOUS SOLUTION AT 298.15K AND 300.15K: A THERMO-ACOUSTIC APPROACH

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ABSTRACT
Ultrasonic velocity, density and viscosity of diethylamine hydrochloride in aqueous solution at varying concentration (0.1 to 10) mol/kg at 298.15K and 300.15K have been determined. The derived acoustic parameters like adiabatic compressibility, free length (L_f), free volume (V_f), internal pressure (π_i), acoustic impedance (Z) and Rao's constant (R) have been calculated from experimental data. Molecular interactions in terms of measured and evaluated physical parameters have been discussed. Solute–solvent interactions are predominant over solute–solute interactions in the present investigation.

Keywords: Diethylamine hydrochloride, ultrasonic velocity, molecular interactions.

1. INTRODUCTION

The Physical properties as a function of concentration and temperature evaluated using density viscosity and ultrasonic velocity plays an important role in the development of molecular model as well as process design and operation in chemical engineering [1]. On the basis of these properties the nature, strength and type of molecular interaction in a given solution can be understood in depth. There are various techniques to determine the physical properties but nowadays ultrasonic technique has been adopted due to its simplicity and many other advantages over other techniques. The organic compounds amines has strong electron donating tendency and can form hydrogen bond in self associated complexes or with appropriate groups. Researchers have been concluded that the acidic and basic properties of amino acids play an important role in understanding many properties of proteins [2].Therefore it is worthwhile to carry out the studies on physical properties of aqueous diethylamine hydrochloride. The molecular structure of diethylamine hydrochloride [3] is as shown in Fig.1

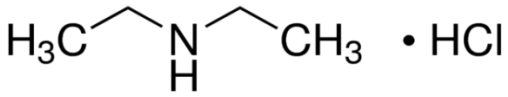

Fig-1: Diethylamine hydrochloride

Diethylamine hydrochloride is used as a reactant in the production of dyes and pharmaceutical compounds such as ranitidine. It is employed in the synthesis of diethylaminoethyl (DEAE) cottons by reacting with cotton cellulose in the presence of sodium hydroxide [4].

2. EXPERIMENTAL DETAILS

In the present investigation water soluble, white crystalline powder of diethylamine hydrochloride (CAS NO: 660-68-4), molecular weight is 109.50 g/mol having molecular formula $C_4H_{11}N.HCl$ was obtained from LOBA CHEMIE PVT.LTD. India. The double distilled water was used to make fresh solution of different composition. The ultrasonic velocity of pure water and solution of different composition at temperature 298.15K and 300.15K were measured by using digital ultrasonic pulse echo velocity meter(VCT 70A). Digital ultrasonic pulse echo velocity meter is a simple and direct reading digital system to determine the velocity in which Piezo–electric transducer is provided at the end of the liquid cell to generate and receive the ultrasonic echo waves through the solutions under observation. The temperature around the cell was controlled by circulating the water from thermostat (Model–i-therm, AI–7982). The density of solution was measured by using highly accurate specific gravity bottle method. To determine the viscosity of the solutions, an Ostwald's viscometer was used.

3. MATHEMATICAL FORMULAE

Acoustic Impedance (Z)

$Z = U \rho_s$ Kg $m^{-2} s^{-1}$

ρ_s and u are the density and ultrasonic velocity of solution respectively.

Adiabatic Compressibility

$$\beta_{ad} = \frac{1}{U^2 \rho_s} \qquad N^{-1}m^2$$

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Free Length (L_f)

$$L_f = K_1 \beta_{ad}^{1/2} \qquad \text{m}$$

K_1 is the temperature dependent constant (93.875+0.375T) $\times 10^{-8}$ and T is absolute temperature.

Free Volume (V_f)

$$V_f = \left(\frac{M_{eff} U}{k\eta}\right)^{3/2} \qquad m^3 mol^{-1}$$

M_{eff} = Molecular Weight

k = Temperature independent constant (4.28×10^9) and η is viscosity of solution

Internal Pressure (π_i)

$$\pi_i = bRT\left(\frac{k\eta}{U}\right)^{1/2}\left(\frac{\rho^{2/3}}{M_{eff}^{7/6}}\right) \qquad \text{Pa}$$

b = 2 for all liquids

R = Gas const (8.314)

T is temperature in kelvin

k is temperature independent constant (4.28×10^9)

Relaxation Time (τ)

$$\tau = \frac{4\eta}{3\omega^2 \rho_s}$$

where η is the viscosity of solution

Molar sound velocity (R)

$$R = \frac{M_{eff}}{\rho}(U)^{1/3} \qquad m^5 N^{-1}$$

4. RESULT AND DISCUSSION

The experimentally measured physical parameters of aqueous diethylamine hydrochloride at temperature 298.15K and 300.15K are as given in Table 1. The variations of these parameters are graphically shown in **Fig.2. (a-c).**The careful perusal of Table.1 shows that all these three basic parameters increases with increase in number of solute particles.

Table-1: Measurement of ultrasonic velocity, density and viscosity of aqueous diethylamine hydrochloride at 298.15K and 300.15K

(mol/kg)	u(m/s)		$\rho_s 10^3$ (kg/m^3)		η (N.s.m^{-2})	
	298.15K	300.15K	298.15K	300.15K	298.15K	300.15K
0.1	1502.540	1506.778	0.9986	0.9986	9.10E-04	1.06E-03
0.2	1511.650	1515.324	0.9990	0.9989	1.15E-03	1.38E-03
0.3	1520.870	1525.834	0.9996	0.9992	1.44E-03	9.41E-04
0.4	1529.578	1533.970	1.0004	1.0000	8.25E-04	9.92E-04
0.5	1540.287	1544.103	1.0012	1.0007	1.83E-03	9.54E-04
0.6	1549.220	1553.080	1.0014	1.0009	1.17E-03	1.05E-03
0.7	1558.906	1562.815	1.0016	1.0012	1.18E-03	1.15E-03
0.8	1568.714	1572.672	1.0022	1.0016	1.85E-03	1.79E-03
0.9	1579.980	1582.655	1.0022	1.0020	2.23E-03	2.19E-03
1	1590.056	1591.409	1.0029	1.0024	2.26E-03	1.72E-03

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In the present investigation, it is found that ultrasonic velocity increases (fig.2.a) with increase in number of solute particles in solvent. The increase in velocity indicates strong solute –solvent interactions [5-6].The variations in adiabatic compressibility and free length with concentration shows opposite trend to that of ultrasonic velocity and density suggesting that the system is becoming compact and less compressible. The compactness in the solution is clear indication of existence of specific interaction.

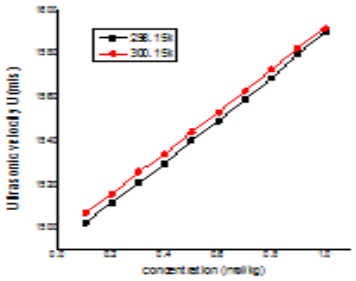

Fig-2.(a)

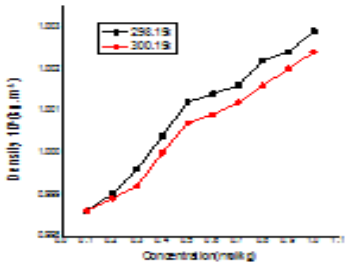

Fig-2.(b)

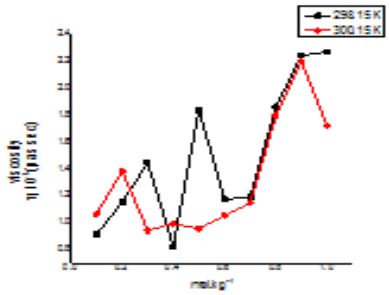

Fig-2.(c)

Fig-2 (a-c): Variation of ultrasonic velocity, density and viscosity with different concentration of aqueous diethylamine hydrochloride at 298.15K and 300.15K

In order to know the nature, strength and type of molecular interaction, various thermo-physical parameters such as Adiabatic compressibility (β), Acoustic impedance (Z), Free length (L_f), Free volume (V_f), Internal pressure ($л_i$), Relaxation time (τ) and Rao's constant have been evaluated by using the experimentally measured parameters and are as given in Table.2.The trends shown by these physical parameters with concentration and temperature are analyzed in the light of structural variations taking place in solution. The existence of molecular interaction can be known from very important physical parameter free length. It has been observed from the fig. 3(b) that free length of the solution varies similar to adiabatic compressibility. Decrease in free length with rise in concentration indicates that medium is becoming denser and it suggests that solute –solvent interactions are significant and structure promoting behaviour on the addition of solute [7, 8].The useful information regarding the molecular interactions between the components of solution can be obtained with the help of physical parameters internal pressure and free volume. Internal pressure is the resultant of attractive and repulsive forces exists in between the components of solution.

Table-2: Evaluated physical parameters of aqueous diethylamine hydrochloride at 298.15K and 300.15K

(mol/kg)	**β 10^{-10} ($N^{-1}m^2$)**		**L_f 10^{-11} (m)**		**V_f 10^{-8} (m^3mol^{-1})**	
	298.15K	300.15K	298.15K	300.15K	298.15K	300.15K
0.1	4.435	4.411	4.332	4.335	1.856	1.48
0.2	4.380	4.360	4.305	4.310	1.336	1.019
0.3	4.325	4.299	4.278	4.279	0.973	1.854
0.4	4.272	4.250	4.252	4.255	2.299	1.75
0.5	4.210	4.191	4.220	4.225	0.711	1.899
0.6	4.160	4.142	4.196	4.201	1.418	1.675
0.7	4.108	4.089	4.169	4.174	1.427	1.506
0.8	4.054	4.037	4.142	4.147	0.745	0.789
0.9	3.996	3.984	4.112	4.120	0.576	0.595
1	3.994	3.939	4.085	4.096	0.579	0.877
(mol/kg)	$л_i$ 10^9(P_a)		Z 10^6($kg.m^{-2}.s^{-1}$)		τ 10^{-13} (s)	
	298.15K	300.15K	298.15K	300.15K	298.15K	300.15K
0.1	2.708	2.939	1.501	1.505	5.379	6.240
0.2	3.007	3.310	1.510	1.514	6.705	8.028
0.3	3.320	2.695	1.520	1.525	8.310	5.393
0.4	2.479	2.733	1.530	1.534	4.698	5.621
0.5	3.647	2.646	1.542	1.545	10.28	5.331
0.6	2.882	2.743	1.551	1.555	6.506	5.810
0.7	2.860	2.826	1.561	1.565	6.492	6.249
0.8	3.533	3.487	1.572	1.575	10.02	9.629
0.9	3.828	3.810	1.584	1.586	11.91	11.63
1	3.803	3.331	1.595	1.595	11.88	9.007

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Internal pressure provides a measure of explaining molecular interactions, internal structure, clustering phenomenon, ionic interactions and dipolar interactions [9]. Many researchers have theoretically calculated the internal pressure of liquid and liquid mixtures [10, 11]. The variation of internal pressure as shown in fig.3 (c) of solution with concentration shows that molecular association is predominant over dissociation. The physical parameter free volume fig. 3(d) supports the trends observed for internal pressure and free length. The acoustic impedance is given by the relation $Z=\rho u$. The acoustic impedance (Z) has been found to be increased Fig.3 (e) with rise in concentration. This indicates that solute-solvent interactions are increased.

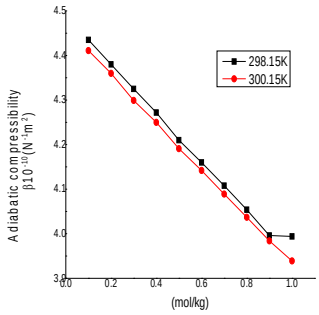

Fig-3 (a)

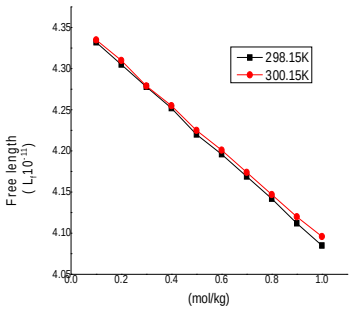

Fig-3 (b)

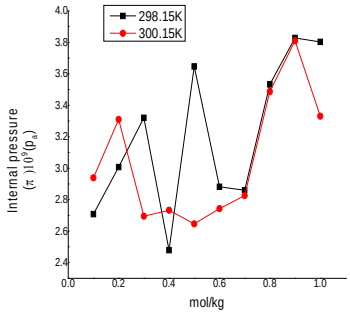

Fig-3.(c)

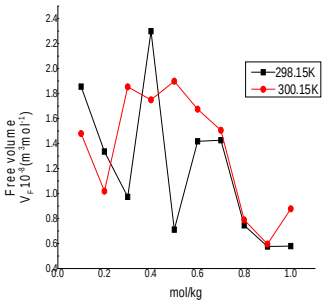

Fig-3.(d)

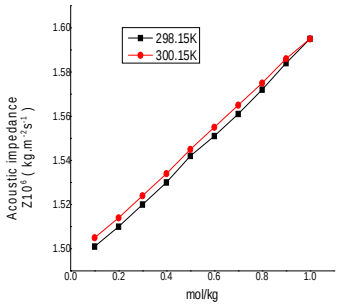

Fig-3.(e)

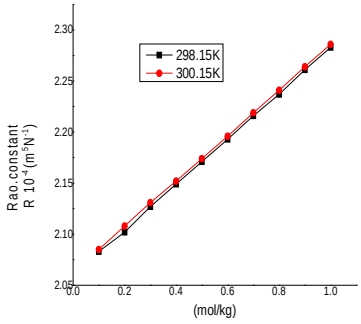

Fig-3.(f)

Fig-3 (a-f): Variation of adiabatic compressibility, free length, internal pressure free volume, acoustic impedance and Rao's constant with different concentration of aqueous diethylamine hydrochloride at 298.15K and 300.15K respectively.

Acoustic impedance is the complex ratio of effective sound pressure at a point to the effective particle velocity at that point [12]. Increase in acoustic impedance with concentration and temperature indicates that molecular interactions are associative in nature [13]. The relaxation time is as given in Table. 2. The relaxation time increases with concentration. This seems to happen mainly due to relaxation processes occurring due to rearrangement of molecules [14-16] concentration.

5. CONCLUSIONS

The computed acoustical parameter and their values point to the presence of specific molecular interaction in the mixtures. The variation of Ultrasonic velocity, density, viscosity and acoustic parameters at different concentration and temperatures has been widely studied. The solute- solvent interactions are predominant over other interactions. Solute has structure making tendency in solution.

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THE EFFECT OF FOLIAR APPLICATION OF SALYCYLIC ACID ON GROWTH AND SECONDARY METABOLITES PRODUCTION OF BIOPHYTUM SENSITIVUM L

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ABSTRACT
In present study, the effect of foliar application of SA at concentration of 0.1mM, 0.5mM and 2.5 mM and control (Spraying with water only) were studied on growth and secondary metabolite content of methanolic extract of Biophytum sensitivum L. Therefore a pot culture experiment was conducted; The foliar spray of SA was given every 10 days of interval. All plants including treated and control plants were harvested after 40 days. Results indicated that the increasing concentration of SA shows significant effect on height of plant and number of leaf. While fresh weight and dry weight did not show any difference in treated and control plants. However, low concentration of SA (0.1mM) showed the highest increase in total phenolics, alkaloids, flavanoids and tannin content. Present study concluded that the growth characters and secondary metabolite contents were enhanced when plants treated with SA.

Keywords: Alkaloids, Flavonoids, Foliar spray, Phenolics, Salicylic acid, Tannin.

I. INTRODUCTION

Medicinal plants are the "backbone" of traditional medicine, about 3.3 million people in less developed countries for fulfilling their traditional herbal medicinal need depends on medicinal plants (Davidson-Hunt 2000). Most of these studies concluded that medicinal property of any plant is because of the presence of secondary metabolites. These metabolites are distributed in very specific group of plants and restricted to particular parts of plant. In modern times, for drug discovery and development of drugs various natural products has been isolated from plants. During the last 20 to 30 years, the analysis of secondary plant products has gaining importance (Okada et al. 2010).

Elicitors can be defined as substances that initiate or increase the biosynthesis of secondary metabolites in plants, both in medicinal important plants and the species categorized as functional foods (Taguchi et al. 2001; Radman et al. 2003). Plant elicitors refer to chemicals that can trigger physiological and morphological responses and secondary metabolism in plants (Houghton et al. 1999). In most of studies Salicylic acid were used as abiotic elicitors for increasing the secondary metabolite contents in various plants. Salicylic acid (SA) is a phenolic compound, benzoic acid play an important roles in plant defence responses to biotic and abiotic stress (Popova et al, 1997; He et al, 2002; Noreen et al, 2009; Hayat et al, 2005). Achillea millefolium L. showed the significant effect on growth and phenolics content when sprayed with salycylic acid (Pedro et al. (2016). The essential oil content of chamomile under normal and heat stress conditions as induced by exogenous application of salicylic acid (Mojtaba Ghasemi et al. (2016). For enhancing the medicinal properties of plants new trend of SA as elicitor has been gaining attention in the present literature. Thus, the aim of this study was to evaluate the effect of different concentrations of SA on B. Sensitivum L. in order to promote growth and simultaneously increase the synthesis of secondary compounds in this medicinal species.

II. MATERIALS AND METHODS

2.1 Plant Material

Seeds of Biophytum sensitivum L. were collected in the month of November from the field of Pharmacy department, RTMN campus, Nagpur. Seeds were stored in zip lock bag. 4 Seeds were sown directly in each pot containing soil, sand and vermicompost in 3:1:1 proportion in month of July. All pots were arranged in randomized complete block design in three replicates. Similarly, whole plant material was collected in the month of September.

2.2 Spray Treatment

Concentrations of 0.1, 0.5, and 2.5 mM were made by dissolving Salicylic acid (SA; 2-hydroxybenzoic acid) in 100 μL dimethyl sulphoxide followed by volume made up with distilled water.

2.3 Sampling and Collecting Data

All plants were first cultivated for 15 days before salicylic acid treatment; pots containing four plants each were sprayed with water (control) and plants were sprayed with 0.1mM, 0.5mM and 2.5mM Salicylic acid. The treatment was given every 10 days of interval. After 40 days, all plants in pots of control and treated plants were harvested. All the growth parameters such as height of plants, number of leaves, fresh weight and dry weight were evaluated at the time of harvest. Analyses of secondary metabolites were done by spectrophotometery.

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2.4 Extraction
All dried samples were ground in a grinder and passed through a sieve. Dried plant powder weighed carefully and extract preparation through Soxhlet apparatus in methanol. The extract was filtered and evaporated on water bath.

2.5 Determination of Total Phenolics Content: [23]
Total Phenolic content was determined by Folin-Ciocalteu method. To 1ml of each sample extract 3 ml of distilled water and 0.5 ml of Folin-Ciocalteu reagent was added. After 3 minutes 2 ml of 20% sodium carbonate was added and the contents were mixed well. The development of blue colour complex was measured at 650nm in UV visible spectrophotometer at 650nm. Different concentrations of standard (Catechol) solution (10mg/100 ml) were used to plot the calibration curve. Results were expressed as mg catechol/100g of fresh weight material.

2.6 Determination of Total Alkaloid content (TAC): [20]-[21]
Total alkaloid content was measured using BCG by spectrophotometric method. 1gm/ml of methanolic plant extract was dissolved in 2 N HCl and then filtered. The pH of phosphate buffer solution was adjusted to neutral with 0.1 N NaOH. 1 ml of this solution was transferred to a separating funnel, and then 5 ml of BCG solution along with 5 ml of phosphate buffer were added. The mixture was shaken in separating funnel and the complex was extracted with chloroform by continuous shaking. The extract was collected in a 10 ml volumetric flask and diluted to volume with chloroform. In this method yellow colour complex is formed when alkaloid reacts with BCG. The absorbance of the yellow colour complex was measured in UV visible spectrophotometer at 470 nm. Different concentrations of standard (Atropin) solution (10mg/100 ml) were used to plot the calibration curve.

2.6 Determination of Total Flavonoid Content (TFC): [26]
The total Flavonoid content of the plant extract was determined by aluminum chloride method. In this method 1ml of sample extract was added with 2 ml of distilled water followed by addition with 0.15 ml of sodium nitrite (5% $NaNO_2$, w/v) solution and mixed. After 6 minutes, 0.15 ml of (10% $AlCl_3$, w/v) solution was added. The solutions were allowed to stand for 6 min and after that 2 ml of sodium hydroxide (4% NaOH, w/v) solution was added to the mixture. The final volume was made to 5 ml with distilled water, mixed thoroughly and allowed to stand for another 15 min. The absorbance of each mixture was determined at 510 nm against the blank. Different concentrations of standard (Tannic acid) solution (10mg/100 ml) were used to plot the calibration curve.

2.7Determination of Tannin Content: [14]
Tannin content in plant extract was determined by Folin –Denis method. In this method 1 ml of plant extract was made upto 7.5 ml with distilled water. Then 0.5ml of Folin-Denis reagent and 1ml of Na_2CO_3 solution were added .The total volume of the solution made to 10 ml with distilled water. Formation of blue colour complex when tannin react with tungsto molybdic acid in alkaline medium. Absorbance of the blue colour solution was measured at 700nm. Different concentrations of standard (Tannic acid) solution (10mg/100 ml) were used to plot the calibration curve.

III. RESULTS AND DISCUSSION
In plants, growth occurs due the synthesis of growth regulators such as auxin, cytokinin, gibberellins, ABA and ethylene. In the present investigations results obtained shown that growth parameters increases when plant faced stress condition. Total results of the study divided into first and then content of secondary metabolites like phenols, tannins alkaloids and flavonoids.

3.1 Effect of Salicylic Acid on Growth
The results indicated that the different concentration of salicylic acid (0.1mM, 0.5mM, 2.5mM) showed significant increase in growth characteristics like height of plant and number of leaves,(Table-1).Similar kinds of results were reported in many plants treated with salicylic acid. Cumin plant showed the significant effect height of plant treated with salicylic acid (Rahimi et al, 2013). Similarly, the marigold showed the significant increase in number of branches, number of leaves and leaf area when sprayed with salicylic acid (Pacheco et al, 2017) Dry weight and fresh weight did not show significant difference in treated and control plants. Similar results were reported in basil (Karalija et al,2017).

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Table-1: Effect on Height of Plant, Number of Leaf, Fresh Weight and Dry Weight in B. sensitivum L. Plants Treated with Different Concentrations of Salicylic Acid

S. No.	Treatments	Height of plant cm	Number of leaves	Fresh weight gm	Dry weight gm
1	**Control**	2.50±0.25	7.20±0.84	1.39±0.01	0.33±0.07
2	**0.1mM SA**	2.76±0.17	11.60±0.55	1.39±0.01	0.32±0.05
3	**0.5mM SA**	4.16±0.17	14.40±1.14	1.38±0.03	0.33±0.05
4	**2.5mM SA**	4.74±0.15	17.40±1.67	1.4±0.03	0.34±0.05

Values are mean + SEM (n=3).

3.2 Effect of Salicylic Acid on Secondary metabolites

SA plays an important role as abiotic elicitor in plants and can increase the production of different groups of secondary metabolites such as terpenes, alkaloids, flavonoids, phenolic compounds and phytoalexins (Silva et al, 2014). Plants treated with different concentration of salicylic acid such as 0.1mM, 0.5mM and 2.5mM of salicylic acid showed a increase in secondary metabolite contents compared to control in B sensitivum L.(Table 2.) The highest rise in the total phenolic content, total alkaloid content, total flavaonoid content and tannin content were observed in plants treated with concentration of 0.1mM of salicylic acid. In proposed study the level of secondary metabolite contents decreases with increase in concentration of salicylic acid. Similar results were reported in different plants which indicated that salicylic acid had significant effect on secondary metabolite contents. Plants of Achillea mellefolium L. treated with 0.50 and 1.00mM concentration of salicylic acid showed the increase in total phenolic content as compared to control (Gorni et al, 2016). Similarly, the flavanoid content oc Cyclora paliurus , which increased firstly then decreased with rising concentration (Xie et al, 2016).

Table-II: Effect on total phenol content, total alkaloid content, tannin content, total flavonoid content in B. sensitivum L. plants treated with different concentrations of salicylic acid.

Sr. No.	Treatments	Total phenol content mg/gm	Total alkaloid content mg/gm	Tannin content mg/gm	Total flavanoid content mg/gm
1	**control**	1.834±0.006	18.6±2.5	0.2±0.02	118.66±2.51
2	**0.1mM SA**	2.41±0.100	46.13±3	0.8±0.001	281±2.51
3	**0.5mM SA**	2.09±0.005	29.2±2	0.317±0.002	252±1.09
4	**2.5mM SA**	1.94±0.004	20.±1.7	0.298±0.001	171.8±2.55

Values are mean + SEM (n=3).

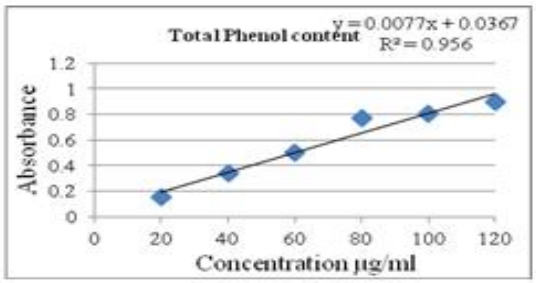

Fig-1- Calibration curve (Catechol)

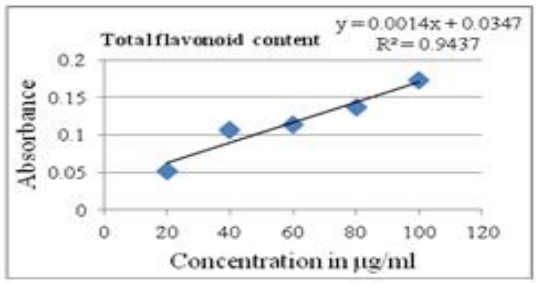

Fig-2-Calibration curve Quercetin

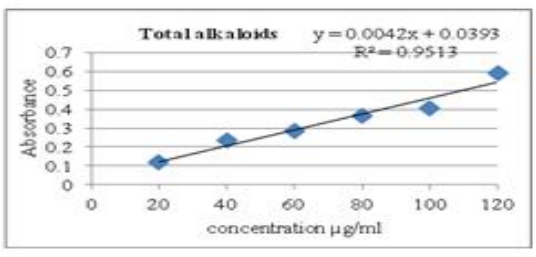

Fig-3- Calibration curve (Atropine)

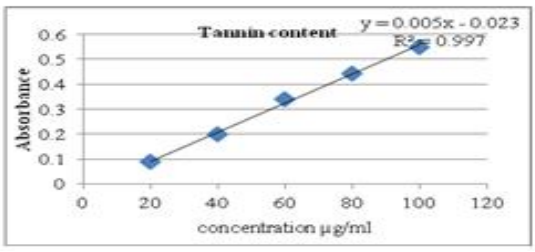

Fig-4- Calibration curve (Tannic acid)

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CONCLUSION

Growth of the plants may be stimulated by number of internal and external factors such as temperature, moister, drought, rain etc. In present study demonstrated that growth of the plant like increase in height, increase in number of leaves due the treatment of salicylic acid. Secondary metabolites content of plants also increase significantly. Specifically low concentration of salicylic acid showed the highest increase in secondary metabolite content of selected medicinally important plant B. sensitivum L.

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THE REVIVAL OF SREE SANKARA'S HYPOTHESIS OF APPEARANCE AND REALITY: A CRITICAL ANALYSIS AND APPRAISAL (SOCIETY FOR NEW TESTAMENT STUDIES)

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ABSTRACT
The main foci of this paper are to delineate the distinction between appearance and reality in the light of Sree Sankara's Advaita Philosophy and to look at how Sankara's notion of appearance and reality is enjoying a contemporary revival, and it is important to try to develop an understanding of why this is so. The central theme of the notion of Sankara philosophy is that Brahman or the absolute spirit is the only reality and everything else is an illusory appearance of Brahman. The major essence of Sankara's Philosophy can be expressed in the form of a half verse, 'Brahma Satyam Jagat Mitya Jivo Brahmaiva Na apara' which means 'Brahman is real the world is unreal and the so-called jiva nondifferent from Brahman'. In the current consciousness study, Sree Sankara's notion of Brahman and Jagat is so conundrum in the material life of postmodern people. But it is inevitable to believe that Sree Sankara's philosophy is not a conundrum for common people in contemporary society but the very conundrum for the non-common people.

Keywords: Appearance, Reality, Advaita Vedanta, Brahman, Jiva, Absolute

1. INTRODUCTORY REMARKS

Sree Sarikara is the greatest significant philosophers not only in the east but also in the west. He has made bright contributions in determining the philosophical quest. Appearance and reality are binary but amalgamated philosophies in philosophy. These are not only the metaphysical central issues but also their nature and position form of epistemological pursuit. Sankara constructs a system of non-dualism out of Vedanta Sutra maintaining that there is only one reality and the universe is an illusory manifestation of the one absolute. The present study deals with the reflections of traditional and contemporary discourses. This paper consists of two sections such as Section A: An Exposition of Appearance and Reality in Sankara's Philosophy, Section B: Sree Sankara's Hypothesis of Brahman & Jagat – A Critical Analysis and Appraisal

2. SECTION A: AN EXPOSITION OF APPEARANCE AND REALITY IN SANKARA'S PHILOSOPHY

Sankara says that the ultimate reality is non-dual Atman, but all determinate knowledge presupposes the modification of the basic consciousness or pure awareness through the mental model (*Antahkarana vrtti*) corresponding to its object. Whenever the basic consciousness takes various forms through mind corresponding to different objects, then we have model consciousness (*vrtti-Caitanya*). Determinate knowledge presupposes (a) *pramatr Caitanya* (a knowing subject or the cognitive consciousness characterized by the internal organ), (b) *pramana-Caitanya* (the faculty of knowledge determined by the modification of the internal organ) and (c) Visaya-Caitanya (the pure awareness determined by the object known).

Though mental mode or internal organ is said to reveal the object, it is the Atman that reflects in it (Ánandajnyána, Śankaráchárya, Śankaránanda, Vámana, & Vidyáraṇya, 1889, Sankara's Bhasya on Taittiriya Upanisads, pp. ii-1).

The Upanisads maintains that the reality or truth is one and there is no plurality anywhere. Sankara compounded it by adding that the many thus are rejected is merely an illusion. Reality is Brahman and the diversity of the world cannot be equally real. The real is what is free from self-contradiction. The world is full of contradictions, so it is not real. Brahman alone is real, because, Brahman alone is free from self-contradiction reality. The real is that whichever was is and will be. The world of experience is not present at all time and hence it is not real. The world is said to be an appearance. It is neither *sat*as) nor *asat* (is not) but it is *satasat-vilaks referenced* referene) Sankara's concrealityon of real is that of eternal being Brahman, which is the sole reality. Similarly his conception of unreal is absolutely absolute nothing. The world with all its variety is neither absolutely real nor absolutely unreal. The world of appearance is said to be sat of existing, since it appears to be so. It has practical efficiency or value. Since it exists for a time it is *sat*. But since it does at exist for all tiatit is *asat*. It is neither *sat* nor *asat*. This is the reason why the world is described as other than real and unreal. Its nature is indescribable. It is *satasat-vilaksana*.

Sankara does not dismiss the worldly as absolutely unreal, but only assigns to iautologicalto logical status. In other words the things of the world though not ultimately real are yet of a certain order of reality. Sankara's

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fundamental position is that whatever is perceived must be so real. Unreal things like heir's horn, sky lotus etc, are never perceived. Hence what is perceived can never be wholly unreal but is cannot be complete suffers' non-contradiction tradition seems to be Sankara's chosen criterion of truth, for instances, instance is mistaken for air or nair is mistaken for silver. These objects are perceived by a single individualist and lasts only for a few seconds. But they are real experiences.

In the same way, objects that are seen in dreams are real, so long as they last. But they suffer contradiction when a higher experience has taken possession of the mind. The snake is sub related when the light is brought that in and rope is seen in its place. These experiences belong to the lowest order of reality. They are known as *pre-Sattasika satta* or phenomenal reality. In the case of rope snake illusion the snake belongs to the *pratibasika* level because it is perceived by single individual, the dream objects also belong to this category (Dave & Śaṅkarācārya, 1988).

The things of the world belong to a higher order reappears A rope some appear to be sum different individual in some point of time and the same to the same the individual at different time. Its reality is public whereas, the he reality of snake is private. What is a matter of common experience belongs to a higher or matter of reality. Our waking experience belongs to this category. The things that we perceive in the waking state have an abrading reality. The world cannot therefore, be dismissed as a momentary illusion. It belongs to the order of empirical reality of *Sattavaharika satta*. But ever this world is not absolutely real because it is sub related in a still higher experience. When Brahman consciousness arises the reality of the world suffers contradiction.

The knowledge of the sole reality of Brahman contradicts the knowledge of the empirical world. But Brahman consciousness can never suffer any contradiction, Brahman consciousness is pure intuition. This highest intuition is called *Sattaamartika satta* or transcendental reality. This is the only reality. In short, Brahman is the sole reality and under the limitation imposed by our intellect and sensory apparatus it appears as the world. The three orders of reality do not represent the kind's distinct kind of reality independent of one another. But they are appearances of a transcendental reality which is the sole reality admitted in the system. This conception is based on the possibility of human experience rising from lower to the higher plane (Dayananda & Arsha Vidya Research and Publication Trust (Chennai, India), 2016).

3. SECTION B: SREE SANKARA'S BRAHMAN & JAGAT – A CRITICAL ANALYSIS AND APPRAISAL

Ultimate Reality-Brahman in Advaita knows and between distinction of 'existence and character' 'reality and ideal', 'subject and predicate'. 'Second less one" (*ekamevadvitiyam*) is the central text of Advaita metaphysic. Reality has no internal or external relation, since there is nothing outside it, similar or dissimilar to V*ijayaatiya-vijatiya-svagata-bedarahitam* (Mādhava, Bhāratītīrtha, & Shastri, 1965, Pancadasi, II, p. 20) For example, the tree has internal differentiations li, e foliage, fruits and flowers. It is different from other trees. It is different from things which all, not trees. It has therefore, *svagata*, *sajatiya* and *vijatiya* differences. But, Brahman is undifferentiated pure consciousness and *the irisayacinmatram*, mass of intelligence *prajnanaghana*. An absolutely pure, utterly difference less being is very difficult to conceive in our imagination that is, due to biological reasons, pictorial the reality practical.

Reality in Advaita looks, so perilously a content less abstraction that is a very easily be mistaken for the *sunya* or the void of the Buddhists. Sankara was aware of this danger when he said, "Brahman free from space, attributes, motion, fruition and difference, being in the highest sense and without second, seems to the slow of mind no more than non-being" (Dave & Śaṅkarācārya, 1988, Commentary on Cahndukya Upanisads VIII. 1.1). Reality is inaccessible to our ordinary modes of thought and speech. It is eternal, pure, and free intelligence. When reality is intuited in integral experiences all dualisms vanish, and thought and speech vanish with them. Then Sankara observes: " knowledge does not wait even for the moment immediately net the annihilation of duality, for if it did, there would be an infinite regress, and duality will never be annihilated, the two are simultaneous" (Yeats, 1961, Commentary on Mandukya Upanisads, pp. 1-7). The test of reality is endurance. What at one time is and at another time is not, is not real. Sankara lays down the principle thus: "that is real whose nature by which it is cognized remains constant, and that is unreal, whose nature by which it is determined, aries" (Lahiri & Satyeswarananda, 1992, Sankara on Taitiriya Upanisads, Mem. Ed Vol, p-62).

The central mystery of existence seems to be, then, the fact of the appearso-calledhe many: the so called relation of the one to the many. The Advaitin's position is that the problem of real between is the relation of the one and the many. The Advaitin's position is that the problem of real thing to one and the many does not simply exist. The real cannot possibly be related with the unreal. It is impossible to associate that which does not exist with that which alone exists or to associate two things neither of which exists. Advaita system postulates the

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principles of non-difference, *ananyatva*, as a substitute for the indefensible finite thereby relation, there by denying the duality of the relation.

All the Upanisadic utterances point to the non-difference of the effect from the cause. For any relation, there should be two terms at least. But, here it is found that there is only one term, Reality or the Appearance. When the realization of reality is secured, the finite loses its being. Conversely, if untruth is to be canceled or should be cancelled, if the finite is the negation of the infinite, the negation of the finite is the affirmation of the infinite. Negation and affirmation cannot co-exist when there is no co-existence of two, there relationship less a causal relation between the two (Rāmānuja, Viraraghavacharya, & Bhashyam, 1957).

The world according to Advaita Mayas, the projection of maya which is the root of all diversified existence so, Maya is Mula Prakritirdial cause, *mulaprakrti* of the world-process. It is also called avidya. It is this that brings about a superimposition of the many on the one. Its Maya not that Brahman and maya all independently the material causes. Advaita is wedded to the theory of *vivarta* or appearance of the world in a substrate. Vimuktatman in his *Ista-Siddhi* brings out the causality of Brahman for the world by a striking illustration of the picture on the canvas. The picture is the variegated world. It is based on the One. This is like saying that darkness is based on light, old on free. It is to this perplexing difficulty that the image of the world as based on Brahman points the world is a picture because, like the picture, it does not exist apart from its substrate.

The world is not merely a *citra*Citraicture, but a *maya-citra*, because unlike the case of the picture where, though the picture is inseparable from the canvas, the material cause, namely, the color, of the picture is separate from the canvas, here the material cause of the world-picture is not separate from the substrate of the word Maya namely, in Brahman, maya is neither separate nor one with Brahman. That is why it is said to be inexplicable (Forsthoefel, 2002).

Brahman is the substrate of the world and the world cannot be said to be either a modification or an attribute of Brahman. While, the world depends upon Brahman for its existence Brahman exists in its own right. This unique relation of the world to Brahman is Maya described as caused by maya, which is itself as indeterminable, *anirvacaniya*, as real or unreal, as the world that is the product. The many are perceived while reality is the one. The experience of plurality is a superimposition on the one. This superimposition Maya is the work of maya that is beginning natural.

Avidya, *maya* and *ajnana* are synonymous and are the material cause of the world. The reality is one, yet it is wonderful and mysterious that there is the presentation of many in it. The world that is the effect is denied in its cause, which is nothing but, Brahman. The effect does not exist apart from the cause and is manifested by the luminosity and reality of the cause. The world-effect, *karyaprapanca*, is not existent in Brahman. If Karya world of many is a *karya*, an effect of Brahman; it can never be denied because it will be Brahman itself which is the only existent (Modi & Śaṅkarācārya, 1943).

The world-effect is neither different not identical, nor different-cum non-different from Brahman. If the world-effect is different from the cause i.e. Brahman, then Brahman itself will be an effect according to the principle "*yavadvikaram tu vibhhaga lokanat*" (Modi & Śaṅkarācārya, 1943, Brahmasutra II. iii. 7). (Wherever there are effects, there is division as in ordinary life). Nothing which is not an effect is seen to be divided and vice versa. If Brahman is different from the world it will become an effect and perishable. Nor can be the world non-different from Brahman, there will be unintelligibility of the scriptural texts like "*brahmaivedam amaram*". All this is Brahman, immortal, "*atmaivedam*", "All this is the self" (Sundaram, 196callsp. 233-234).

One entity call it Truth or reality appear seems any as the one sun is seems to be many in the reflection in the myriad particles of water, or as the same space appears divided because of the vessel in which it is contained. And as an effect, it is not different from its cause, Brahman. It does not have a reality of its own, though in itself it has practical efficiency. Thus to say in the many is to stay in the error. To get the truth, the empirical must be sub related by the transcendental, which is mere existence.

The world of *Maya* is the world of nascence, te apparent plurality. While, the empirical world of the magic construction has its own laws and principles of operation, the apparently various laws governing the variety of things are traceable, as has been said, to single primordial cause, viz; Maya or *Avidya*, the lows of which is Brahman itself. Both the changes and consistencies, uniformities amidst diversities are caused metrically by Mayaan which again is informed by intelligence that is Brahman. Thus, while it is understandable that there is law, order and harmony in the world, the entire arrangement of the worlds of events in time and things in diversity and mutual relations conceals the truth that is one and changeless (O'Neil, 1975).

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While reality is difference less, the world is constituted of many, characterized by changes. To get the truth that is one, one has to transcend the many and the Maya cause of the many maya. The world of many, being th yieldthat science studies, yields us many truths. But these are really errors in the sense that they relate to many, characterized by change, not being capable of being proved to be either so-called unreal or both. Our so called truths of a word make-believe nature all only make believe, and point to the truth that is singular. Truth is that which has reference to existents and real and sihe tnce Brahman alone is real, truth is Brahman itself. Truth, in Advaita, therefore, is Reality.

Sankara says that Brahman's truth is affirmed by speaking of its existence, for it is asserted that the existing is the truth (Sharm, in general, maya or knowledge in general is to be understood as a blend of both a *vrtti* of the internal organ and *saksin* the basic consciousness. The *vrtti* elements are contingent in jnana but the element of basic awareness is eternal. Both mediate and immediate knowledge all *vrttis* of the in tern imminent in which *saksin* is immanent. Immediate knowledge is not necessarily born of sense perception. Object example, without sense objet relation the empirical self is immediately known (Sundaram, 1984).

4. CONCLUDING REMARKS:

On the basis of the above arguments, we would like to conclude that Sarikara successfully removes all the distinction and duality and find the fJivanmuktiation of life as Jivan mukti. But contemrealize people are failed to realise the Kantian noumenal entity which is called Atman or Brahman in Advaita Vedanta. For modern people, Brahman is unknown and unknowable. But Sankara declares that Brahman is the basis of all illusions, the lawyer of all nascence.

The substrate of the world-appearance is reality or Brahman. The world has a sort of reality, indeed. A mere nothing could never appear as anything. One never commits a mistake in the judgments about the son of a barren woman for the simple reason that there could be no judgment on a thing that never exists at any time. The illusory, snake, the illusory silver and the illusory man appear in the real rope, the real shell, nowhereareal tree. There is now here just emptiness of being.

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WIRELESS SENSOR NETWORK BASED HYBRID ENERGY SOURCE THREE PORT CONVERTER VOLTAGE CONTROL

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ABSTRACT
Recent advances in embedded systems and wireless sensor networks (WSNs) made it possible to realize low-cost monitoring and automation systems for smart grids. This paper presents control strategy and powermanagement for an integrated three-port converter, which interfacesone solar input port, one bidirectional battery port, and anisolated output port.. WSN-based smart grid applications have been introduced, and some WSN standards and communication protocols have been discussed for smart grid applications.experimental results verify the convertercontrol design and power management during various operationalmodes using wireless sensor node.

Keywords: Smart Grid, Wireless Sensor Network, Converter Control Strategy, Hybrid Energy System.

I. INTRODUCTION
The present electric power appropriation arrange is exceptionally intricate and ill-suited to the necessities of the twenty-first century. Among the inadequacies are an absence of computerized investigation, poor perceive ability, mechanical switches causing moderate reaction times, absence of situational mindfulness, and so on. These have added to the power outages occurring in the course of recent years. Some extra restraining factors are the developing populace and interest for vitality, the worldwide environmental change, hardware disappointments,vitality stockpiling issues, the limit constraints of power age, one-way correspondence, diminish in non-renewable energy sources and flexibility issues. Likewise, the ozone harming substance emanations on Earth have been a huge risk that is caused by the power and transportation enterprises. Thus, another matrix framework is direly expected to address these difficulties. Because of the

Land conditions and versatility sustainable power source assets got a more prominent effect in dispersed age. Antiquated electrical framework was not intended to meet out the present day's ability and bidirectional power flow support. To address these issues smart grid developed. At the point when the present electrical network winds up plainly more astute by ending up more solid, predictable, and moderate and supports more circulated age will be named as smart grid.

Wireless Sensor Networks that play a vital role in various monitoring applications even in the most robust scenarios will be an ideal candidate. Emerging of such a smartergrid will increase the reliability of the systemby taking proactive measures in case of power failure and also in the occurrence of natural calamities. The increased capacity of distribution generation will facilitate the consumers through reducing their dependency on grid added to that emission of greenhouse gases through the burning of fossil fuels will thereby reduce. Theseadvantages were nothing when there is the occurrence of varying faults like voltage rise, reverse power flow, etc., fortunately the distributed generations uses electronic converters and inverters thus can enable islanding mode incase of grid failure or power shutdown to overcome the issues of distributed generation. Sensing and control system has three main phases namely: Sensing phase, data communication phase and control phase. The sensing part can be done effectively by the use of Wireless Sensor Nodes (WSN).

Basically, two types of information infrastructure are neededfor data flow in a smart grid system.

The first flowis from sensor and electrical appliances to smart meters,the second is between smart meters and the utility's datacentres. The first data flow can beaccomplished through power line communication or wirelesscommunications, such as ZigBee, 6LowPAN, Z-wave and others. For the second data flow, cellular technologies or the Internet can be used In any case, there are key restricting components that ought to be considered in the brilliant metering arrangement process, for example, time of organization, operational costs, the accessibility of the innovation andcountry/urban or indoor/ outdoor environment, and so forth.

This paper proposes a WSN based communication system for the monitoring of distributed generation, loads and transmission lines in the electrical grid and a controller system for automated control on the electrical grid.

The rest of the paper is organized as follows: Section 2 presents the related work about the wireless control strategies. Section 3 discusses about the fuzzy logic based relay node selection. The performance evaluation, analysis and simulation results are discussed in section 4 and finally the Section 5 provides the conclusions.

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II. RELATED WORKS

Salvadori et al [1] proposes a digitalsystem for condition monitoring, diagnosis and supervisory controlapplied to smart grids. The system is based on hybrid networkarchitecture (HNA), consisting of a wired infrastructure, a wirelesssensor network (WSN), a power line communications (PLC) anda controller area network (CAN).

Sinan Kurt et al [2] constructs a detailed link layer model by employing the characteristics of Tmote Sky WSN nodes and channel characteristics based on actual measurementsof SG path loss for various environments. A novel MixedInteger Programming (MIP) framework is created by usingthe aforementioned link layer model for WSN lifetime maximizationby joint optimization of transmission power leveland data packet size.

Benazir Fateh *et al.[3]* develops a real-time situational awareness framework for the electrical transmission power grid using Wireless Sensor Network (WSN). While WSNs are capable of cost efficient monitoring over vast geographical areas, severaltechnical challenges exist. The low power, low data rate devices cause bandwidth and latency bottlenecks. In this paper, our objective is to design a wireless network capable of real-time delivery ofphysical measurements for ideal preventive or corrective controlaction.

Cristina Alcarazet al.[4]proposes an EWS based on Wireless Sensor Networks (WSNs) (under the ISA100.11a standard) and reputation for controlling network behaviour. The WSN are organized into clusterswherea cluster head (CH) is designated. This CH will contain a*Reputation Manager Module*. The usability of this approach is alsoanalysed considering a smart grid scenario.

Vehbi et al.[5] starts with an overview of the application of WSNs for electricpowersystems along with their opportunities and challenges and opens up future work in many unexploited research areas indiverse smart-grid applications.

Francesco et al.[6] presents an IoT software infrastructure that enables energy management and simulation of new controlpolicies in a city district. The proposed platform enables the interoperability and the correlation of (near) real-time buildingenergy profiles with environmental datafrom sensors as well as building and grid models.

Falabretti et al.[7] describes the experimental activities developed in the IoT Lab of Politecnico di Milano, focused on the use of energy storage systems for the primary frequency control. The IoT Lab is a multi-departmental Lab devoted to design and test experimentally innovative IoT algorithms and TLC techniques for smart user applications.

Anjan et al.[8] constructs to build an end-to end protection system insmart grid application, it is required to have calibration of thesecurity requirements of different sub systems. The paperpresent a framework for calibrated security measures for smartgrid which could also be the base for other IoT applications suchas Industrial Control Systems (ICS).Hamed Mortaji et al.[9] proposes the use of a novel algorithm for smart direct load control and load shedding to minimize thepower outage in sudden grid load changes, as well as reduce the Peak-to-Average Ratio (PAR). The algorithm uses forecasting,shedding, and smart direct load control. The algorithm also uses the Internet of Things and stream analytics to provide real-timeload control, and generates a daily schedule for customers' equipped with IEDs, based on their demands, comfort, and the forecasted load model.

Mitali et al.[10] proposes the main part of articleis smartgrid meter. When LED in smart meter gives 3200blinks this means one unit is consumed. Secondfeature of this project is one micro switch is fitted inmeter. This is to prevent meter tempering. There isone hidden switching circuit in that, whenever anyperson try to open the meter switch will get popupand controller send the message to owner andconsumer. Third feature of project is control meter, if bill is not paid by customer then owner can cut themeter. Acquiring of data needs human resources, wecan save this critical resource by using smart gridapplication.

Nagendra et al.[11] develops an Advancement in high speedcommunication and low cost sensor coupled with theincreased deployment of the advanced provide utilities withbetter information to manage the grid. It comprises of a twowaycommunication where electricity and information areexchanged by the consumer and utility to maximizeefficiency. The control centre ensure the smart grid optimizecircuit VAR flow and voltages, there by power theft locationcan be monitored with help of the smart transformers andsmart energy meters.

III. PROPOSED SYSTEM

This section introduces the WSN controlled three-port topology and controlstructure.As shown in Fig. 1, it is a modified version of pulsewidth-modulated (PWM)half-bridge converter that includesthreeBasic circuit stages within a constant-frequencyswitching cycle to provide two independentcontrol variables,

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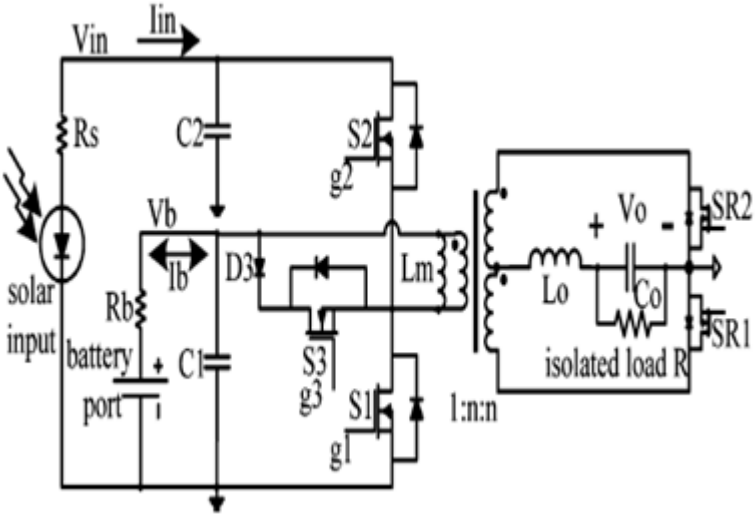

Fig-1: Three-port modified half-bridge converter topology

Namely, duty-cycles *d*1 and *d*2 that are used to control S1 and S2,respectively. This allows tight control over two of the converterports, while the third port provides the power balance in the system.The switching sequence ensures a clamping path for theenergy of the leakage inductance of the transformer at all times.This energy is further utilized to achieve ZVS for all primaryswitches for a wide range of source and load conditions

Operational Modes

Having different operational modes is one of the unique featuresfor three-port converters.

Since MPPT can notably boost solar energy extraction ofa photovoltaic (PV) system, the longer insolation period meansthat MPPT is more often operated to allow a smaller solar arraywhile managing the same amount of load. Two assumptions aremade to simplify the analysis: 1) load power is assumed to beconstant and 2) battery overdischarge is ignored because PV arraysand batteries are typically oversized in satellites to provide some safety margins. Four stages in satellite's one-orbit cycleyield two basic operational modes as follows.In battery-balanced mode (mode 1), the load voltage is tightlyregulated, and the solar panel operates under MPPT controlto provide maximum power. The battery preserves the powerbalance for the system by storing unconsumed solar power orproviding the deficit during high-load intervals. Therefore, thesolar array can be scaled to provide average load power, whilethe battery provides the deficit during peak power of load, whichis attracting to reduce solar array mass.In battery-regulationmode (mode 2), the load is regulated andsinks less power than is available, while the battery charge rate is controlled to prevent overcharging. This mode stops to startmode 1 when the load increases beyond available solar power,i.e., battery parameter falls below either maximum voltage settingor maximum current setting.

IV HARDWARE IMPLEMENTATION AND RESULT

This chapter describes hardware implementation of our proposed converter .fig shows circuit diagrams,input and output of converter voltages

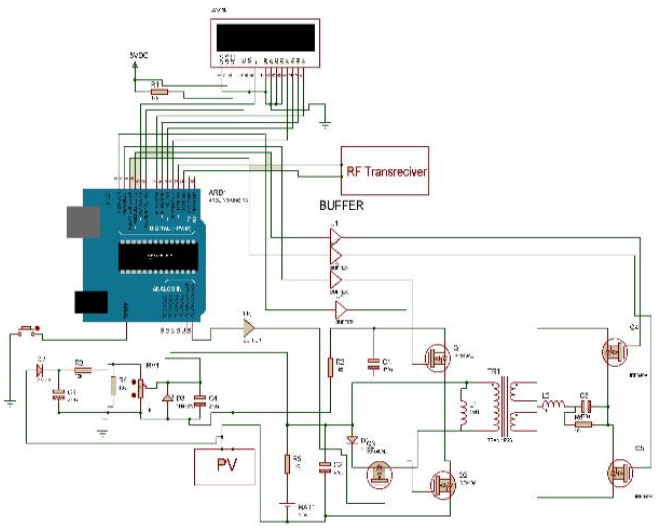

Fig-2: Circuit diagram for receiver side

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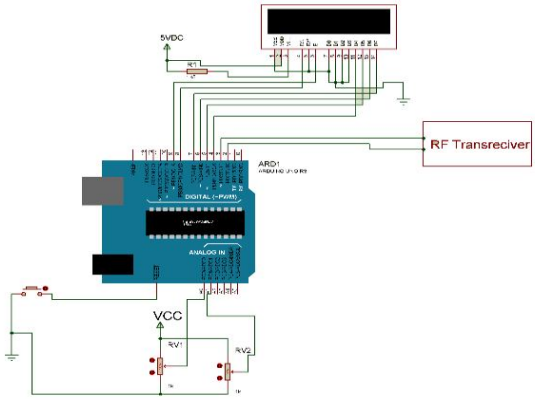

Fig-3: Circuit diagram for controller side

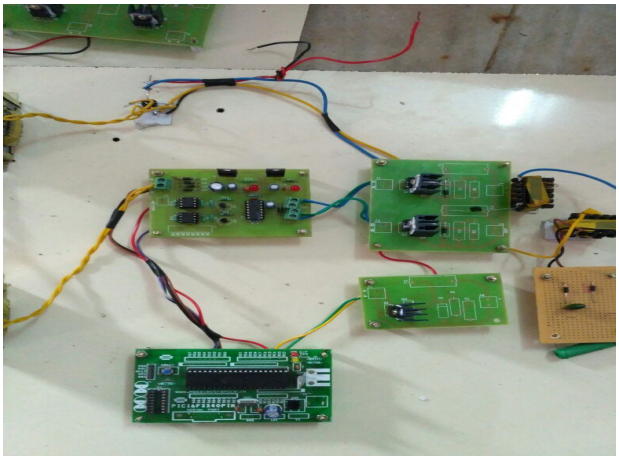

Fig-4: Overall converter hardware implementation

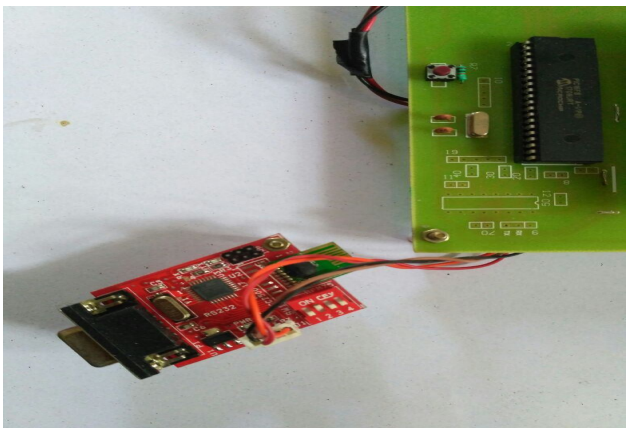

Fig-5: Zig bee module

Fig-6: Input voltage

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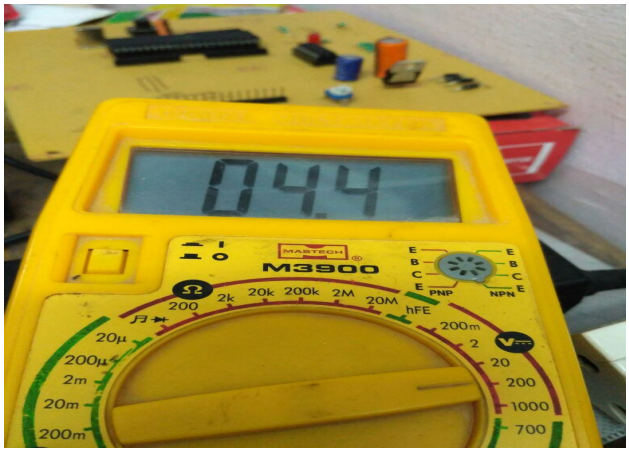

Fig-7: Output voltage

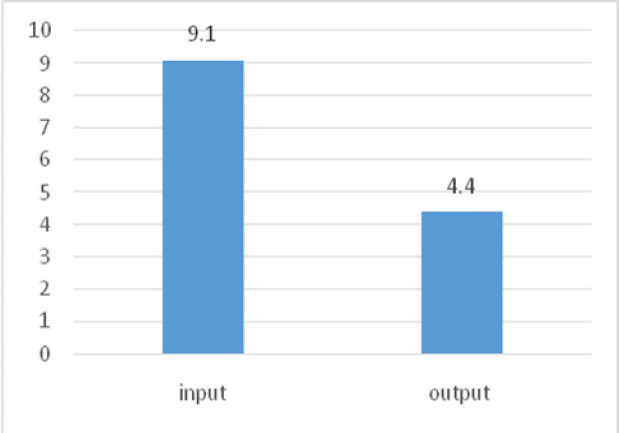

Fig-8: Input and Output voltage comparison

V CONCLUSION

This paper presents major opportunities and design challenges of WSNs for smart grid applications. WSN-based smart grid applications are introduced, and main WSN standards and communication protocols are discussed for smart grid applications.The WSN control strategy and modeling of the three-port dc/dc converterfor satellite application that interfaces a solar input panel,a rechargeable battery port, and an isolated output port werepresented in this paper. The converter has three circuit stagesto allow two control inputs that are used to regulate two of thethree ports. The output voltage is regulated at any given time,but either input port or battery port can be regulated dependingon which is most urgently needed according to availablesolar power and battery state of charge. The control design formultiport converter is challenging and needs to manage power flow under various operating conditions.Therefore, the controlstrategy must be “powerful” and “intelligent” enough to realizecomplicated control tasks, and should have different operationalmode transitioncontrol.

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COLOR PIXEL BASED IMAGE SEGMENTATION USING ENHANCED DATA CLUSTERING ALGORITHMS APPLYING ON TIGER IMAGE DATASET

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ABSTRACT
Image segmentation is a plays of vital role of image partitioning into multiple region (pixel clustering). The aim of segmentation is to obtain a new image in which it is easy to detect regions of interest, localize objects, or determine characteristic features such as edges. Image segmentation is one of the important methods to classify the pixels of an image correctly in a decision oriented application. It divides an image into a number of discrete regions such that the pixels have high similarity in each region and high contrast between regions. Segmentation is the partition of a digital image into regions to simplify the image representation into something that is more meaningful and easier to analyze. Considering that an image can be regarded as a tiger image dataset in which each pixel has a spatial location and a color value, color image segmentation can be obtained by clustering these pixels into different groups of coherent spatial connectivity and color. Conservation of tiger has been the challenging task. This work would add a small account to the herculean task of conserving the species. This work proposes an algorithm from which the age of the tiger can be inferred. This work combines the domain of image processing with data mining to infer the age of tiger. This research work proposes a method to find the age of the tiger, using color as a parameter. Color pixel based image classification and clustering techniques has been used to identify the age of the tiger.

Keywords: image segmentation, clustering, age calculation, Enhanced k-means clustering algorithm, time complexity and accuracy.

INTRODUCTION
Clustering is a strategy that arranges the simple information judiciously and looks through the concealed examples that may exist in datasets. It is a technique for gathering information objects into muddled groups with the goal that the information in a similar cluster are comparable, yet information having a place with divergent group vary [12]. They require for sorting out the sharp rising information and taking in selective data from information, which makes clustering strategies are broadly connected in numerous application regions, for example, man-made consciousness, science, client relationship administration, information pressure, information mining, data recovery, picture preparing, machine picking up, promoting, solution, design acknowledgment, brain science, measurements et cetera. [4] K-means a numerical, unconfirmed, non-deterministic, iterative technique. It is straightforward and quick, so in numerous down to earth applications, the strategy is turned out to be an extremely compelling way that can deliver huge clustering comes about concern. In any case, it is extremely reasonable for creating globular clusters [7]. The k-means calculation is compelling in creating clusters for some reasonable applications in developing regions like Bioinformatics. Be that as it may, the computational difficulty of the interesting k-means calculation is high. Besides, this calculation brings about various kinds of clusters relying upon the irregular decision of starting centroids. This composition manages a heuristic method in light of association and dividing the data information for choice enhanced beginning centroids, accordingly enhancing the exactness of the k-means calculation.

RELATED WORK
K. A. Abdul Nazeer et al [1] describes the major problem of the k-means algorithm is about selecting of initial centroids that completely produces different clusters. But final cluster quality in algorithm depends on the selection of initial centroids. Two phases includes in unique k means algorithm: first for determining initial centroids and second for assigning data points to the nearest clusters and then recalculating the clustering mean. But this enhanced clustering method uses both the phases of the original k-means algorithm. This algorithm combines a systematic technique for ruling initial centroids and a resourceful way for assigning data points to clusters. But still there is a limitation in this enhanced algorithm that is the value of k, the number of preferred clusters, is still mandatory to be given as an input, regardless of the allotment of the data points.

Shi Na et al. [2] has proposed the analysis of shortcomings of the standard k-means algorithm. As k-means algorithm has to analyze the distance between each data object and all cluster centers in each iteration. This repetitive process affects the efficiency of clustering algorithm.

Chen Qi et al. [21] describes a new clustering algorithm of text mining based on improved density clustering. The clustering algorithm based on density is widely used on text mining model for example the

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DBSCAN(density based spatial clustering of application with noise) algorithm DBSCAN algorithm is sensitive in choose of parameters, it is hard to find suitable parameters. In this paper a method based on k-means algorithm is introduced to estimate the E neighborhood and min pts. Finally an example is given to show the effectiveness of this algorithm.

Kamran Khan et al. [22] presents the summary information of the different enhancement of density-based clustering algorithm called the DBSCAN. The purpose of these variations is to enhance DBSCAN to get the well-organized clustering results from the fundamental datasets. In addition it also Highlights the research contributions and found out some limitations in different research depicts the critical evaluation in which comparison and contrast have been taken out to show the similarities and differences among different authors' works. The spatiality of this work is that it uncovers the writing survey of disparate DBSCAN solution and gives a tremendous measure of data under a solitary paper.

Md.Sohrab Mahmud et al. [23] has proposed an algorithm to compute better initial centroids based on heuristic method. The newly presented algorithm results in highly accurate clusters with decrease in computational time. In this algorithm author initially compute the usual score of each data points that consists of multiple attributes and weight factor. Merge sort is applied to sort the output that was previously generated. The data points are then divided into k cluster i.e. number of desired cluster. Finally the nearest possible data point of the mean is taken as initial centroid. Experimental results show that the algorithm reduces the number of iterations to assign data into a cluster. But the algorithm still deals with the problem of transfer quantity of desired cluster as input.

METHODOLOGY

K-MEAN CLUSTERING ALGORITHM

K-means is one of the simplest and most effective unsupervised learning algorithms to solve well known clustering problems. In general, we have n data points $\boldsymbol{x_i}$ i=1...n that needs to be partitioned in k clusters [6]. The aim is to assign a cluster to each data point. K-means is a clustering method that aims to find the positions μ_i, i=1...k of the clusters that minimize the distance from the data points to the cluster. K-means clustering solves

$$\text{argmin}_c \sum_{i=1}^{k} \sum_{x \in ci} d(x, \mu i) = \arg \text{minc} \sum_{i=1}^{k} \sum_{x \in ci} \| x - \mu i \|_2 \quad \text{.....(1)}$$

Where c_i is the set of points that belong to cluster i. The K-means clustering uses the square of the Euclidean distance $\boldsymbol{d(x, \mu_i) = \|x - \mu_i\|2^2}$. This problem is not insignificant (in fact it is NP-hard), so the K-means algorithm only hopes to find the total minimum, possibly getting stuck in a diverse solution [12][15].

Algorithmic steps:

Let $X = \{x_1, x_2, x_3, \ldots\ldots, x_n\}$ be the set of data points and $V = \{v_1, v_2, \ldots\ldots, v_c\}$ be the set of centers.

1) Randomly select *'c'* cluster centers.

2) Calculate the distance between each data point and cluster centers.

3) Assign the data point to the cluster center whose distance from the cluster center is minimum of all the cluster centers.

4) Recalculate the new cluster center using:

$$\boldsymbol{v_i = (1/c_i) \sum_{j=1}^{c_i} x_i} \quad \text{.....(2)}$$

Where, *'c_i'* represents the number of data points in i^{th} cluster.

5) Recalculate the distance between each data point and new obtained cluster centers .

6) If no data point was reassigned then stop, otherwise repeat from step 3.

MODIFIED K-MEANS ALGORITHM

This algorithm partitions the entire space into unique segments and calculates the frequency of data point in every segment. The segment which has maximum frequency of data point can have the maximum probability to contain the centroid of cluster. Similar like the traditional K-mean algorithm the number of cluster's centriod (k) will be provided by the user and the number of divisions will be k*k ('k' vertically as well as 'k' horizontally).A simple data structure is required to store some information in every iteration, which is to be used in next iteration. This technique avoids calculating the distance of each data object to the cluster centers repeatedly and

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thus the running time is saved. This technique can effectively recover the speed of clustering and accuracy, reducing the computational complexity of the K-means.

M-K -MEANS ALGORITHM

1. Compute the distance of each data-point di (1<=i<=N) to all the centroids Cj (1<=j<=k) as d (di, Cj);

2. For each data-point di, find the closest centroid Cj and assign di to cluster j.

3. Set Cluster Id[i]=j; // j:Id of the closest cluster

4. Set Nearest _Dist[i] = d (di, Cj);

5. For each cluster j (1<=j<=k), recalculate the centroids;

6. Repeat

7. for each data-point di, a. Compute its distance from the centroid of the present nearest cluster; b. If this distance is less than or equal to the present nearest distance, the data-point stays in the cluster; c. Else for every centroid cj (1<=j<=k) compute the distance d (di, Cj); d. End for;

8. Assign the data-point di to the cluster with the nearest centroid Cj

9. Set ClusterId[i]=j;

10. Set Nearest_Dist[i] = d (di, Cj);

11. End for (step (2));

12. For each cluster j (1<=j<=k), Recalculate the centroids until the convergence criteria is met.

Figure-1: An Modified K-Means Clustering Algorithm

Algorithmic steps

Let D = {d1, d2...dn} be the set of n data items and k be the number of desired clusters.

For each column of the data set, determine the range as the difference between the maximum and the minimum element.

1. Identify the column having the maximum range.

2. Sort the entire data set in non-decreasing order based on the column having the maximum range.

3. Partition the sorted data set into ‘k’ equal parts

4. Determine the arithmetic mean of each part obtained in Step 4 as c1, c2….ck;

5. Take these mean values as the initial cancroids.

6. Repeat.

7. Allocate each data item di to the cluster which has the nearby centroids;

8. Calculate new mean of each cluster; until convergence criterion is met.

RESULT AND DISCUSSION

This paper focuses on the system that have collected 500 different images of an adult tiger. They differentiate the image with different colors. Clustering is done on the different age group of tigers and with the different skin color and stirpes. It is segmented based on different ages and colors of the tiger. By clustering each images are grouped by its difference in the age and color. By segmenting each different image, the same age and the

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same color images are clustered. In order to check the performance of our color image segmentation approach, the real time tiger image data sets has been used. The data sets are collected from various resources on the web page and the data set has varying types of size and colors of images and they too differ in the format as .gif, .jpg, .png, .trf. Image segmentation process is implemented and demonstrated using MATLAB. The version of MATLAB is 8.6(2015b) and corei3 processor, graphics card on nvidia and support for other system facilities as to use.

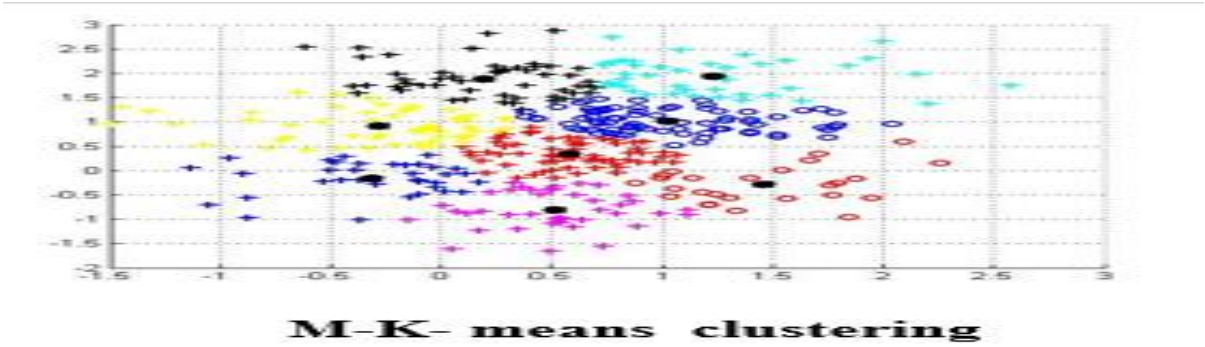

Figure-2: Data clustering for M-K-Means clustering algorithm.

Table-1: Data clustering for 10, 50 and 100 iteration is compared with Existing and Proposed algorithms

	10 Iterations		50 Iteration		100 Iteration	
	Accuracy	Time Period	Accuracy	Time Period	Accuracy	Time Period
M-K-Means	87.6	0.56	89.4	0.89	92.4	1.12
k-Means	86.9	3.52	90.56	2.25	92.3	2.43

The above table 1 shows that the data clustering for existing and proposed methods like K-Means, M-K-Means, is 10, 50 and 100 iteration for the real time tiger image dataset. These algorithms are compared taking is to account both accuracy and time period calculation for the real time tiger image dataset. Where the M-K-Means algorithm accuracy level is higher than the other algorithms and loss execution time is taken on these algorithm. When these algorithms are compared with the other algorithms and much efficient result to be generate the M-K-Means.

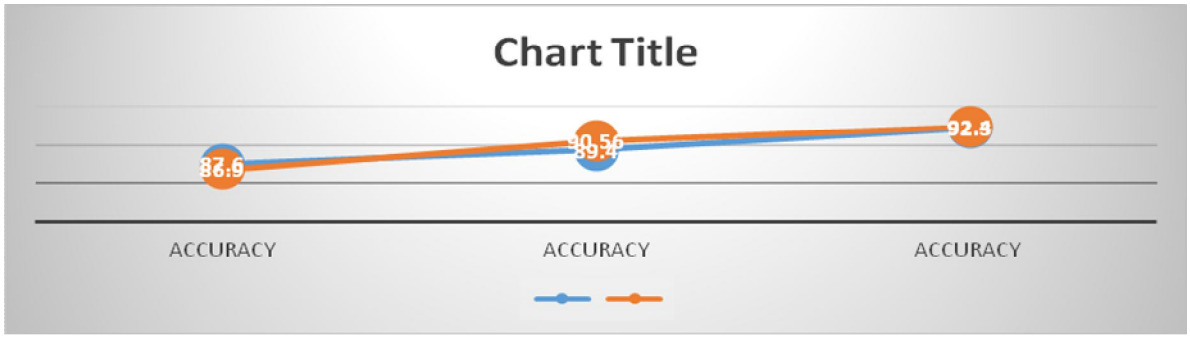

Figure-3: Overall accuracy chart on data (tiger image dataset) clustering for existing and proposed methods as 10, 50 and 100 iteration.

The above figure 3 shows that the data clustering for 10, 50 and 100 iteration compared with the accuracy of Existing and Proposed methods as K-Means, M-K-Means, clustering. The accuracy chart is figurate on table 1.

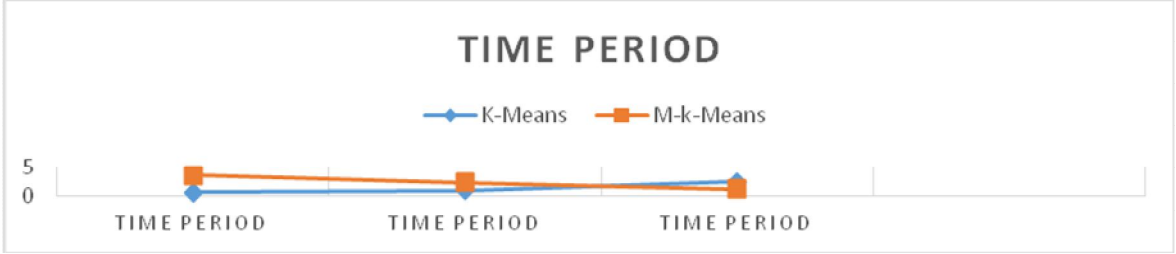

Figure-4: overall time period calculation for the real time dataset (tiger image), data clustering with the existing and proposed methods on 10, 50 and 100 iterations.

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The above figure 4 shows that the data clustering for 10, 50 and 100 iteration compared with the time period calculation of Existing and Proposed methods as K-Means, M-K-Means, clustering. The overall time period calculation is based on table 1.

CONCLUSION

Proposes a new clustering algorithm namely as M-K-Means techniques has been done this paper. Hence, this paper has been focuses on color pixel based image segmentation as pixel classification, pixel clustering, find the age of tiger and also used with algorithms. The proposed algorithms can execute the high performance result will be generated. The clustering result much effective and efficient process to be handle with the tiger image dataset, when compared the results on the proposed methods as highest accuracy rate on M-K-Means in 100 iteration is 92.4% and lowest accuracy rate on the proposed algorithms as K-Means, 92.3% respectively and difference between these algorithms as 0.1, execution time is taken by the individually as 1.12sec is M-K-Means, 2.43sec is taken by K-Means, So, the highest accuracy rate on M-K-Means is (92.4) and loss execution time (1.12) during the running time and generated the better clustering results on M-K-Means. Future research work is to improvement of accuracy and reduction is time complexity. The results are evident highly with increase is iterations. These factors shows that that the evident results with increasing iteration.

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SEASONAL VARIATION OF PHYTOPLANKTON DIVERSITY AND IT'S RELATION WITH PHYSICO-CHEMICAL PARAMETRS OF WATRE IN THE RIVER TEESTA, WEST BENGAL, INDIA

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ABSTRACTS
A survey was done on phytoplankton density and diversity indices and it's relation with physico-chemical parameters of water in the river Teesta. The study was done from March 2014 to February 2016 i.e. two years. A total of 24 genera of phytoplankton under five classes such as Chlorophyceae (12 species), Cyanophyceae and Bacillariophyceae (5genera each) and Euglenophyceae and Dinophyceae (1 genera each) were found during the study period. Range of seasonal value of phytoplankton density (13 to 27 org./l), species diversity index (2.44 to 2.88), Margalef's species richness index (3.11 to 4.69) and species dominance index (0.055 to 0.099) were recorded in the river Teesta. Maximum and minimum number of phytoplankton genera, density, species diversity index and Margalef's species richness index were found in winter and monsoon season respectively. Number of phytoplankton genera, phytoplankton density and species diversity index(H') showed positive and significant correlation with P^H, total dissolved solid, conductivity, dissolved oxygen, total alkalinity and total hardness and inverse correlation with water temperature, free carbon dioxide, and chloride. But species dominance index (λ) showed reverse correlation in comparison to other indices.

Keywords: Diversity indices, phytoplankton, physcio-chemical parameters, Teesta and correaltion

1. INTRODUCTION

Phytoplanktons are primary producer of an aquatic ecosystem and also serve as a bio-indicator (Anitha Devi *et. al*, 2013). Monthly and seasonal variation of phytoplankton density and diversity depends on the availability of nutrients, water temperature and other limnological factors. Phytoplanktons are important source of organic carbon (Gaikwad and Chavan, 2004). Planktons are very sensitive to the minor changes in the environment in which they live. Therefore, plankton population study may be served as a reliable tool for bio-monitoring the pollution status of water bodies (Mathivanan and Jayakumar, 1995)

Few workers such as Pal (2015), Patra (2011) and Mondal(2009) contributed in the plankton diversity in the North Bengal. The objective of this study was to assess the phytoplankton density and diversity of the river Teesta, its seasonal fluctuation and relation with physic-chemical parameters of water.

2. MATERIALS AND METHODS

Sampling sites- Two sampling sites are selected for study i.e. site-I at Gajol doba(latitude-$26^0$44'55.4''N and longitude -$88^0$35'37.0''E) and Site-II at Haldibari(latitude-$26^0$23'01.2''N and longitude - $88^0$50'38.0''E).

Samplings were done at monthly interval in early morning from 6AM to 9 AM. Physico-chemical parameters such as water temperature, pH, TDS were evaluated at sampling sites and others parameters were evaluated at laboratory. For phytoplankton analysis, 10 liter of water sample was filtered through phytoplankton net and then centrifuged at 1500 to 2000 rpm at laboratory (Trivedy and Goel, 1984). Density and diversity indices were recorded with the help of Lacky drop method (Lacky, 1938).

Physico-chemical parameters of water such as temperature, pH, dissolved oxygen, conductivity, total dissolved solid, total hardness and total chloride were evaluated by standard method (APHA, 2005).

For identification of phytoplankton we used following references such as -Turner (1982); Presscot,(1962) and APHA (2005). Diversity indices like Shannon's diversity index(Shannon,1949), Simpson's dominance index(Simpson, E.H.,1949) and Margalef's species richness index(Margalef,1968) were evaluated. Statistical analysis of data was done with the help of PAST 3.0 and SPSS 16.0 software.

Duration of study- Duration of study is two year, from March 2014 to February 2016.For seasonal analysis November to February is regarded as winter season, March to June as summer and July to October is regarded as winter season.

3. RESULT AND DISCUSSION

A total of 24 genera of phytoplankton belonged to five classes were found during the whole study period. Most dominant class is Chlorophyceae with 12 species, followed by Cyanophyceae and Bacillariophyceae with 5 genera each and Euglenophyceae and Dinophyceae with one genus each. Average maximum phytoplankton density was recorded in winter season and lowest value was found in monsoon during the whole study period.

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Maximum number of phytoplankton genera was recorded in winter season (24) followed by summer(23) and monsoon(14) at site-I and similar findings also observed in site-II. Maximum and minimum density were found winter (27 org./l in site-I and 26 org./l in site-II) and monsoon season (14 org./l in site-I and 13 org./l in site-II) . Highest Species Diversity Index (H') was recorded in winter season (2.98 at site site-I and 2.87 at site site-II) and lowest value was found in monsoon season(2.45 at site site-I and 2.44 at site site-II).Maximum Margalef's Species Richness Index (R) was observed in winter season (4.69) followed by summer(4.60) and monsoon(3.16) at site-I. Similarly highest Margalef's Species richness index (R) was observed in winter season (4.28) followed by summer(4.22) and monsoon(3.11) at site-II. Maximum and minimum species dominance index (λ) were evaluated at monsoon and winter season respectively.

Table-1: Phytoplankton diversity in the river Teesta from March 2014 to February 2016

Srl. No.	Class	Genera	2014-2015		2015-2016	
			Site-1	Site-2	Site-1	Site-2
1.	Cyanophyceae	*Nostoc sp.*	+	+	+	+
2.		*Anabaena sp.*	+	+	+	+
3.		*Anacystis* sp.	+	+	+	+
4.		*Spirulina sp.*	+	+	+	+
5.		*Oscillatoria sp.*	+	+	+	+
6.	Chlorophyceae	*Clamydomonas sp.*	+	+	+	+
7.		*Chara sp.*	+	+	+	+
8.		*Chlorella sp*	+	+	+	+
9.		*Closterium sp.*	+	-	-	-
10.		*Spirogyra sp.*	+	+	+	+
11.		*Oedogonium sp*	+	+	+	+
12.		*Ulva sp.*	+	+	+	+
13.		*Ulothrix sp.*	+	+	+	+
14.		*Coelastrum sp.*	+	+	+	+
15.		*Cosmarium sp.*	+	-	+	+
16.		*Zygnema sp.*	+	+	+	+
17.		*Volvox sp.*	+	+	+	+
18.	Bacillariophyceae	*Cymbella sp.*	+	+	+	+
19.		*Tabellaria sp.*	+	+	+	+
20.		*Pinularia sp.*	+	-	-	+
21.		*Navicula sp.*	+	+	+	+
22.		*Diatoma sp.*	+	+	+	+
23.	Euglenophyceae	*Euglena sp.*	+	+	+	+
24.	Dinophycea	*Ceratium* sp	+	+	+	+

Table–2: Seasonal density and diversity indices of Phytoplankton at site-I and II of the river Teesta from March 2014 – February 2016.

Study period	March 2014 – Feb. 2016			March 2014 – Feb. 2016		
Study sites	Site-I			Site-II		
Season / Div. indices	Summer	Monsoon	Winter	Summer	Monsoon	Winter
Number of Genera (S)	23	14	24	21	13	23
Density (org./L)	20	13	27	17	13	26
Species Diversity Index(H')	2.90	2.45	2.98	2.77	2.44	2.87
Margalef's Species Richness Index (R)	4.60	3.16	4.69	4.22	3.11	4.28
Species Dominance Index (λ)	0.0605	0.093	0.055	0.065	0.099	0.063

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Maximum P^H, total dissolved solid, dissolved oxygen, conductivity, total alkalinity and total hardness were reported in winter season at both the sites, followed by summer and monsoon season. Maximum and minimum chloride was reported in summer and monsoon season. Maximum water temperature and free carbon dioxide were recorded in monsoon and followed by summer and winter.

Number of phytoplankton genera(S) showed positive and significant correlation with P^H, total dissolved solvent, conductivity, dissolved oxygen, total alkalinity and total hardness and inverse correlation with water temperature, free carbon dioxide, and chloride. Density of phytoplankton had positive and significant correlation with P^H, total dissolved solvent, conductivity, dissolved oxygen, total alkalinity and total hardness and negative significant correlation with water temperature, free carbon dioxide, and chloride. Similarly species diversity index(H') showed positive and significant correlation with P^H, total dissolved solvent, conductivity, dissolved oxygen, total alkalinity and total hardness and inverse correlation with water temperature, free carbon dioxide, and chloride. Margalef's species richness index (R) had negative and significant correlation with P^H. Species dominance index (λ) showed positive and significant correlation with water temperature, free carbon dioxide and chloride and significant negative correlation with P^H, total dissolved solvent, conductivity, dissolved oxygen, total alkalinity and total hardness.

Table-3: Seasonal variation of physico-chemical parameters at site –I and II of the river Teesta during first year from March 2013 to February 2014 and second year from March 2014- February 2015 of study period

Study period	March 2014 – Feb. 2016			March 2014 – Feb. 2016		
Study sites	Site-I			Site-II		
Parameter / Season	Summer	Monsoon	Winter	Summer	Monsoon	Winter
Water Temperature (^{0}C)	24.625	28.52	16.6	24.80	28.17	17.09
P^H	7.46	7.34	7.56	7.39	7.26	7.54
Total dissolved solid (mg/L)	31	22.12	31.87	33.75	22.5	34.25
Conductivity (µmhos)	73.27	67.73	77.1	73.57	68.86	77.99
Dissolved Oxygen (mg/L)	7.3	6.81	7.51	7.19	6.74	7.59
Free Carbon dioxide (mg/L)	3.44	4.23	2.67	3.02	4.06	2.93
Total alkanity (mg/L)	30.62	21.48	34.09	29.11	22.06	34.65
Total hardness (mg/L)	18.13	10.22	22.26	19.44	11.44	22.02
Chloride content (mg/L)	4.585	3.51	4.36	4.52	3.84	4.33

Table-4: Pearson's correlation coefficient matrix for Phytoplankton and physico-Chemical parameters of water of the river Teesta (n=48, d.f. 46).

	WT	P^H	TDS	COND	DO	FC	CL	TA	TH
Number of Genera (S)	-.756**	.307*	.592**	.723**	.677**	-.416**	-.740**	.729**	.734**
Density (org./L)	-.826**	.296*	.666**	.690**	.673**	-.520**	-.803**	.777**	.715**
Species Diversity Index(H')	-.687**	.351*	.555**	.704**	.646**	-.421**	-.675**	.683**	.692**
Margalef's Species Richness Index (R)	-.122	-.298*	-.217	-.016	-.194	-.105	-.123	.086	.088
SpeciesDominance Index (λ)	.624**	-.389**	-.521**	-.676**	-.620**	.436**	.613**	-.640**	-.645**

WT= Water temperature; pH= Power of hydrogen ion concentration; COND= conductivity; DO= Dissolved oxygen; FC= Free carbon dioxide

TA= Total alkalinity; TH= Total hardnes and CL= Chloride;

**** Correlation is significant at the 0.01level (2-tailed);**

*** Correlation is significant at the 0.05 level (2-tailed**

4. CONCLUSION

A total of 24 genera of phytoplankton were found during the whole study period.Chlorophyceae is dominant class (12 species), followed by Cyanophyceae and Bacillariophyceae (5 genera each) and Euglenophyceae and Dinophyceae (1 genera each). Maximum phytoplankton density, number of genera, species diversity index, Margalef's species richness index was recorded in winter season due to low volume of water and high nutrient

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content in winter season Lowest value was found in monsoon due to high volume of water and low nutrient content in monsoon season during the whole study period. A relationship between pollution condition and species diversity was proposed by Wilham and Dorris (1966) as, species diversity value > 3 = indicates clean water ; 1-3 = moderately polluted water and < 1 = Highly polluted water. This river showed a moderate level of pollution load.

Maximum dissolved oxygen was recorded in winter season similar findings suggested by Hancock (1973). Cold water has a maximum capacity to hold dissolved oxygen than warm water and lower rate of respiration in winter season leads to maximum dissolved oxygen in winter season(Welch, 1952).Minimum total hardness and alkalinity were recorded in monsoon season due to dilution of water. Similar findings has been reported by Patralekha (1994), Thapa-Chhetry and Pal (2011).

Number of phytoplankton genera, phytoplankton density and species diversity index(H') showed positive and significant correlation with conductivity due to increased concentration of major ion which is essential for phytoplankton(Rodhe, 1949). The total hardness of water is dependent on calcium and magnesium salts, which are essential for the phytoplankton growth, hence phytoplankton density and diversity showed positive and significant correlation with total hardness.

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THEORETICAL MODELS EXPLORING THE LINK BETWEEN HUMAN RESOURCE MANAGEMENT PRACTICES AND ORGANISATIONAL PERFORMANCE: A REVIEW

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ABSTRACT
This paper discusses twelve prominent conceptual models that emerged during the time period 1984 to 2008 in the area of Human Resource Management that probes the link between human resource practices and organisational performance, popularly known as the 'black-box'. The analysis revealed that there is no consensus among the researchers regarding how many boxes needs to be included in the link and the same inconsistency applies to the minimum and maximum number of variables in each box. Also, there is no unanimity in the variables that are to be regarded as the end link of the chain. All though many studies are conducted in later years too no noted new theories emerged till date that explored the link differently. Thus, there is a greater need to carry more in-depth research in this study area.

Keywords: Black-box Models, Human Resource Management Practices, Organisational Performance

1. INTRODUCTION

Decades have rolled by since the first spark of debate started on the link between Human Resource Management (HRM) and Organisational performance. But this debate still looks as if it is untouched even after years of efforts by eminent research scholars to unravel the mechanisms of this link. This is evident from the amount of scholarly articles that are published over the years but the work done till date still looks insufficient. This is because the study area relates to human resource of an organisation which in turn is related to 'Organisational Behavior' discipline. Behavior of an individual can never be predicted accurately and therefore trying to probe the Human Resource – performance link has turned out to be a never ending and a daunting task thereby rightly being termed as 'the Black-Box' in HRM literature. This grey area in HRM was further probed to find out the process through which the employees of an organisation contributed to its performance. One of the initial major attempts to gain insight into this linkage was the Harvard model in the year 1984 followed by 11 other major works that emerged till 2008. Although plenty of research works got published in this area since 2008, these works were predominantly based on the earlier models. Thus, no major theoretical models emerged after 2008. The next sections of this paper make an attempt to analyse and compare the above mentioned models and draws conclusions based on the analysis.

2. THEORETICAL MODELS EXPLORING HUMAN RESOURCE PRACTICES AND PERFORMANCE LINKAGE

Over the years, attempts are constantly made to link HRM and Organisational performance which has led to the development of various models over the years. The most prominent models of HRM – Performance link are discussed below:

2.1 Model by Beer et. al., 1984 - The Harvard Model

The Harvard model brings out the integration between business and society by projecting HRM as a system that connects objectives of the organisation into societal well-being and back into human resource activities. It initiated the idea that people in an organisation should be regarded as assets instead of variable costs. Developed by Beer et. al. (1984), the Harvard Model, considered as a soft model of HRM, offers significant insights into HRM-Performance linkage by stating that the HRM policies should be defined in tandem with environmental factors and stakeholders' concerns, focusing ultimately on achieving the wellbeing of individuals, organisation and the society through employee commitment, competence development, coherence among employees and cost effectiveness.

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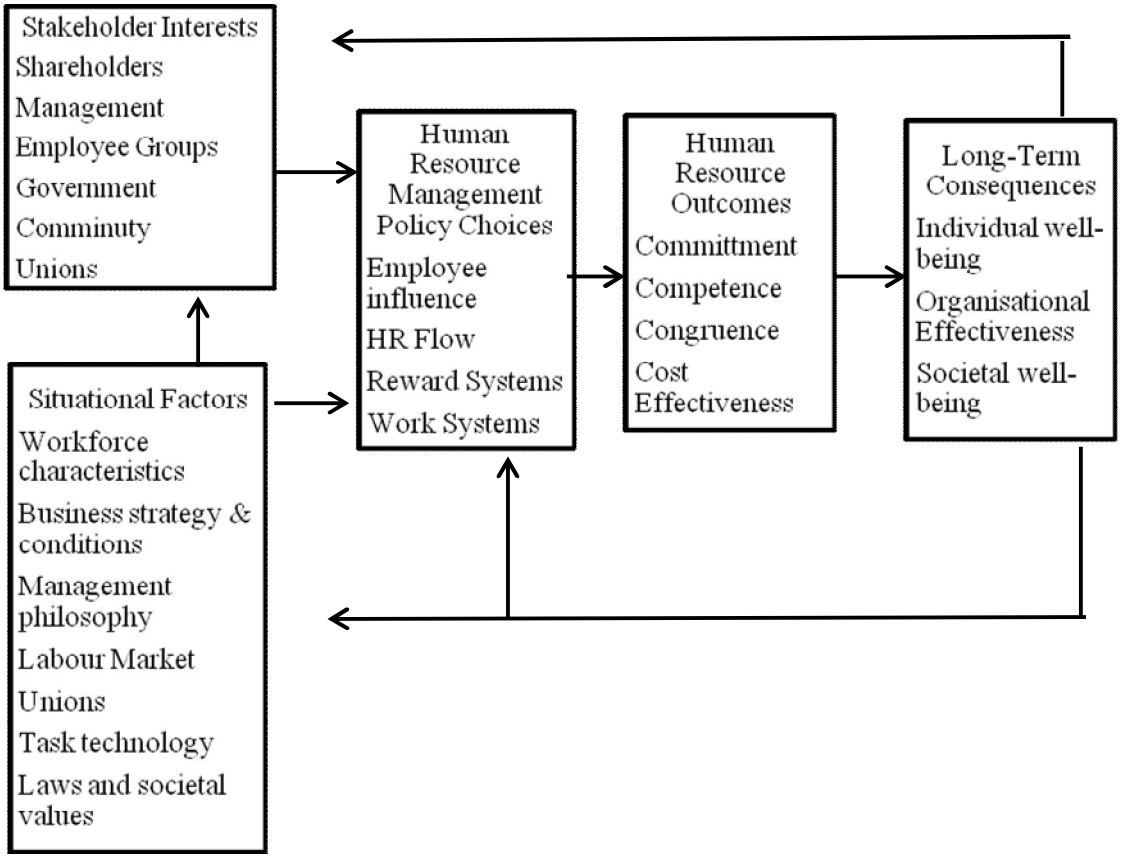
Figure 2.1: The Harvard Model by Beer et., al. (1984)

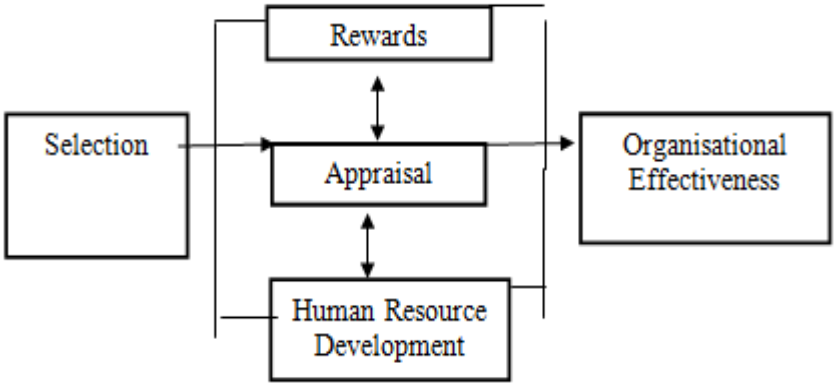


Source: The Harvard Framework for HRM, Beer et. al. (1984)

2.2 Model by Fombrun et. al., 1984

Fombrun et al. (1984) developed the early model of HRM which emphasised the interrelatedness and coherence of HRM activities. Their model focussed on four key HR components selection, rewards, appraisal, and human resource development as depicted in figure 2.2 which ultimately aims at organisational effectiveness. This model strongly expressed the coherence of internal HRM policies and the necessity of linking internal HRM policies and practices with that of the organisation's external business strategy thereby giving a pedagogical framework for illustrating the nature and significance of four crucial HR practices and the interactions among them. But the main drawback of this model is its prescriptive nature by considering only four HR practices and completely neglecting other crucial HR practices. Also, it ignores different stakeholders' interests, the situational factors and the notion of the strategic choice of the management.

Figure-2.2: Model by Fombrun et. al. (1984)



Source: Fombrun et. al. (1984)

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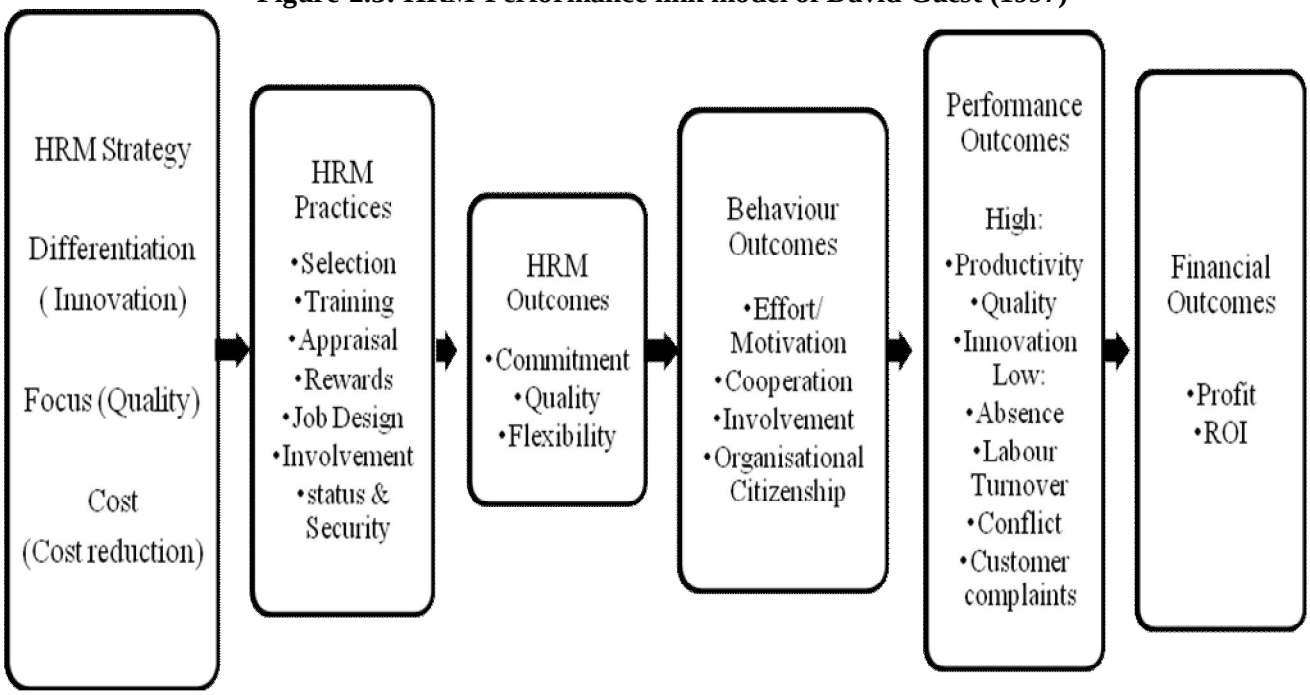
2.3 Model by David Guest, 1997

According to the model proposed by Guest (1997), improved performance is achieved through the human resource of an organisation. The highlighting features of this model are the proposals which it lays down to justify the HRM – performance link. First, the model acknowledges the strategic nature of HRM by linking HRM with the general business strategies of differentiation, focus and cost, which gets translated into HR practices. Second, taking the shelter of expectancy theory the model proposes that performance at individual level is dependent upon high motivation levels, possession of required skills & abilities and an appropriate role and clear understanding of that role. This results in choosing those HR practices that lead to high quality staff, high employee commitment and highly flexible staff. Third, the appropriate choice of HR practices results in behavioural outcomes which includes efforts/motivation, cooperation, involvement and organisational citizenship behaviour. Fourth, the model comes out with three types of outcomes viz., behavioural, performance and financial outcomes. In addition, it proposes that behavioural outcomes lead to performance outcomes which in turn lead to financial outcomes. Thus, Guest's model (1997) incorporates concepts of strategic integration, high quality, high commitment and high flexibility so as to ensure a balance between hard and soft HRM.

Figure-2.3: HRM-Performance link model of David Guest (1997)

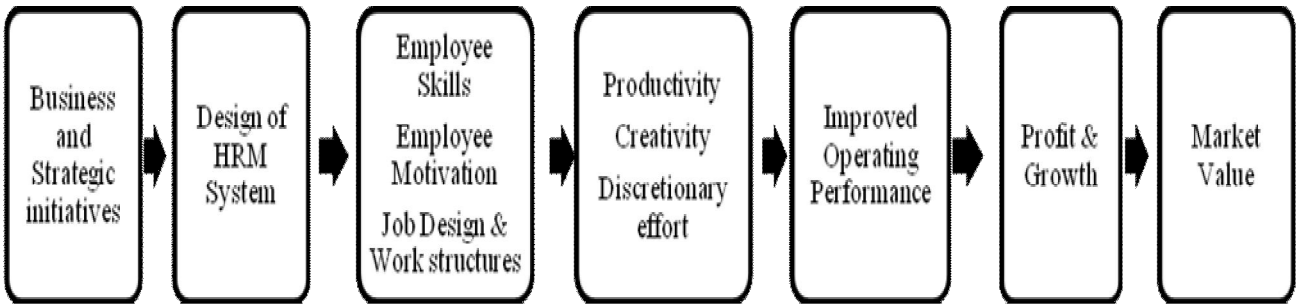


Source: David Guest, 1997

2.4 Model by Becker et. al., 1997

This model begins with the preposition that the business and strategic initiatives of the organisation drives the design of the HRM system. The HR system so designed directly affects the employee skills, employee motivation & job design and work structures which in turn impact the employee's productivity, creativity and discretionary behaviour. These employee outcomes get reflected in the operational performance of the organisation which is defined by profits and growth, ultimately determining its market value.

Figure-2.4: Model by Becker et. al., 1997



Source: Becker et al. (1997)

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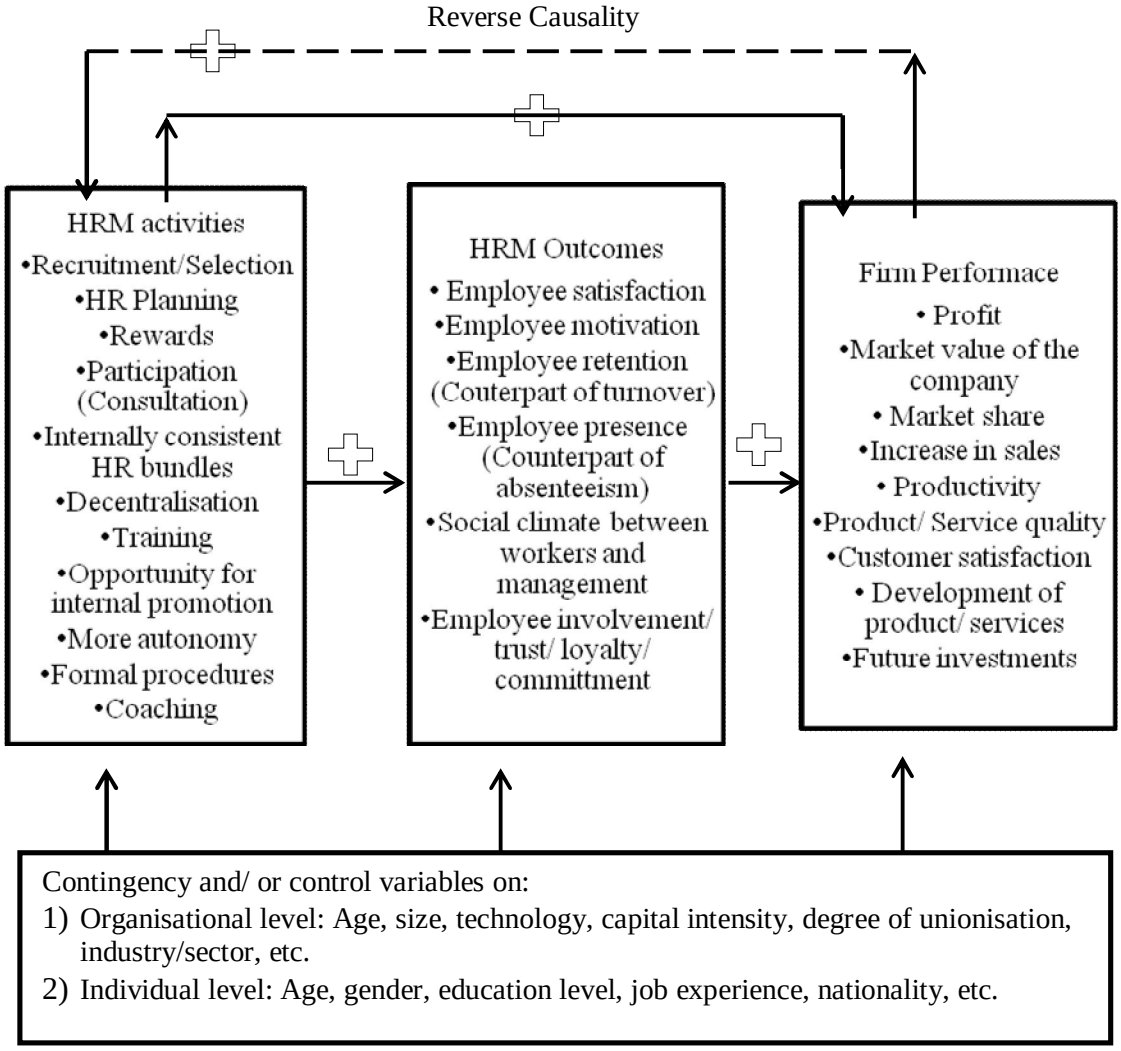
2.5 Model by Paauwe and Richardson, 1997

Synthesising the results of prior research work, Paauwe and Richardson (1997) proposed a model that links HRM activities to firm performance directly and also through the mediating mechanism of HR outcomes. In addition, they also addressed the issue of reverse causality as denoted by the dotted lines in their model which suggests that an organisation faring better in terms of profit, market value, market share, sales, product/service quality and customer satisfaction, develops better products, improves productivity and increases future investments will be willing to adopt better HRM activities for its employees which will in turn result in better HRM outcomes that ultimately leads to improved firm performance. This model also takes into account the contingency and control variables at organisational level as well as individual level.

Figure-2.5: Model by Paauwe and Richardson, 1997



Source: Paauwe and Richardson, 1997

2.6 Model by Appelbaum et. al., 2000 – The AMO Model

This model, very well known as AMO model, posits that HR practices plays a positive role in improving employee performance by encouraging them to exhibit positive discretionary behaviours. Improved employee performance is the result of developing the abilities and skills of employees to do their job, improving their motivation level for discretionary effort, and providing them with the opportunity to make full use of their skills and be motivated. Thus, this model identifies three key components - ability, motivation and opportunity (AMO). In case the key components AMO are missing, discretionary effort will not be forthcoming. The implicit assumption that is underlying this model is that managing employees at the individual level blends together a range of HR policies and practices that are inter-related, are mutually supportive and can be bundled.

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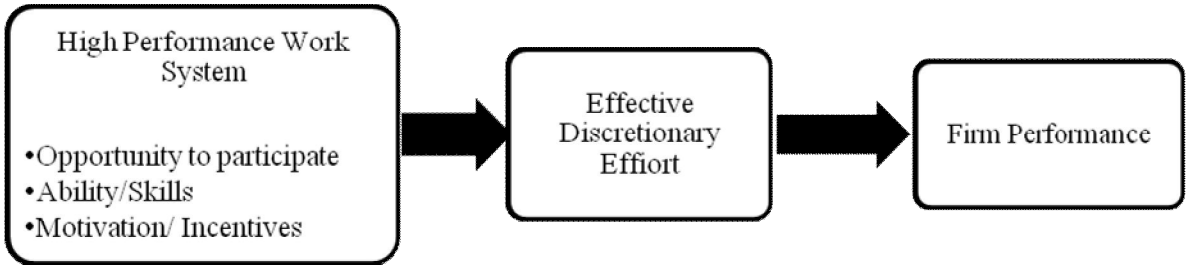
Figure-2.6: The AMO Model by Appelbaum et. al., 2000

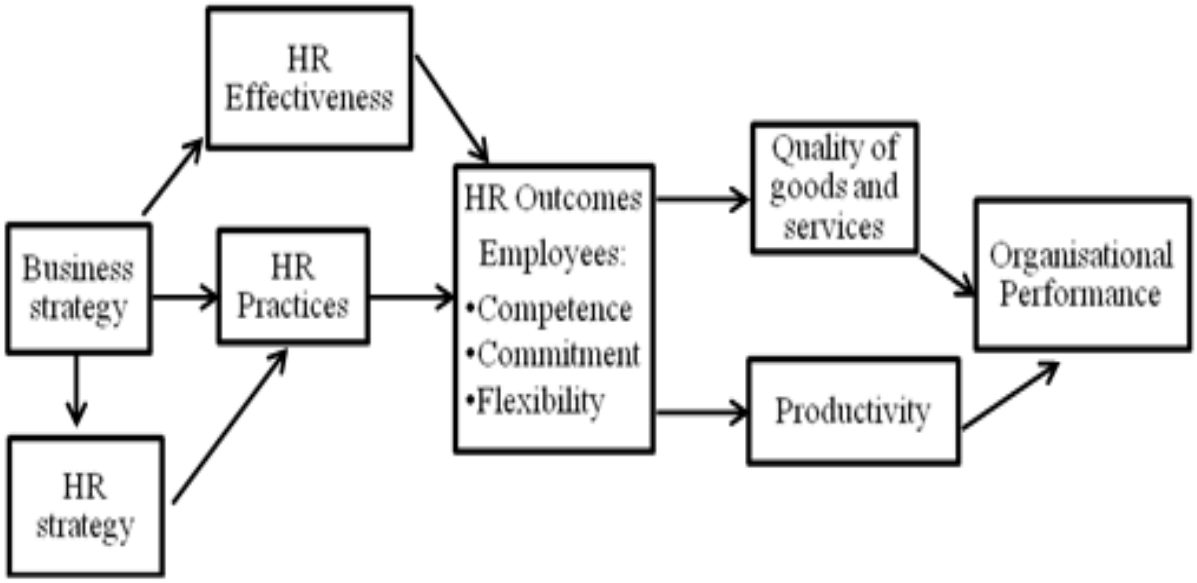


Source: Appelbaum et. al., 2000

2.7 Model by Guest et. al. 2000

Guest et. al.'s (2000b) model links human resource strategies and organisational performance through the mediating effect of HR outcomes. Broadly, this model proposes a path model that links together business and human resource strategies, which are treated as the input variables with performance outcomes. Guest opines that the HR outcomes should reflect employee behaviour and attitudes in the form of improved employee competence, commitment and flexibility that gets translated into internal performance by way of productivity and quality of goods and services and external indicators in the form of organisational performance. The human resource practices that are practiced in the organisation are derived out of its business strategy and HR strategy. They propose that the HR strategies of the organisation are influenced by business strategy as well. The distinct variable that this model speaks about is the HR effectiveness. It is particularly important since it gives an opportunity to evaluate how well the practices are working to elicit positive HR outcomes.

Figure-2.7: Model by Guest et al., 2000



Source: Guest et. al., 2000

2.8 Model by Purcell et. al., 2003

The People-Performance framework given by Purcell et.al., (2003) asserts that performance is a function of Ability and Skills, Motivation and Incentive and Opportunity to participate. Advocating that the relationship between HR practices and performance is additive and not multiplicative, the model suggests that HRM practises impact individual performance if HR practices adopted by the organisation encourages discretionary efforts, develops skills and provides opportunity to employees to perform. The model is built on two central assumptions to unlock the HRM – performance linkage. One, it suggests that almost all employees have the capacity to engage in discretionary behaviour. Second, it emphasises the critical role of line managers since they have the discretion to implement HR practices and also the discretion as to how they behave towards the employees through enacting, leading and controlling. This model focuses on the employees' abilities and skills. It also focuses on motivation since the employees want to do the job and are also given sufficient incentives to do it. Along with the incentives, they are also provided with opportunities to participate and the work environment provides necessary support and chances for expression.

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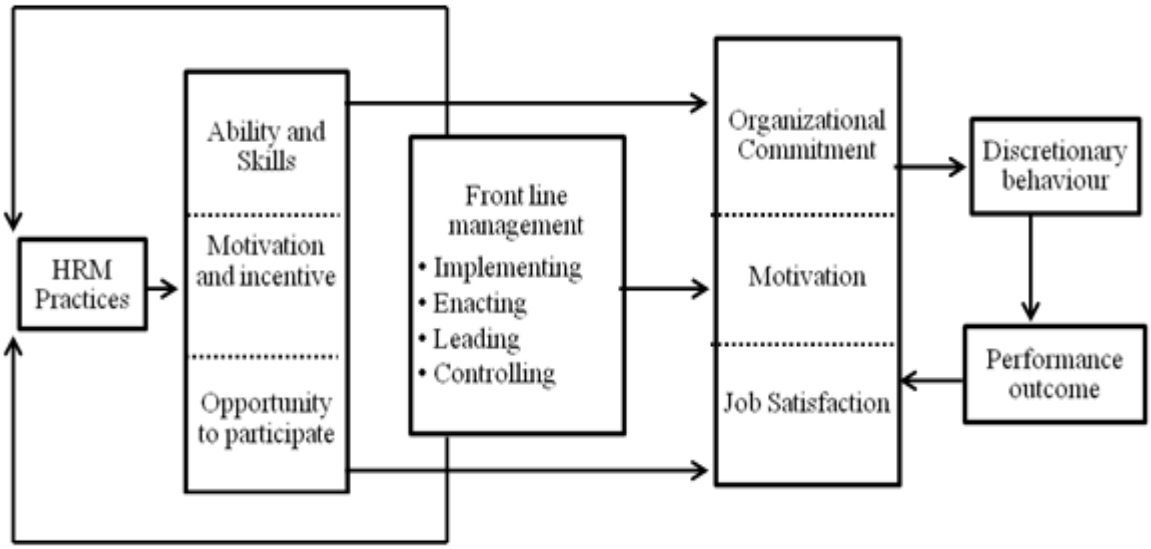
Figure-2.8: Model by Purcell et. al., 2003

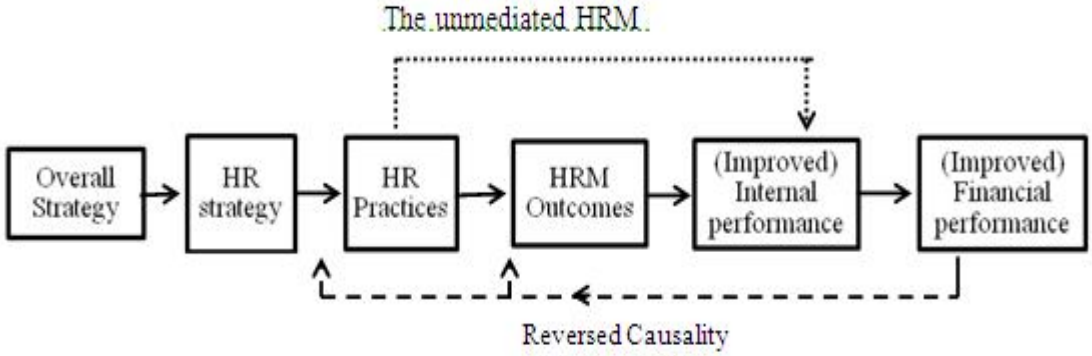


Source: Purcell et. al., 2003

2.9 Model by Boselie et. al., 2005

The model given by Boselie et al (2005) comes out with the understanding that HRM follows 'downstream' from the overall strategy of the organisation. This is based on the assumption that the strategic objectives of the organisation will either prescribe the HRM inputs or HRM is built in response to these objectives. Either ways, the HRM interventions so derived gives rise to HRM related outcomes which, if better, will then improve the internal performance of the organisation by way of increased productivity and quality, ultimately resulting in improved financial performance. However, being in line with Paauwe and Richardson's (1997) model but deviating from the other models, this model projects the direct effect of HR practices on internal performance without the mediating role of HRM outcomes. In addition it also focuses on the reversed causality which specifies that since the organisation has improved financial performance, the HR practices are applied effectively.

Figure-2.9: Model by Boselie et. al., 2005



Source: Boselie et. al., 2005

2.10 Model by Wright and Nishii, 2006 - The Link Model

Wright and Nishii (2006) examined the mediating processes by distinguishing intended HR practices, actual HR practices and perceived HR practices. They used multiple levels of analysis to examine the mediating processes that might occur in the HRM-performance link. Wright and Nishi's (2006) model includes intended HR practices i.e., HR practices that are intended to be implemented in the organisation; actual HR practices i.e., HR practices that are actually delivered by line managers and perceived HR practices i.e., the way employees perceive HR practices. The employment relationship stems from the intended HR practices and the actual HR practices whereas perceived HR practices and employee reaction forms the core of psychological contract. Their model throws light on the key role played by the line managers by way of interpreting and implementing the HR practices. It also emphasises on the four different processes viz., implementation of the intended HR practices, communication of the actual HR practices, moderation as to how the employee reacts after forming a perception of the HR practices that are being implemented and coordination between the way in which employee reacts and the impact it has on the organisation's performance.

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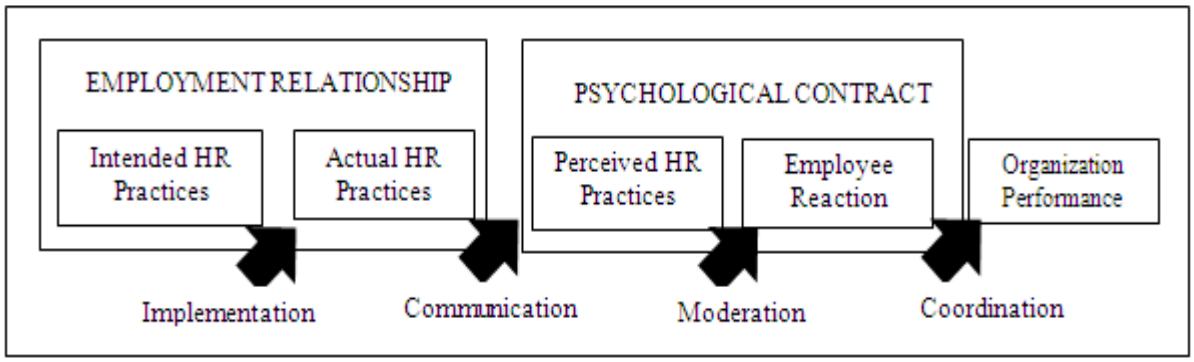
Figure-2.10: The Link Model by Wright and Nishii, 2006

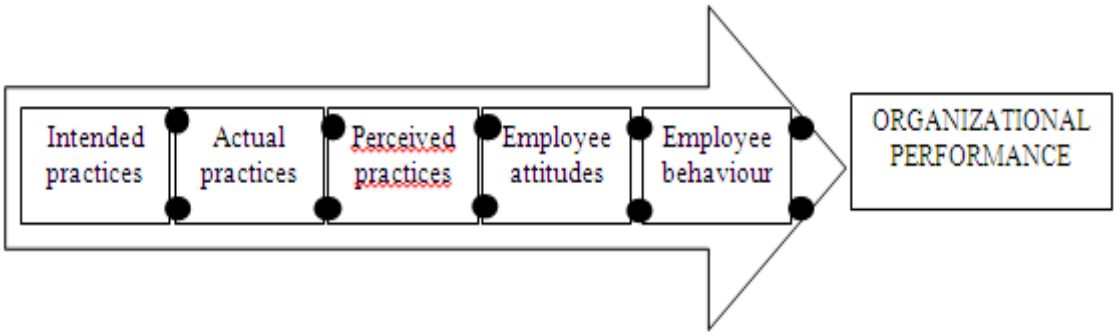


Source: Wright and Nishii, 2006

2.11 Model by Purcell and Hutchinson, 2007

Developing on Wright and Nishii's (2004) model, Purcell and Hutchinson (2007) subdivided employee reactions into employee behaviour and attitudes. Their people management-performance causal chain begins with intended HR practices which are influenced by the nature of the business, the strategy and values of the organisation and its work structures. Intended HR practices then leads to actual HR practices which are implemented in the organisation. Higher the match between intended and actual HR practices, higher is the employee satisfaction and organisational performance as noticed by Khilji and Wang (2006). The HR practices that are implemented in the organisation are judged by the employees and are perceived as per their individual perceptions which are influenced by the individual's expectations, beliefs, previous and current job experiences which in turn results in attitudinal outcomes such as job involvement, job satisfaction, commitment and morale which culminates into performance-related behaviours which might be in the form of discretionary behaviours, organisational citizenship behaviours and engagement behaviours. Ultimately the employees' behaviour affects organisational performance which is measured in terms of profit, market share, sales, market value, service quality, customer satisfaction and financial performance.

Figure-2.11: Model by Purcell and Hutchinson, 2007



Source: Purcell and Hutchinson, 2007

2.12 Model by Boxall and Purcell, 2008

This model is based on the ideas of Wright and Nishi's (2006) model and includes management intentions, management actions, workforce perceptions, workforce outcomes and organisational outcomes thereby trying to integrate individual and collective levels of analysis. Their model starts the HR – performance link with the management's intentions in respect of values formulated and employee relations style adopted by senior management; HR policies aimed at building individual and organisation level performance; and operational and financial policies that affects employee experience at work place. The management's intentions are delivered through the direct actions of senior managers, HR specialists and line managers and their direct actions influence the perceptions of the workforce individually and collectively. Workforce perceptions results in responses and outcomes. Responses in the form of skill and knowledge enhancement, improved quantity and quality of effort and increased cooperation levels and outcomes in the form of employee commitment, quit intentions, employee turnover, job satisfaction, stress levels and work-life balance. These responses and outcomes mediate the relationship resulting in organisational outcomes which is valued in terms of labour productivity levels, organisational flexibility, social legitimacy and financial performance. This model also projects the reverse causal effect wherein organisational outcomes reinforces the management's intentions and strengthens the workforces' perceptions.

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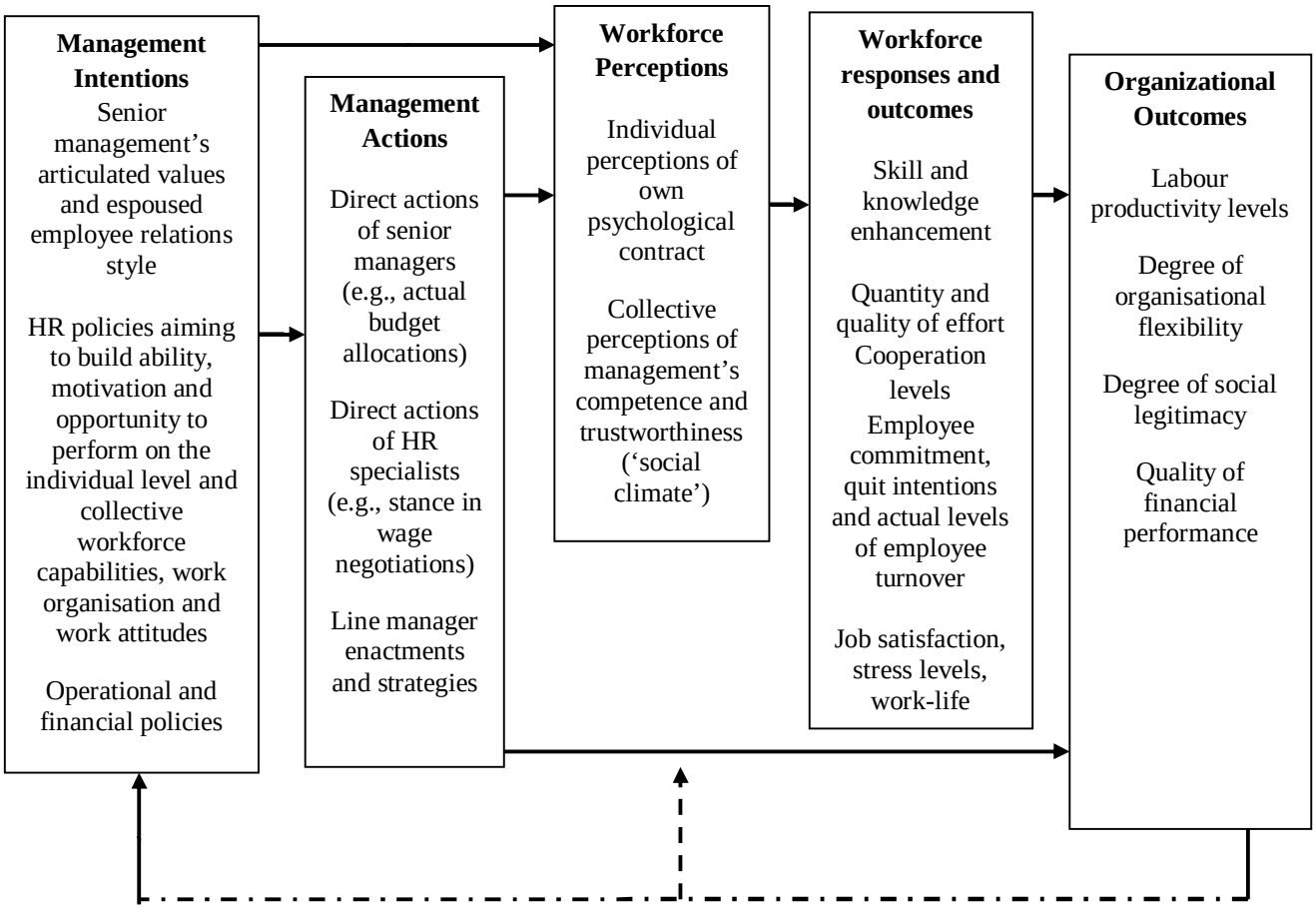
Figure-2.12: Model by Boxall and Purcell, 2008



Source: Boxall and Purcell, 2008

Thus, these theoretical models provide an insight and a general awareness of the concept of black-box, even though conclusive evidence as to the exact mediating factors cannot be drawn since the models differ in their choice of mediating factors.

3. COMPARATIVE ANALYSIS OF THE THEORETICAL MODELS

A comparative analysis of the above discussed 12 theoretical models presented in table 3 below, points out that there are inherent problems faced while trying to find out the way in which human resource strategies are linked to organisational effectiveness. The significant questions that arise in the midst of this debate can be looked into from quantitative aspects and qualitative aspects (Wright & Gardner, 2000; Asta & Zivile,2010). From quantitative perspective two crucial questions arise: (i) How many boxes needs to be included while trying to open up the black box and (ii) How many variables should be included in each of these boxes. When looked into from the qualitative angle, the following questions arise: (i) What should be the starting link in the HR-performance chain (ii) Which are the HR practices that are to be included while probing this link (iii) What constitutes the mediating variables (iv) Whether organisational effectiveness becomes a part of this chain and (v) What should be considered as the end link of the chain.

When analyzing the various models that theorize HR – performance link, it is seen that from the quantitative perspective, there is no consensus among the researchers regarding how many boxes needs to be included in the link. The minimum number of boxes is two and maximum number is eight. Same inconsistency applies to the minimum and maximum number of variables in each box. Barring the works of Beer et. al. (1984) where minimum is three and maximum is seven and Paauwe & Richardson (1997) where minimum is six and maximum eleven, all other works have a minimum of one or two variables in each box and a maximum of three or four variables. The same vagueness applies even to the questions posed under qualitative base and there are no plausible answers to these questions. Some of the models start with business or overall strategy and others start with HR practices. Five models do not specify the HR practices and the remaining models do not have a consensus as to the HR practices that are included. Three of the models do not mention the HR outcomes, whereas the other models used varied HR outcomes like effective discretionary effort, motivation, job satisfaction, employee attitudes and behaviour. Further, except for three models, all the other models include

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organisational effectiveness/ performance in their link. There is no unanimity in the variables that are to be regarded as the end link of the chain. All this ambiguity surrounding the HR-performance link thus necessitates more in-depth research into this study area.

Table-3.1: Comparison of the theoretical models that analyse the 'Black-box'

Author/ Authors	Quantitative aspect		Qualitative aspect						
	Number of boxes in the model	Minimum & Maximum number of variables in the boxes	HRM Strategy	HRM Practices	Human resources related outcomes	Mediating Variables	Organisational Effectiveness \ Organisational Performance	Starting link in the model	End outcome/ End link in the model
Beer et. al. (1984)	5	Min: 3 Max: 7	Not involved	Not specified	✓ Commitment ✓ Competence ✓ Congruence ✓ Cost Effectiveness	Human resource outcomes	Specified	Situational factors and Stakeholder interests	✓ Individual well-being ✓ Organisational effectiveness ✓ Societal well-being
Fombrun, et. al. 1984	5	Min: 1 Max: 1	Not involved	Specified	✓ Not involved	Not involved	Specified	Selection	✓ Organisational Effectiveness
David Guest, 1997	6	Min: 2 Max: 7	Involved	List of practices specified	✓ Commitment ✓ Quality ✓ Flexibility	HRM outcomes	Specified	HRM Strategy	✓ Financial outcomes : Profit and ROI
Becker et al. (1997)	7	Min: 1 Max: 4	Not involved	Not specified	✓ Productivity ✓ Creativity ✓ Discretionary effort	Not involved	Not specified	Business and Strategic Initiatives	✓ Market value
Paauwe and Richardson, 1997	3	Min: 6 Max: 11	Not involved	List of practices specified	✓ Employee satisfaction ✓ Employee motivation ✓ Employee retention ✓ Employee presence ✓ Social climate ✓ Employee involvement/ trust/ loyalty/ commitment	HRM outcomes	Specified	HRM activities	✓ Firm Performance • Profit • Market value of the company • Market share • Increase in sales • Productivity • Product/ Service quality • Customer satisfaction • Development of product/ services • Future investments
Appelbaum et., al. 2000	3	Min: 1 Max: 3	Not involved	Not specified	Not involved	Effective discretionary effort	Specified	High Performance Work System	✓ Firm Performance
Boselie et. al., 2005	6	Min: 1 Max: 1	Involved	Specified	Involved	HRM outcomes	Specified	Overall Strategy	✓ (Improved) Financial performance
Purcell et al 2003	6	Min: 1 Max: 4	Not involved	Specified	✓ Organisational commitment ✓ Motivation ✓ Job satisfaction	Organisational commitment Motivation Job satisfaction	Not specified	HRM Practices	✓ Performance outcome
Guest et al, 2000	8	Min: 1 Max: 3	Involved	Specified	✓ Competence ✓ Commitment ✓ Flexibility	HR outcomes	Specified	Business Strategy	✓ Organisational performance
Wright and Nishii, 2006	3	Min: 1 Max: 2	Not involved	Specified	Not involved	Not involved	Specified	Intended HR Practices	✓ Organisation Performance

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Purcell and Hutchinson, 2007	6	Min: 1 Max: 1	Not involved	Not Specified	✓ Employee attitudes ✓ Employee behaviour	Not involved	Specified	Intended Practices	✓ Organisational Performance
Boxall and Purcell (2008)	5	Min: 1 Max: 2	Not involved	Not specified	✓ Skill & knowledge enhancement ✓ Quantity & quality of effort ✓ Cooperation levels ✓ Employee commitment, quit intentions & actual levels of employee turnover ✓ Job satisfaction, stress levels, work life balance	Workforce responses and outcomes	Not specified	Management Intentions	✓ Organisational outcomes: • Labour productivity levels • Degree of organisational flexibility • Degree of social legitimacy • Quality of financial performance

4. CONCLUSION

The HR scholars, over the years, are trying to explore the link between Human Resource Practices and Organisational performance as evidenced by the number of studies that are conducted in this area. This research paper analyses twelve noted theories that are widely referred by the scholars. It has to be noted that the most prominent theories emerged during the period 1980 through 2008. As such, the area relating to the 'Black-box' still remains grey. The more studies are conducted, the more mysterious it gets which has resulted in no conclusive link to fall back on. In the recent decade all though many studies are conducted to probe the link, these studies based their logic and analysis on the above discussed theories and no noted new theories that explored the link differently emerged till date. Thus, there is a need to conduct more research in this area.

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MECHANISM OF INTERTEXTUALITY FOR SEMANTIC THEORY: JULIA KRISTEVA'S PERSPECTIVE

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ABSTRACT
The main foci of this paper are a stab to submit and interrogate the several notions and philosophies' relating to intertextual semantics in Kristeva's thought. Julia Kristeva's contribution to the doctrine of intertextuality is colossal. She has coined the term intertextuality. Generally, we understand that intertextuality is the combination of text. Intertextuality is literary, socially, culturally, contextually, institutionally…molded. For Kristeva, the notion of intertextuality cannot be detached from socio-cultural textuality, languaculture textuality which is the milieu in which intertextuality is created. Sometimes the term intertextuality is associated with postmodernism. Intertextuality often reinstates intersubjectivity. Intertextuality today is demanding to formulate the interactional semantics of text.

Keywords: Intertextuality, Semantics, Intertextual Semantics, Intersubjectivity & languaculture.

1. INTERTEXTUAL SEMANTICS: A PRELIMINARY NOTATION

Intertextuality is a doctrine which is associated with the philosophy of language and the linguistic philosophy, more precisely with that sphere of philosophy of language and the linguistic philosophy where semantics encounters discourse analysis.

The term intertextuality has been derived from the Latin word *intertexto* which means to intermingle a text's meaning by other texts. It was first introduced by French semiotician Julia Kristeva in her essays such as "Word, Dialogue and Novel" (1966) and then in "The Bounded Text" (1966-67). With regard to the concept of intertextuality, she argues that "each text is an intersection of other texts where at least one other text can be read" (Kristeva, Gora, Jardine, & Roudiez, p. 66). With regard to texts, Kristeva claims that there are two relationships going on whenever we read a text: there is the relationship between the author of the text and reader of a text (the horizontal axis) and between the text and other texts (the vertical axis). It is the vertical axis that gives us our definition of intertextuality (Kristeva, Gora, Jardine, & Roudiez, p. 69). Kristeva declared that 'every text is from the outset under the influence of other discourses which impose a universe on it' (Kristeva 1974, 388–9; trans. by Culler 1981, 105).

This paper consists of three parts; the first part is discussed about the space of texts which is the important factor for the formulation of intertextuality another way we can say it intertextual semantics because it build a semic set among texts. The second part basically focused on a philosophical notion of semantic textuality as well as intertextuality. And the final part delineates a view which is making relation between world and subject for developing a notion of intertextual semantics. It expresses a kind of philosophical concept called intersubjectivity. And with regard to Kristeva's perspective of intertextuality, this can be our objective of the research. Is Kristeva's concept of intertextuality suitable for intertextual semantics?

2. THE WORD WITHIN THE SPACE OF TEXTS

Taking place from the foregoing investigation, we are going to defining the specific status of the word as a signifier for different modes of intellection within different texts put poetic analysis at the sensitive center of contemporary 'human' sciences – at the intersection of language with space. To investigate the status of the word is to study its articulations with other words in the sentence, and then to look for the same functions or relationships at the articulatory level of larger sequences. In this regard, we must first define the three dimensions of textual space where various semic sets and poetic sequences function. These three dimensions or coordinates of dialogue are *writing subject*, *addressee* and *exterior texts*. The word's status is thus defined horizontally (the word in the text belongs to both writing subject and addressee) as well as vertically (the word in the text belongs to prior texts.

She argued that rather than confining our attention to the structure of a text we should study its 'structuration' (Chandler, 2007, p. 197). This involved sitting it 'within the totality of previous or synchronic texts' of which it is a semantic 'transformation' (Coward & Ellis, 1977, p. 52).

Kristeva's, main assertion with regard to intertextuality is that texts draw their meaning from other texts and that all texts absorb and transform other texts. It means intertextuality refers to the intersection and cross-referencing that exist between texts, where the understanding of any one text may refers to the understanding of

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another text or terms. Any text can be analyzed in terms of the other texts that it has absorbed and transformed. And all texts are constructed from a 'mosaic of citations' (Kristeva, Gora, Jardine, & Roudiez, 1980, p. 35).

The significance of Kristeva's approach is that a 'mosaic of citations', every text is an absorption and transformation of another text. So the key component of her perspective text intertextuality erases the boundaries between literary texts. The text is therefore productivity and this means that is a permutation of texts, intertextuality: in a space of a given text, several utterances, taken one another. Studying a text as intertextuality means considering it as such within society and culture. Furthermore, emphasizing that all specific texts are an assimilation and transformation of all other texts. Intertextuality has two facets: 'the web of relations that produce the structure of the text; and 'the web of relations linking the text with other discourses' (Kristeva, Gora, Jardine, & Roudiez, 1980, p. 36-60). Though Janathan Culler is critical of Kristeva, has the basic position is not very different from her view that intertextuality is the 'discourse space' that yields a text intelligible (Culler, 1981, pp. 106-107).

Culler in his book *The Pursuit of Signs* has claims that intertextuality as virtually synonymous with 'presupposition' (Culler, 1981, p. 102) and he argues that intertextuality is less a name for a work's relation to prior texts than a designation of its participation in the discourse space of a culture (Culler, 1981, p. 103). And in framing the sign he emphasizes the context of the reader as a central element in the processes of framing which is something reader does to make texts intelligible (Culler, 1988, p. ix).

But perhaps it is James W. Voelz who articulates a reader as text view most clearly. An intertextual approach to textual interpretation sees texts …..as products of 'various cultural discourses'. This means that intertextuality concerns itself, not with the relationship between a text of verbal signs and other texts of verbal signs or more specifically, between a text of written verbal signs and other texts of written verbal signs, but it also and especially concerns itself with the relationship between a text of signs of any sort and other sets of signs as text, whether verbal or non-verbal in nature (Draisma & Iersel, 1989, p. 27-34).

3. TEXTUAL SEMANTICS IS THE BUILDING BLOCK OF INTERTEXTUALITY

Intertextuality is used to describe the ways that text's meaning formed by other texts and also it enables us to understand texts. As we know writers and artists are influenced by some characteristics of texts that the texts are associated together. For example, a writer who has observed a certain film may be influenced by some of the ideas in that film. This influence may become apparent in their writing as they work on a novel, poem or play. Writers can make a text seem more realistic by referring to ideas, people or events that exist in the real world - our world. By making reference to things we can relate to, writers help us to feel a sense of familiarity with the world they are creating for us. In this sense, intertextuality may be deliberate or unintentional. Therefore, sometimes writers may not be aware of the influence that other texts have on their work. In contrast, other writers seek to transform an inspiring idea from another text into a fresh concept that carries additional meanings. Writers and artists frequently borrow or bring back into existence of the semantic status of the text. It is fun to explore the new ways in which they are presented. Studying intertextuality goes beyond just identifying similarities between creative works. It also looks some intertextual shaping techniques that are used to link texts together. These include appropriation, allusion, parody, imagery, and quotation. Hence, intertextuality is best known for its semantic applications and solutions. Therefore, the main motto of many researchers, in addition, made use of it in order to determine how texts can be hung together. However, (Kristeva, Gora, Jardine, & Roudiez, 1980, p. 36) states that "any text is constructed as a mosaic of any text is the absorption and transformation of another".

4. INTERTEXTUALITY IS THE BUILDING BLOCK OF INTERSUBJECTIVITY

According to Kristeva, intertextuality reinstates intersubjectivity. Kristeva in her *Revolution in poetic language* has declared that the notion of intertextuality can be interchangeable to intersubjectivity. This is the most creditable dimension that Kristeva has added to the subject of intertextuality is that she has extended the nature and scope of intertextuality to incredible dimensions. Intertextuality negotiates with the horizons of numerous disciplines. With regard to intersubjectivity in the intertextual framework, Kristeva precisely and successfully has undertaken its study in the discipline of psychoanalysis. In case of psychoanalysis, Kristeva asserts that a psychoanalytic cure leads us into considering the word as body and the body as a word. This interrelationship is best summed up that "Intertextuality" is often used interchangeably to describe the manner in which texts "intersect" with each other; or even the possibility of different texts being analyzed by applying similar techniques. Kristeva endeavored to move the theory of intertextuality beyond the narrow constraints of texts. She widened its scope to include entire signifying systems. For her, every writing as a major form of inter-art or intertext. In this respect, any work of art does not emerge from nothingness, but rather interacts with other texts. It describes the text as an entity that finds its existence between several other entities (Kristeva, Roudiez, &

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Waller, 2006, p. xx). As stated by Michael Worton and Judith Still in *Intertextuality: Theories and Practices*, "the theory of intertextuality insists that a text [...] cannot exist as a hermetic or self-sufficient whole, and so does not function as a closed system" (Worton & Still, 1995, p. 1). This is because the writer is not an isolated being.

According to Kristeva, intertextuality is mechanism for semantics theory which concerns systematic relationships and process between texts and it refers to the influences of one text up on another text. Further, Allen states that in order to get the interpretation of a text, the reader has to follow a network of textual relations. Consequently, reading becomes a process of moving between texts. However, intertextuality is considered as a network which functions as a bridge to relate each text to the texts surrounding it. It is much depicted in the claim that the text, itself, is the mere dependent source for determining the meanings of words involved. Intertextuality is regarded as a network, functioning as a linguistic link employed to connect each text segment with the texts surrounding, or associated with it.

5. CONCLUDING REMARKS

This can be clinched from our inquiry is that the mechanism of intertextuality provided a concept called semantic unity. According to Kristeva's perspective of intertextual semantics, it is a holistic philosophical approach for the shake and safeguarding of the notion of semantic theory. In this sense, Kristeva says, it is very difficult to understand the meaning of a text without associating with another text. There are some minor problem in this study has been to consider that intertextuality is the vital podium to build intertextual semantics theory but there are difficulties to relate texts with texts where participants frequently draw a contradictory text in order to repel contrasting claims, giving the same words different meanings, or using them to different intent. We think that this is not the problem of participants rather the problem of incommensurability due to the use contextualism in intertextuality. Therefore, it concerns that Kristeva's account of semantics is so far as sustainable semantic theory.

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FICTION/HISTORY: A STUDY OF KURT VONNEGUT'S SLAUGHTERHOUSE-FIVE

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ABSTRACT
Fiction and history has always been inextricably linked to each other. Kurt Vonnegut's novel, Slaughterhouse-Five has been taken up to examine the nature of relationship history and fiction share as well as their point of departure, if any possible. Though fiction relies on the imaginative faculty of humankind, history is considered to be about and of factual things and phenomenon. But on closer examination it is found that the act of writing fiction bears in fact much similarity with history writing. Slaughterhouse-Five broach this very issue of unreliability of history by opening fissures of possible truths through fiction. Fiction provides a discourse through which to arrive at truths otherwise seem unlikely to exist. The basic hypothesis is that:

- *History is inadequate to know "facts".*
- *History cannot fathom human emotion.*
- *Fiction serves as a gateway to different realities.*

"We experience the "fictionalization" of history as an "explanation" of history for the same reason that we experience great fiction as an illumination of a world that we inhabit along with the author. In both we recognize the forms by which consciousness both constitutes and colonizes the world it seeks to inhabit comfortably" – Hayden White.

Kurt Vonnegut's *Slaughterhouse-Five or The Children's Crusade (*1969), a novel on the historical event of the Dresden massacre does what Hayden White explicates in his theory on history and fiction. Vonnegut opens up the issue of unreliability of history –its truth claims, the objective nature of its knowledge as something which is construed, running the risk of being biased. Billy Pilgrim, the central character of the novel experiences the atrocious Dresden and it is through him that the reader comes to see the Dresden event. In here, historical event is colored with Vonnegut's imagined character diluting the boundaries between historical narration and fiction. Vonnegut goes a step further in including some of the science fiction elements, quiet moments of comic relief and all these aid in interpreting/reading history not as a single truth but having multiplicity of truths. Vonnegut rewrites the history of the Dresden air raid deploying innovative strategies, and thus "storify[ing]" the "atrocity" (Freese, "Kurt" 1). He questions historiography and its claim to "objectivity, neutrality, impersonality, and transparency of representation" (Hutcheon, *A Poetics of Postmodernism*, 92).

Kurt Vonnegut carves out his war experience into the novel *Slaughterhouse-Five* but in a way different than those of Joseph Heller, Earnest Hemingway, and Norman Mailer. His *Slaughterhouse-Five* defies modernist notion of realism. By implementing postmodern techniques of writing such as self-reflexivity, discontinuity, and intertexuality he writes about the tale of Billy Pilgrim who is more or less the surrogate of Vonnegut himself. But the question arises as to how much of the novel is based on history and how much of it is an illusion of reality. *Slaughterhouse-Five* allows room for such introspection. The novel deals with Vonnegut's real life experience at Second World War in Dresden. He was twenty –two when he went into war and was taken a prisoner by the German armies in Dresden when he saw the horrifying Allied bombing of the Dresden city from close quarter. In an interview with Lee Roloff, Vonnegut says, "I saw a hell of a lot of it (death) during the Battle of the Bulge when my division was wiped out. But then in Dresden I saw a mountain of dead people" (85).

The narrator of the novel closely resembles Vonnegut as does Billy pilgrim too. The novel begins with the lines, "ALL THIS HAPPENED, more or less. The war parts, anyway, are pretty much true" (1). These lines bring home the point of the story being based somewhat on true events. It does not directly assert that all the events described in it to be entirely true. The narrator explains that he has "changed all the names" (1). Any assurance to the representation is outright discarded.

To pen down his trauma of Dresden into words and for finding a sense of purpose in this life, in a world of bourgeoisie consumerism, he takes resort in science-fiction writing techniques and adapted its methods to tell his tale. The narrator is present in this world as well as he enters into an imaginary land, a planet called Tralfamadore. The planet is presented as real as the world of humans. The planet of Tralfamadore is different in the sense that it is administered by different physics. There he is kept with a famous movie star Montana Wildhack in a menagerie. Vonnegut searches for the panacea through imagination that can heal the mortified wounds and neutralize the brutalities caused by the war, Dresden firebombing in particular. Chapter one in the

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novel depicts a disoriented Dresden where the narrator finds himself in with his war time buddy, Bernard V O'Hare, a real character. This is the Dresden of post-world war, everything seems displaced and communication misplaced. The narrator is grappling with this place of unstable and unpredictable ground that apparently characterizes war experience. Chaos has uprooted nature. Although world wars have ended, and the narrator is recounting the events of it that happened twenty-three years ago, the chaos and this brutality have found a new medium of manifestation through the Vietnam War. The structure of the novel reflects this discontinuity. The story is not recounted in sequence rather the narrator jumps throughout the narrative through "prolepsis" and "analepsis" as the narrator claims that he "has come unstuck in time" (19). Even the sentences are brisk and short to go parallel, it seems, with the present chaotic world.

Self-reflexivity, a feature of a type of fiction called metafiction is used extensively by Vonnegut to draw the readers to the notion of the events elucidated as not wholly true. As mentioned in the previous chapter metafiction is the process to make a literary text aware of its own fictionality. He, however, does not make any distinction between what is "fact'' and what is "fiction". The task is unto us to find out the thin line between history and fiction. As the story begins we meet the narrator who remembers when after the World War he held the work of police reporter. The narrator visits Germany after many years with his war-time buddy Bernard O'Hare and encounters in a taxi an American war of prisoner named Gerhard Muller whose mother died in Dresden bombing. The whole chapter deals with the narrator coming to terms with his writing of a war book. In the process he gets acquainted with many personalities both real and imaginary. The narrator writes about his endeavor to write this very war novel. He says:

When I got home from the Second World War twenty-three years ago, I thought it would be easy for me to write about the destruction of Dresden, since all I would have to do would be to report what I had seen. And I thought, too, that it would be a masterpiece or at least make me a lot of money, since the subject was so big. (2)

He then goes on to cite examples of works centering on the Dresden event. To make his version of Dresden plausible he supplants quotes from other sources for instance, *Dresden , History, Stage and Gallery,* by Mary Endell. The narrator even thinks of naming it "the Children's Crusade" and vindicates his stance for choosing this name. In giving out intimate details of his life, the narrator attempts to look credible before his readers. The narrator then starts with the life history of Billy Pilgrim- the character of his book. The chapter two of the novel begins as:

Billy Pilgrim has come unstuck in time. [He] has gone to sleep a senile widower and awakened on his wedding day. He has walked through a door in 1955 and come out another one in 1941. He has gone back through that door to find himself in 1963. He has seen his birth and death many times…and pays random visits to all the events in between. (19)

Events in Billy's life happen in random order. He sweeps through different planes of reality. The structure of the novel is cyclical. Only linearity appears when Billy's birth and few subsequent events are described. Billy is born in 1922 and this resembles the year of Vonnegut's birth also. The novel begins with the events of Dresden and too with it which refers to the cyclical nature of the novel paving way for self-reflexivity of the novel to pose the challenge to conventional plot narrative techniques. The story is in the form of a story-within-a-story, where the Billy Pilgrim's experience is taken into account. Billy even appears in first person 'I', for instance, "when I was somewhat younger, working on my famous Dresden book, I asked an old war buddy named Bernard V. O'Hare if I could come to see him. He was a district attorney in Pennsylvania. I was a writer on Cape Cod. We had been privates in the war, infantry scouts" (3) the fictional account is given credence by real events.

Moreover, the narrator points out the story's own constructive elements. Once again when he calls his friend and tells him, "I'm writing this book about Dresden. I'd like some help remembering stuff. I wonder if I could come down and see you, and we could drink and talk and remember" (4) this shows the constructedness of the story while at the same time relying on real events, a past reality. This reality somehow gets distorted in the next chapters where the real events amalgamate with fictional ones. As Patricia Waugh claims that metafiction engages in creating a fictional illusion and then shedding out that illusion, Vonnegut through this technique assimilates reality and fiction where reality or history is nothing more than a mediated or provisional version of truth. Therefore, Vonnegut goes beyond this provisional history to seek an alternative reality free of manipulations of dominant systems of human society.

Instead of making it a case-history or documentary and telling the events in a straightforward manner, Vonnegut chooses Billy to retell the history of war. Traumatized at a very tender age by his father who tossed him down into swimming pool Billy becomes a dormant boy. He joins the army where he becomes the

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chaplain's assistant. Though not fit for the army, he is sent to fight the enemies in the Battle of the Bulge. Eventually he is captured and taken as war of prisoner by the Germans. There he undergoes from mental breakdown and starts hallucinating. After witnessing the Dresden bombing and mass cremations, he returns home frenzied from the aftermath. He marries the daughter of an optometrist and bequeaths huge sum of property. However shell-shocked from the war he admits into a mental asylum to cure his schizophrenia in 1948. In the hospital he meets Eliot Rosewater. Through Rosewater he becomes acquainted with the works of Kilgore Trout. This writer explores the possible realms of life in the universe and condemns the life on humans on earth. Billy can relate his sufferings of hallucinations with the writings of the author and becomes engrossed in them. He takes recourse to science-fiction to tackle his otherwise disturbed life. Though he puts up a happy family man portrait of himself, the war experience is gnawing his inner faculty. He starts believing that he is abducted by aliens but after meeting with an accident and a blow in his head he starts making public his belief in the occurrence of the abduction, thus creating nuisance for his daughter and son-in-law. In this way the story remains no longer a case history, it goes further to show the dereliction and ill effects war brings to war veterans and human, in general. The fragmented story shows the fragmented life of Billy, torn between reality and illusion and failure to grasp successfully either of them.

Kurt Vonnegut raises issues of war where it is no longer projected as a fantastic adventure but points directly toward its absurdity. The creatures of Tralfamadore stands in juxtaposition to humans, their philosophy is in subversion to the ideological base of human society.in chapter eight of the novel, a quartet marks quite an impression on him, he goes upstairs and "thought hard about the effect the quartet had had on him, and then found an association with an experience he had had a long time ago" (145). Vonnegut emphasises that at this particular moment he does not need to travel in time to experience the memory rather he remembers it "shimmeringly" (145). And the narrator then goes on to describe the bombing of Dresden on the night of February 13, 1945:

He was down in the meat locker on the night that Dresden was destroyed. There were sounds like giant footsteps above…the rest of the guards had, before the raid began, gone to the comforts of their own homes in Dresden. They were all killed with their families. (146)

The narrator describes that after the bombing Dresden became "moon" and had nothing "but minerals" (146) and the neighbourhood was filled with dead bodies. As Billy remembers the event he is suddenly transferred into the world of Tralfamadore where the Hollywood star, a fictional character, insists him to tell a story and he tells about this horrifying bombing.

Toward the end of the penultimate chapter we see Billy going out on the street and doing so, he comes across an adult shop and sees the novels of Kilgore Trout that have been kept on the other side of the window panes. He goes inside and takes one of his novels. As he goes through his novels he comes through few passages that resemble what he had read in the mental asylum. In fact it was about "an Earthling man and woman who were kidnapped by extra-terrestrials" (165) and were put in zoo for display on a planet called Zircon-212. This pirouettes the story back into a vortex where everything the reader is made to believe is suspended. Billy being unstuck in time then no longer is credible, it gives way to the readers to side with the logical explanation that Billy constructed such realities after reading this book. The question then the author seems to raises is how far realities are perceivable. Before revealing this, the readers seem to be content with the possibility of such reality. But as soon as it is revealed, our cognizance regarding perceived realities and imaginative power are put to question. The author implicitly suggests that as a mechanism for coping, people create different realities to sustain themselves. The science-fiction strategies are used to blur further any distinction between history and fiction. Atrocity committed in such magnitude calls for new kind of consciousness that defies any conventional historiographical and fictional writing ways.

Both historiography and fiction rely on possible realities beforehand any event though they search in different ways, one through existing datas and the other through spanning stories. As historiography according to Hayden White, "prefigures the historical field and constitutes it as a domain upon which to bring to bear the specific theories [it] will use to explain 'what was really happening in it'" (Freese, 20). Vonnegut breaks into fourth dimensional world of Tralfamadore, where spatial and temporal laws are diverted in multitudinous ways. Tralfamadore as it has been stated earlier is the alternative to the sordid world of humans. According to Peter Freese, the movement within the two worlds helps Vonnegut achieves:

Three goals at once, namely, to relativize the official versions of a historical event by reconstructing it from an idiosyncratic point of view, to thematize contemporary problems through a subjective consciousness, and to extrapolate the possibilities of tomorrow from the potential of today. ("Slaughterhouse-Five", 23)

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Other characters in the novel also aid to the process of recreating history of the time, who are part of the war either directly or indirectly. Some are participants, while others are witnesses. Vonnegut gives reference to the history written on the Dresden war on many occasions throughout the novel. While historians insist on facts and statistics Vonnegut gives an alternative version of the war. Historians traditionally relegate human desires and emotions to minimal position, or often time no position at all. Hence, Vonnegut through the portrayal of different characters gives a history of the war from the participants' view point. These serve as counter narratives in many cases. Roland Weary, Paul Lazzaro, and Edgar Derby are among the many characters that were with Billy at the war time. Through these characters we come to see their perspectives on war. Historians otherwise would have never given space for personal accounts, but Vonnegut through this fictional characters attempts to show possible version of history that involves human desires and emotions.

Each of the character gives his perspectives of war through their speech and actions. Vonnegut by incorporating these fictional characters shows the possible narratives of war, which are most of the time silenced deliberately or forcefully. The rhetoric of war is put to scrutiny by these counter- narratives. Each one of them creates or constructs a reality of their own, be it Billy's resort to Tralfamadore or Weary's own invented story or Wild Bob's delirium. These fictional constructions give the impression that war renders everyone into a state of delusion and escaping and imagination help them to maintain their equilibrium. For those who fail to do so cease to exist.

Kurt Vonnegut in representing the annihilation of Dresden goes against the grain of official records and history of the World War II. As Billy Pilgrim lies in his hospital bed he meets Bertram Copeland Rumfoord "a retired brigadier general in Air Force Reserve". He is the professor of History at Harvard and has written twenty–seven volumes *Official History of the Army Air Force* that has "almost nothing" about Dresden. That "howling success" (157) of the United States has been excluded from it so that the general populace does not come to know of it.

Vonnegut highlights therefore the conspiratorial nature of governmental plans and operations. Rumfoord discloses, "Americans have finally heard about Dresden" and since they have heard it now he feels obliged to mention it in his recent book and from "the official Air Force standpoint, it'll all be new" (157) thus pointing out the cynicism of government servants and their bent to biased outlook. Bertram Rumfoord is a fictional creation, albeit he helps to bring out the secretive nature of government and the deliberate silence maintained by officials and the official history. Moreover, Vonnegut includes in the novel a preface written by an actual United states Air force Lieutenant general Ira C. Eaker to David Irving's real book on the Dresden bombing named *The Destruction of Dresden*. Rumfoord reads on where the general writes:

I find it difficult to understand Englishmen or Americans who weep about enemy civilians who were killed but who have not shed a tear for our gallant crews lost in combat with a cruel enemy…it might be well to remember Buchenwald and Coventry, too. (154)

Eaker justifies the act of bombing by insisting that "it had to be done". He shares the same outlook with Rumfoord, both blind believers of governmental actions. Even the unabashed acceptance of Air Marshal Saundby in attempt to validate the air attack says:

That the bombing of Dresden was a great tragedy none can deny. That it was really a military necessity few, after reading this book, will believe. It was one of those terrible things that happen in wartime, brought about by an unfortunate combination of circumstances. (154)

By saying that, the army personal is marginalising the mass murder at the expense of vindicating their official stance. Their views are rather narrow-minded, cringed with patriotism failing to empathise with loss of lives on the other side of the enemy lines. Billy Pilgrim's narrative on the other hand depicts history of that experience that is unadulterated and unbiased. But his experience is rendered to almost muted condition and all he is able to utter about it is "I was there" which no one pays any heed to. In the first chapter, the narrator tells:

I happened to tell a University of Chicago professor at a cocktail party about the raid as I had seen it, about the book I would write. He was a member of a thing called The Committee on Social Thought. And he told me about the concentration camps, and about how the Germans had made soap and candles out of the fat dead Jews and so on.

All I could say was, "I know, I know, I know." (8-9)

Thus, whenever he begins telling his experience he is exasperated in his longing to make them understand. What Vonnegut tries to imply is that suffering of war transcends boundaries. Vonnegut uses extensively

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historical and official records and data of the raids into his novel. It incorporates President Truman's announcement about the exigency of the atom-bombing in Hiroshima. He justifies this as necessary action taken to save the civilization. Vonnegut seems to suggest that the United States attempts to convert the raid of Dresden into heroic magnitude. A retired brigadier of U. S. army named Bertram Rumfoord says that it is unnecessary for historians to include such an event in fear that it may tarnish the reputation of the air force of United States.

Apart from the fabrication, the official history gives regarding the event, the novel has mention of other events and personages that depict moments in American as well as world history. The novel ends with the narrator giving out the latest events occurring at that time- the casualties of Vietnam War, the assassination of Robert Kennedy, and the death of father and his war companion Edgar Derby. In describing these events we see Vonnegut goes on to intermingle both real and fictional characters' deaths. The dialogic discourse occurs between characters both real and fictional. The narrator talks with Harrison Starr about his writing a novel:

I said that to Harrison Starr, the movie-maker, one time, and he raised his eyebrows and inquired, 'Is it an anti-war book?' 'Yes,' I said. 'I guess.' 'You know what I say to people when I hear they're writing anti-war books?' 'No. What do you say, Harrison Starr?' 'I say, "Why don't you write an anti-glacier book instead?'" What he meant, of course, was that there would always be wars that they were as easy to stop as glaciers. I believe that too. (3)

Again, we see that Weary has a photograph of a woman and a pony claimed to be world's first dirty photograph, which was clicked by none other than Louis J M. Daguerre and was sold by his assistant Andre Le Fevre. In most cases he offers historical materials to prove his case. When referring to his taking up of optometry, he gives a review of an optometry journal. He refers to Seymour Lawrence, Vonnegut's publisher leading into almost blurring out of history and fiction. There is mention of Billy being selected as the president of the Lion's Club, a famous and actual club having a fictional president. In chapter five of the novel, when Billy and Valencia goes for honeymoon, Billy sees Lance Rumfoord, nephew of another fictional character Bertram Rumfoord, official historian of the United States Air Force. Lance has also come for honeymooning with his bride, Cynthia Landry. Billy says that she was the "childhood sweetheart" (99) of J.F. Kennedy, which points to the interweaving of historical figures with fictional ones. In an interview with Lee Roloff, Kurt Vonnegut explains that he has modeled the character of Billy Pilgrim on a person he knew from war, "gawky guy with very narrow shoulders who should never have been in the army. His name was Edward Crone. He should never have been a soldier. He didn't look like a soldier, in fact he looked like a filthy flamingo" (86). Again, while the narrator makes a promise to Mary O'Hare that this novel will not project war as something dignifying and glamorous where roles will be played by none other than "Frank Sinatra and John Wayne or some of those other glamorous war-loving, dirty old men" (12), it is in fact played by "foolish virgins" (12) and "*babies"* (12).

The story depicts through bits and pieces the social, political and economic circumstances of America of the 1960s. The political unrest that besets America during the cumulative years of Vietnam War is witnessed in Billy's description of his surrounding milieu. In chapter three of *Slaughterhouse-Five*, Billy is seen driving when he abruptly stops at the sign, "Blood Brother" (49) in front of a black ghetto. The narrator says, "The neighborhood reminded Billy of some of the towns he had seen in the war" (48). He is unmoved by the ongoing protest against the bombing of North Vietnam. The riots, protests reflect the escalating fear, disgust, and tension among Americans. The American dream also resonates in the story when we see Billy living a lavish life, becoming an optometrist, having a family, a nice house, and everything that is the *sine qua non* of this ubiquitous dream. Nevertheless, there are loopholes in this dream, as seen in the case of Billy's wife, Valencia. She constantly vows to lose weight but instead ends up eating huge numbers of candy bars. His son joins the Green Berets but before that he went to jail. As a member of the Green Berets he goes to Vietnam. These events described here are the general and prominent things that happened in most of the American family at that juncture. There are mention of the Great Depression and characterizes Valencia as every American ensnared in the world of consumerism and capitalism, "like so many Americans, she was trying to construct a life that made sense from things she found in gift shops" (31). Vonnegut highlights certain notion of American cultural history, Philip Watts points it towards "the epic war movie" ("Rewriting History", 39). The narrator dismisses this cultural phenomenon by saying that there will not be any part for the famous movie stars that transform war into an amusing re-creational spectacle.

Vonnegut refers to many texts and alludes to biblical myths in the process of reconstructing the historic events. To complicate the case further the novel injects the Tralfamadorian philosophy by which every human value system is to be scrutinized. Throughout the novel he cites texts both real and fictional and in some occasions he

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brings in characters from his other novels too. Howard W. Campbell, Jr appears in here as well as in his another novel, *Mother Night* where he is imprisoned in the cell near another prominent historical figure, Adolf Eichmann. Likewise, Eliot Rosewater also appears in another named, *God bless you, Mr. Rosewater.* He inserts limericks, long passages from Charles Mackay's *Extraordinary Popular Delusions and the Madness of Crowds*. Quotations of Horace and Roethke, lines from Erika Ostrovsky's *Celine and his Vision* are taken up too. In making a case for his novel he alludes to the biblical story of Sodom and relates it to his own predicament as a writer, as a person who has to "look back" (18) to the unimaginable events of history. He alludes to the children's crusade of 1213 and speaks of the Bible and hymns in order to place humanity and morality against the atrocities of human.

Together with all the referential statements and allusion, the novel marks toward a postmodern discourse on the history and reality. Even if reality is what we perceive, Vonnegut constantly changes the standpoint of our perception. Novel that rewrites war history through fictionalisation, Vonnegut adds a new consciousness, a prism to look and analyse history that commonly passes as the 'standard' history.

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DISCIPLINARY POWER IN LIGHT OF FOUCAULT AND KAUTILYA: A PHILOSOPHICAL APPRAISAL

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ABSTRACT
In our political life, the concept of 'power' is not a recent debate, but current discussions and arguments call us for a serious discussion to analyse the concept of power as it has become an import concept not only in the academic discussion but also our very day to day social life. In the ancient time, particularly in India, Kautilya discussed the significance of 'power' and how it is important to govern the state systematically. What is power and how it should be operated were the important questions for him. However, the recent debate on power inquires how to characterize power and how we can study it. Though power is often considered as the ability to influence or control the behaviour of people, the recent discussions open up its new dimensions and aspects. To put it another way, much of the recent debate considers power is intertwined with social life as it is inseparable from our political life, especially after Michel Foucault's conceptualization of power. According to him, power can be found anywhere in the society and we must pay attention to its invisible nature. In short, these debates ensure that power has become an important concept in our day to day social life which we must analyse. This paper exhibits a comparative analysis of Michel Foucault's concept of "Panopticon" and Kautalya's concept of 'demonstrating omniscience'. My objectives are, therefore, to handle issues such as the nature of power, its exercises and the relation between power and the subject. Moreover, unlike traditional understanding of power, I will argue power is not essentially repressive but it has productive nature too. To put it plainly, by analysing all these questions, I hope, I can give a better understanding of the 'concept of power'.

Keywords: power, subject, discipline, Panopticon, productive, repressive

INTRODUCTION

This paper presents a comparative analysis of Michel Foucault's concept of 'Panopticon' and Kauṭilya's concept of 'demonstrating omniscience'. In the course of my argument, I shall analysis how power works in its most effective form. Furthermore, I shall try to show, power is more effective when it is less accessible to observation and we need to pay attention to understand it. The view I shall defend or suggest is, power is more effective when it is strategic and tactical rather than compelling forces 'on the physical body'. To put it another way, I shall argue, power should be considered as a technique or strategy which disciplines the human psyche rather than gripping forces 'on the physical body'. Thus, I claim, the operation of power is more effective when disciplining the psyche than coercion on the body, which requires a psychological approach.

This paper handles a number of issues such as the nature of power and its exercises, disciplining the subject[i] etc. Furthermore, I shall suggest that power is an effective tool in order to discipline the subject in a way in which it is not necessarily always negative or suppressive rather, has a productive nature. How power exercise is the task of my paper where I argue that disciplining the psyche or internal coercion without exerting any physical power is the best effective exercise of power. My approach will be to outline and discuss both of the thinkers view not only in terms of nature and exercise of power but also in the way how a subject is disciplined psychologically. In addition, I shall show the main similarities and differences of both views and find out the scope and limits of them. In this conceptual analysis, I will try to examine why power is a major tool in order to govern the state as well as any institution systematically. Moreover, I discuss, by disciplining the subject, how power becomes 'effective operation of power'. In short, how power works in the social life and how these thinker's ideas give a better perspective on the 'concept of power' will be the focus of my paper.

1. Section A: Kautilya's concept of power

In chapter XI of *The Arthashastra*, Kautilya discusses 'Demonstrating Omniscience' which comes under the broad spectrum of psychological warfare where he talks about a method of eliciting obedience from his subjects through a psychological approach. This is a very tactful method where it guarantees the allegiance of subjects in a better way. 'Demonstrating Omniscience', the method, he discusses, is not just eliciting obedience or guarantees the allegiance of his subjects, but it disciplines, trains and supervises subjects. To put it another way, it assures the connection between subjects and king in a more subtle and strong way in which the king's presence is always accessible to the subjects and vice versa. It not only explains the relationship between king and subject but also examines how it helps to govern the state appropriately.

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Kautilya describes, 'Demonstrating Omniscience', the method, is all about how power should work in a state systematically. He claims that power is an effective tool or strategy which enables the king to cultivate as well as maintain the state and the life of the subjects. According to Kautilya, the king's power should exercise very effectively and appropriately in his state so that he can assure proper governance of the state and better life of the subject[ii]. It is not about whether the king has the capacity to hold power, but how it exercises effectively is the crucial issue for Kautilya. Kautilya states, if the power does not work effectively, the king's government does not function systematically thereby he no more able to handle or maintain his subject's life properly.

According to Kautilya, power with subtler tactics which is strategically implied is the best way of exercising power. In other words, King should use a psychological approach, that is, he should make an impression among the subjects that he knows everything, that his presence is pervasive. To put it another way, subjects should be made aware that the king is omniscient, that they are constantly being watched by him. To this effect, the king would project that he is being well informed and well aware of his subjects and their life. The King shall demonstrate his pervasive knowledge and power in many ways[iii]. He must accomplish his pervasive knowledge and presence with the help of spies secretly appointed by him[iv]. They could be saints, soothsayers and even homemakers so that information about every part and aspect of the life of the subjects can be known. They are spread in all departments across the country to accomplish the king's authority; therefore, the subjects think that king is well aware of his subjects. Spies collect all the information about the subject's life which not only includes their domestic affairs and secret activities but also their wants and needs. On the basis of the report given by spies, the king obtains a vast amount of knowledge regarding the subject's life, which helps him in governing the state. Subjects think that they are being watched by the king through spies, consequently, psychologically become disciplined. Even though the king does not have a direct connection with the subject, through spices he governs the subject's life. In short, through 'Demonstrating Omniscience' subtle yet strong connection constructs between them.

When King projects his pervasive knowledge like this, his power would spread throughout the state. As the king's presence can be felt in all his subjects, his power achieves omnipresence nature. As power is pervasive it can touch every part and aspect of the subject's life, therefore, the king will have insidious yet powerful control over his subject. The homework implemented by spies in the background ensures the king's power as omniscience as well as omnipresence. Kautilya claims when power develops into omnipresence, it exercises effectively, therefore, it becomes at its best. As power turns out to be pervasive, the king can control subject properly; he not only controls them but also trains, disciplines and supervises them a good citizen. In addition, subjects would be intimidated to plot against him because they tend to believe that they are constantly being watched. To put it plainly, through 'Demonstrating Omniscience', the governance of the state functions systematically.

2. Section B: Michel Foucault's concept of Power

In the same way, Michel Foucault argues that 'Panopticon'[v] is the best way of exercising power. 'It is a design of a circular prison conceived by the eighteenth-century utilitarian Jeremy Bentham: the design consisted of tiered ranks of cells, which could all be surveyed by a single warder/ guard positioned at the Centre of the circle.' (Barry, P. (2002), p.176) According to his design, it is a cylindrical building prison with cells arranged around an advantageous vantage point positioned at the centre (a tower), where a single watchman/guard can observe all the prisoners all times. The guard is unseen by the prisoners and inmates/prisoners are invisible to one another, but all are all visible to the guard in the centre of the building. Guards, however, will not always be observing each prisoner, but inmates are not sure whether they are being watched at any time. Hence, prisoners tend to believe that they are being observed constantly by the guard; therefore, they must always act in accordance with the rules. However, they believe that they are under constant observation, as the guard located at the centre cannot be seen by them. Therefore, the prisoners can be effectively controlled and their behaviour can be modified. The whole mechanism works as a disciplined form of power that is constantly, unnoticeable and pervasive in the prison. As prisoners think they are under surveillance, power works as an internal coercion without exerting any physical forces. The fear of being caught breaking the rules keep the prisoners following the rules, but this control is thus achieved through an internalised self-surveillance[vi].

As a metaphor, the Panopticon is the best way of the function of power which is the psychological approach for disciplining and supervising of subjects. Placing the subject in a state of constant visibility increases subordination of the subject and guarantees function of power. It not only maximise the efficiency of the institution but also increases the docility and the utility of all elements of the system. Foucault says the disciplinary power used in the prison can be found in places such as schools, hospitals etc. In other words, wherever any "population" that needs to be kept under observation or control, 'Panoptic design' can be used.

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This is a very useful technique in order to assure the ordering of subjects, which operate invisibly on the human psyche or their action. The Panopticon is a technique or a symbol of the disciplinary society which demonstrates constant surveillance not only on an individual in an institution such as prisons but also on society as a whole.[vii] In short, Foucault argues, it is not just a model for institutions, but its mechanism can be applied to society at large.

3. Section C: Comparison of both views

According to both views, power is a tactical tool to discipline the subject and guarantees the allegiance of the subjects in a better way. Direct coercion is no more part of the exercise of power as the physical body is not the application of power but the 'psyche'. A psychological approach is used because power focuses on the subject's behaviour and actions rather than the physical body. Even though, the exercise of power is entirely different 'on the body 'and 'on psyche', both views agree that power works effectively on the psyche than the body. In short, both views assert, power on psyche controls or instructions the subject, thereby, (s) he can be trained, transformed and improved.

There are certain reasons why 'power on psyche' is better than 'power on the body'. The exercise of Power on the body is always visible and overt, therefore, easily recognizable. 'Power on the body' is exercised directly in which king's[viii] presence is necessary. Furthermore, as the body is a visible and material thing, coercion or torture on the body becomes the focus of power[ix]. It is not an effective form of power because power itself in such an act is more violent and the allegiance of subjects is, therefore, difficult. In such a form of power, physical pain is evident and domination would be in its worst form, and the subject feels that they are stifled by the king. It is also possible that the subject can revolt against the king's authority, saying that the king's very act is an injustice. As the king directly involved in the power relation, the subject may doubt their trust in the authority of the king. 'Power on the body' as an effective form of power is difficult to exercise as the king never has access to all subjects. Even though the king gets access to certain subjects directly, in order to exercise such type of operation of power, certain place and time are required as the body is visible and material, which is in practice very arduous. Hence, as an effective operation of power, 'power on the body' is practically onerous and it debilitates the proficiency of the subject as well as weakening the king's governance capacity. Therefore, it is difficult to discipline the subject by compelling forces on the body and make them an effective citizen. In short, even though, the 'power on the body' is a direct operation, it is less effective and more pathological in form.

'Power on the psyche' is quite different and efficient from 'power on the body' because instead of inflicting a painful coercion, it becomes possible to supervise and investigate the subject. 'Power on psyche' is not directly exercising power in the way 'power on the body' does, rather, it is more invisible and indirect. The modality of control implies uninterrupted, constant coercion on the psyche, which is exercised according to constant watching or surveillance. As a result, power works on the subject's behaviour and action. There is no direct involvement of the king's authority, but power considered as an invisible force which indirectly controls the subject's action and behaviour. In this way, power reaches the least observable level and can touch very bottom of the subject's life. It is the psychological technique which disciplining the subject by 'internal coercion' without any physical torture. As the king's authority is invisible, the subject cannot revolt against him directly, therefore, it does not need any direct connection between king and subject. Moreover, disciplining psyche does not need any particular place and time because codification of power works on an invisible and immaterial thing called 'psyche' which does not require any direct, evident, involvement. Therefore, 'power on the psyche' is an effective form of power which in social life is more useful and practical.

It is also evident fact that, according to both views, power is not suppressed but productive. Power normally equates with domination and suppressive in nature. It is considered something always negative and repressive. However, as per Foucault and Kautilya, power is an effective tool or strategy can be used in many senses. Kautilya affirms in order to function the state systematically power should operate in its effective form, whereas Foucault argues disciplinary power increases the docility and utility in any institution. The best advantage of Disciplinary power[x] (power on psyche) is that it is no more concern with the threat of violence or physical torture. As subjects accept willingly rules and regulation without any compulsive domination from outside, physical pain can be avoided. Therefore, the subject allows power spontaneously upon him and assumes responsibility for the constraints of power. In this way, power can train, transform, and improve the subject. Moreover, as subject inscribes in himself the power relation, he thinks power works on him in order to improve or supervise him. As a result, docility and utility increase, which ensure productive results[xi]. The disciplined subject is efficient and trained who can utilize his own ability at maximum which enables him to be productive. Another advantage is that subjects become the object of information than the subject of manipulation and dominance. The subject is revealed new possibilities of knowledge with great beneficent results. For example,

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when the king's power is omnipresent, he acquires not only the subject's domestic affairs and secret activities but also their wants and needs which are very useful in order to govern the state. Similarly, when the culprits are kept in the Panopticon jail, it is possible to reform and supervise them. It is also possible to investigate them and inquire why such crimes are occurring and what the motives behind it are. In short, disciplinary power makes the subject more capable and efficient with new potential outcomes of information.

It is also noted that disciplinary power increases the efficiency of the institution or help to govern the state systematically. Furthermore, it guarantees that there is no longer any need for an "active agent" to display a more overtly coercive power. This suggests that disciplinary power assures the function of power appropriately, even when there is no one actually asserting it. In other words, even though the king does not have direct access to the subject or he has not directly involved people's state of affairs, the king is able to maintain and cultivate the subject's life. In the same way, there is no need for guard's constant watching on prisoners. As the subject is placed in a state of constant visibility, their behaviour can be modified as they must always act in accordance with the rules. These tactics aim to increase the docility and utility which enhance the utility of power. It is in this respect disciplinary power functions automatically.

According to both views, disciplinary power is the effective form of power in which power exercises at its best and maximum[xii]. It exercises at its minimal conceivable cost economically as well as politically. Economically, discipline power involves low expenditure because subjects disciplined particularly by rules and regulations which internalised in them. It is the rules and regulations which, accompanied by the belief that they are under constant surveillance, make them disciplined which does not require expensive economical expenditure. Politically speaking, disciplinary power works as internal coercion which is psychologically inbuilt in the psyche, operates with a low exteriorization. By its discretion, invisible, however, with subtle tactics, power arouses little resistance from subjects. Therefore, strategic yet the psychological nature of disciplinary power works adequately with beneficial outcomes.

4. Section D: Contrast and criticism of two views

Even though Kautilya and Foucault share a similar perspective on power, we could find a few contrasts. Kautilya's approach characterizes power from the perspective of a king who is not an imaginary figure but a reality; whereas Foucault takes Panopticon as an ideal form where 'centralised power'[xiii] is imaginary. Foucault concentrates the diffused nature of power and its exercises where power is an abstract force subordinate to the subjects while dispensing with the need for a king or centralised power. As per Kautilya, even though power is spread throughout the society, it has a centre which aims at the authority of a king who establishes his power on the subject's behaviour without difficulty.

The King accomplishes power as an omnipresent nature through the medium of spies whereas for Foucault there is no mediator, but it is the internalised rules and regulations which discipline the subjects. Kautilya thought that the systematic function of a state, the king is essential and his relationship with the subject would be straightforward and genuine[xiv]. Foucault emphasises what are the strategy and techniques used for disciplinary power in light of the fact that for him it is the exercise of power which is more important.

Despite their contrast, these two views give an incredible understanding of power. However, a few disadvantages can be noted. Whenever rules and regulations naturalize in the psyche of the subjects they become less willing to contest unjust laws. They are no longer able to question whether these mechanisms are needed to be refined or accelerated. On the other hand, they become increasingly redundant; in fact, they follow the authorities even though violence happens to them. The psychological approach constructs a comprehensive set of normative beliefs deliberately among the subject which can make a false reality. This may lead to the hegemony of the king and the exploitation of the subjects. In short, internalizing rules may direct to oppression and exploitation of the subject which is, in fact, can be the strategy of the king primarily for wealth and power. If the mind of the subjects can be controlled, it is feasible for the king to keep away from any potential revolution against him. Consequently, it turns out to be considerably simpler for the king to rule as he could submissive citizens, despite the fact that he is not legitimately dealing with the state.

Similarly, Foucault's Panopticon which focuses surveillance into ever more private aspects of subject's lives brings up the issue of what is the status of resistance and freedom of subjects. It appears that the subject's agency is in question as they may be alienated from their own self or subjectivity. It is also possible that their actions and experiences get meaning and significance according to the rules and regulations. Moreover, the subject's psyche is constructed by the power which is, in fact, may conflict with his/her own nature. It posits the question that whether the subject truly has an agency or not. In addition, power with these respects, have a tendency to normalise human subject in which the subjectivity of a person turns into a social construction by

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which any innate human nature does not have proper functionality. In addition, when power accomplishes inescapable nature, it may prompt determinism by which the subject's own nature, freedom, and resistance are subjugated and consequently they may end up plainly oppressed.

5. Concluding remarks

Unlike the traditional understanding of power, as per the two views, power is not essentially suppressive or negative, but it has a productive nature. It is not necessary to think about power always in terms of domination and violence. Power works effectively when it is more strategical and subtle. Therefore, we have to think about power broadly and consider its invisible functions. Generally, Power is always thought of as a capacity of a particular person or possession of somebody(for instance, state). However, power is not necessarily concentrated in a person, or institution or state, rather it can be seen everywhere in the society. Moreover, it is also important that how significant power is in our day to day life not only in terms of states and other institutions administrations but also constructing our views in the discourse of moral, political, cultural and scientific etc. in which we normally constitute what we are. In short, power becomes an important concept as it intertwines in our life, therefore, its mechanism must be analysed.

Endnotes

[i] ’In the happiness of his subjects lies his happiness; in their welfare his welfare; whatever pleases himself he shall not consider as good, but whatever pleases his subjects he shall consider as good’. (Kautilya and L. N. Rangarajan, 1992, p. 52.)

[ii] Kautilya insists the king must perform his duties. As he says ‘’In the happiness of his subjects lies his happiness; in their welfare his welfare; whatever pleases himself he shall not consider as good, but whatever pleases his subjects he shall consider as good. Hence the king shall ever be active and discharge his duties; the root of wealth is activity, and of evil its reverse’’. (Kautilya and L. N. Rangarajan., 1992, P. 52)

[iii] ‘’The conqueror shall demonstrate his pervasive knowledge by: {i) letting his chiefs know that he is aware of their domestic affairs and secret activities [having found out about them through secret agents]; (ii) unmasking traitors, having first found them out through secret agents employed for that purpose; (iii) revealing that someone was about to make a request for a favour having ascertained that through unnoticed contacts, prior knowledge or signals; and (iv) revealing knowledge about foreign countries before it becomes public, having got [from agents] a secret sealed communication through homing pigeons. {13.1.2} [The conqueror shall make gullible people believe that he is in direct contact with gods by various tricks.’’ (Kautilya and L. N. Rangarajan, 1992, p. 729-730)

[iv] ‘’Assisted by the council of his ministers tried under espionage, the king shall proceed to create spies: --Spies under the guise of a fraudulent disciple (*kápatikachhátra*), a recluse (*udásthita*), a householder (*grihapaitika*), a merchant (*vaidehaka*), an ascetic practising austerities (*tápasa*), a class-mate or a colleague (*satri*), a fire-brand (*tíkshna*), a poisoner (*rasada*), and a mendicant woman (*bhikshuki*)’’.(Kautilya and L. N. Rangarajan,1992,p. 23-24)

[v] ‘A circular prison with cells arranged around a central well, from which prisoners could at all times, be observed’. (Stevenson, Angus, and Maurice Waite, 2011.p.1035*)* .The name is also a reference to ‘Panoptes’from Greek mythology; he was a giant with a hundred eyes and thus was known to be a very effective watchman. (Mays, G. Larry, 2014, p. 44)

[vi] "He who is subjected to a field of visibility, and who knows it, assumes responsibility for the constraints of power; he makes them play spontaneously upon himself; he inscribes in himself the power relation in which he simultaneously plays both roles; he becomes the principle of his own subjection" (Foucault, Michel, 2009,p.202-203)

[vii] "The Panopticon... must be understood as a generalizable model of functioning; a way of defining power relations in terms of the everyday life of men... Bentham presents it as a particular institution, closed in upon itself... But the Panopticon ... is the diagram of a mechanism of power reduced to its ideal form; its functioning, abstracted from any obstacle, resistance or friction, must be represented as a pure architectural and optical system; it is in fact a figure of political technology that may and must be detached from any specific use." (Foucault, Michel, 2009.p. 205)

[viii] In the case of prison, the guard’s presence is necessary.

[ix] It is noted that in old days (even today, for example, in legal and criminal discourse) ‘power on body’ is an acceptable exercise. For instance, in order to punish culprit, the King executes public torture, public execution, and corporal punishment to establish how powerful he is. These all acts come under the category of ‘power on body’ where physical force, dominance and pain are evident

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[x] From here onwards instead of 'power on psyche', I use the word 'disciplinary power 'which is the term coined by Michel Foucault. Even though Kautilya did not use such a word, I would like to claim that his notion of power is disciplinary in nature.

[xi] "If the inmates are convicts, there is no danger of a plot, an attempt at collective escape, the planning of new crimes for the future, bad reciprocal influences; if they are patients, there is no danger of contagion; if they are madmen there is no risk of their committing violence upon one another; if they are schoolchildren, there is no copying, no noise, no chatter, no waste of time; if they are workers, there are no disorders, no theft, no coalitions, none of those distractions that slow down the rate of work, make it less perfect or cause accidents".(Foucault, Michel, 2009.p.202)

[xii] "[The] peculiarity of the disciplines [elements of Panopticism] is that they try to define in relation to the multiplicities a tactics of power that fulfils three criteria: firstly, to obtain the exercise of power at the lowest possible cost (economically, by the low expenditure it involves; politically, by its discretion, its low exteriorization, its relative invisibility, the little resistance it arouses); secondly, to bring the effects of this social power to their maximum intensity and to extend them as far as possible, without either failure or interval; thirdly, to link this 'economic' growth of power with the output of the apparatuses (educational, military, industrial or medical) within which it is exercised; in short, to increase both the docility and the utility of all elements of the system"(Foucault, Michel, 2009.p.202)

[xiii] Even though Foucault talks about guard who watches the prisoners as a centralised form of power, for him Panopticon is a metaphor or ideal form. When we apply Panopticon technique in real life, there is really none who watches subject. It is the rules and regulations which work as a surveillance. When rules and regulations are internalised, subject tend to believe that they are under power. That is why Foucault compares jails, schools, and factories in terms of disciplinary power with their similarities.

[xiv] 'In the happiness of his subjects lies his happiness; in their welfare his welfare; whatever pleases himself he shall not consider as good, but whatever pleases his subjects he shall consider as good'. (Kautilya and L. N. Rangarajan, 1992. P. 52)

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