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An Efficient Parallel Binary Image Thinning Algorithm

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ABSTRACT

Thinning plays very vital role in image processing applications. Thinning basically reduce a thick digital object into a thin skeleton. In this paper we propose a new parallel image thinning algorithm for binary image thinning. The proposed algorithm is efficient enough to produce one pixel width skeleton for all kind of image structures with on loss of connectivity and no extra pixels.

Keywords: Binary image, Thinning, Skeleton, Connectivity, Junction point, Medial line approximation

I INTRODUCTION

Thinning is the process of alteration of digital images into a simplified version of topologically equivalent image. It is very much

useful in solving different image processing related problems such as matching, recognition in different types of image analysis. Thinning is shown in Fig 1.

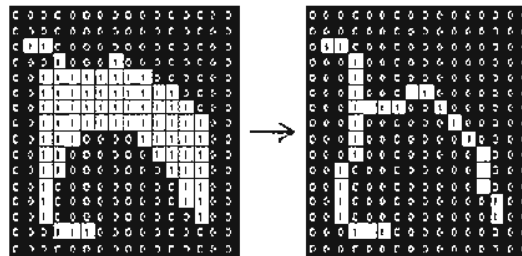


Fig 1: Image Thinning

Image thinning algorithms can be classified as shown in Fig 2.

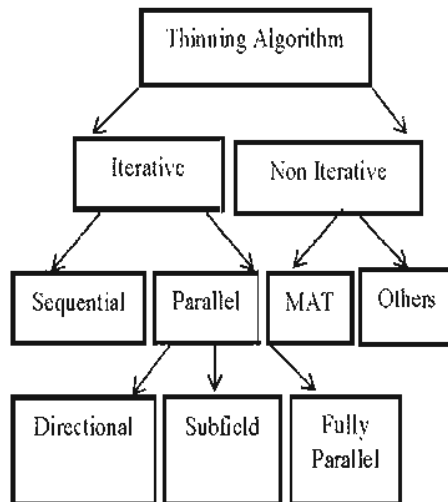


Fig 2: Classification of image thinning algorithms

Iterative thinning algorithms remove pixels iteratively with the analogous conditions for every iteration until pertinent skeleton is found.

Sequential algorithms examine the pixels in a fixed sequence in every iteration for deletion, and the deletion of a point in the $(n+1)^{th}$ iteration depends on all the operations that have been performed previously, i.e., on the outcome of the n^{th} iteration as well as on the pixels processed in the current iteration.

For parallel algorithm omission of pixels in the $(n+1)^{th}$ iteration would depend only on the result that leftovers after n^{th} iteration.

In directional approach iterations are divided into sub iterations which be governed by a single or combination of directions.

Subfield approach breaks down the picture into subfields based on some predefined conditions and pixels of same grounds are removed in parallel.

The same thinning operators (deletion criteria) are used for every iteration in the fully parallel approach.

Non iterative thinning algorithms do not examine discrete pixels one after another, but, they yield a median line or some centerline of the shape and then make a judgment whether to remove that exact boundary pixel or not. Skeleton is obtained in step by step computation.

The medial axis (MA) of a figure can be obtained as the locus of centers of all the maximal disks, inside the figure but not contained in any further disk.

A worthy thinning algorithm should own many properties. First, the algorithm should preserve the connectivity. Second, it should produce one pixel thinned skeleton. Third, it should preserve the topology of the object. Forth, the thinned should approximate the medial line. Fifth, excessive erosion must be disallowed and finally, the algorithm should be fast to produce the output image. These are the most basic requirements from any thinning algorithm.

II PRELIMINARY NOTATIONS

Let, I denotes a binary image which is represented by a matrix M , of size $R \times C$, where R denotes the row and C denotes the column. $M(i, j)$ represents the binary value of the pixel (i, j) . The pixel at position (i, j) is black if $M(i, j) = 1$ and it is white if $M(i, j) = 0$. The white pixels form the background of I , and the black pixels form the foreground.

In a 3×3 mask, the pivot pixel and its eight neighbors with corresponding coordinate position are shown in Fig 3 where, the center pixel Pic_1 is the pixel of interest and also called Pivot pixel.

Pic₉ (i-1, j-1)	Pic₂ (i-1, j)	Pic₃ (i-1, j+1)
Pic₈ (i, j-1)	Pic₁ (i, j)	Pic₄ (i, j+1)
Pic₇ (i+1, j-1)	Pic₆ (i+1, j)	Pic₅ (i+1, j+1)

Fig 3: 3x3 mask

In general any foreground pixel can fall into any four of the following category.

- (a) Junction pixel: a non-zero pixel for which the deletion would break the connectivity of the original pattern.
- (b) Edge pixel: also called boundary, or border pixel which is a non-zero pixel that has at least one zero 4-neighbor pixel (top, bottom, left and right pixels of the pivot pixel).
- (c) End pixel: this is a non-zero pixel that cannot have more than one non-zero neighbor pixel.
- (d) Simple pixel: This is an edge pixel whose removal from the object does not change the topology. We

say that an algorithm preserves the connectivity [8] of any binary image if and only if:

- (e) No object in I can be completely deleted by the algorithm in any iteration.
- (f) It does not connect any actually dis-joint objects in I , nor does it disconnect an existing hole or create any new hole in S .
- (g) It does not disconnect any object in I . And it does not connect any hole of I to another distinct hole or the background of I where a hole may be defined as a background region surrounded by a connected border of foreground pixels.

III RELATED WORK ON NON TEMPLATE BASED PEARALLEL THINNING ALGORITHM

In the past several decades several image thinning algorithm has been proposed. Some of them used some template for deletion. This section excludes those algorithms. Zhang and Suen in the year 1984 proposed an extremely popular thinning algorithm [1]. It works in two sub iterations. But, it is not able to yield correct thinned output for the two pixel width slant lines (in both left to right and right to left direction). And two pixel width squares are completely eliminated. Lu and Wang in the year 1985 projected another algorithm [2] which is the single point alteration of ZS algorithm. This algorithm keeps the two pixel width slant lines intact which was rub out by the ZS algorithm. Performance is same as ZS algorithm on other images. Holt, Stewart, Clint, and Perrott introduced a new thinning method [3] in 1987. There was only one iteration with no sub iteration. Their algorithm yields skeletons more or less same as that of ZS or LW algorithm but does not disturb connectivity. The negatives of this algorithm are diagonal lines are deleted and not able to create one pixel thin horizontal and vertical lines. Y.Y. Zhang and P.S.P. Whang offered a single pass thinning algorithm [4] in the year 1988 which remove completely the patterns which are removed by the ZS algorithm. Moreover two pixel width horizontal and vertical lines are also erased. Zichan Guo and

Richard W.Hall in 1989 proposed a two sub-iteration parallel thinning algorithm [5]. This algorithm is able to thin the two pixel width inclined lines (both left-to-right and right-to-left) into one pixel width inclined line, which was a major shortcoming of the earlier algorithms. It yields medial axis points for horizontal, vertical and diagonal lines. It also yields the results in smaller number of iterations but does not preserve the junction points and generates some extra points. Hilditch's algorithm [6] performs multiple passes on the pattern. This algorithm has the identical problem as ZS algorithm. A. Jagna and V. Kamakshiprasad, describes a parallel thinning algorithm for binary images [7] in 2010. The problems of ZS algorithm are still there in this algorithm. Lynda Ben Boudaoud, Abderrahmane Sider and Abdelkamel Tari proposed a Hybrid Thinning algorithm [8], a combination of directional and sub field approach. This algorithm keeps the topology, connectivity and end points of the original image in the modified thinned image and can yield one pixel thin image. But it has staircase effects in the output image and produces some extra pixels also.

IV PROPOSED THINNING ALGORITHM

In this section, we describe our proposed thinning algorithm. This is a parallel thinning algorithm which uses the 3x3mask shown in Fig 3 and also an extended mask shown in Fig 4.

Pic ₉	Pic ₂	Pic ₃	Pic ₄₃
Pic ₈	Pic ₁	Pic ₄	Pic ₄₄
Pic ₇	Pic ₆	Pic ₅	Pic ₅₄
Pic ₆₇	Pic ₆₆	Pic ₅₆	Pic ₅₅

Fig 4: Extended 4x4 mask used in proposed algorithm

The proposed thinning algorithm works on two phases. The first phase has two sub iterations. Phase 1 will continue iteratively until no more changes with respect to last iteration are determined. Phase 1 will produce either one pixel thin images with some redundant points in some cases or keep the input image intact. The aim of phase 2 is to delete the redundant points produced by phase 1 and make one pixel thin output when the phase 1 kept the input image intact.

The proposed algorithm requires the computation of the following parameters.

- (a) A = number of 0 to 1 transition in the ordered set (Pic₂, Pic₃, Pic₄, Pic₅, Pic₆, Pic₇, Pic₈, Pic₉, Pic₁).
- (b) B = number of non-zero neighbor in the 8 neighbors of pivot pixel p₁.

- (c) M₁ = (Pic₂ * Pic₄ * Pic₆) for first sub iteration and (Pic₂ * Pic₄ * Pic₈) for second sub iteration.
- (d) M₂ = (Pic₄ * Pic₆ * Pic₈) for first sub iteration and (Pic₂ * Pic₆ * Pic₈) for second sub iteration.
- (e) C = (~Pic₂ * (Pic₃ | Pic₄)) + (~Pic₄ * (Pic₅ | Pic₆)) + (~Pic₆ * (Pic₇ | Pic₈)) + (~Pic₈ * (Pic₉ | Pic₂)).
- (f) N₁ = (Pic₉ | Pic₂) + (Pic₃ | Pic₄) + (Pic₅ | Pic₆) + (Pic₇ | Pic₈)
- (g) N₂ = (Pic₂ | Pic₃) + (Pic₄ | Pic₅) + (Pic₆ | Pic₇) + (Pic₈ | Pic₉)
- (h) N = min(N₁, N₂)
- (i) M₃ = ((Pic₂ | Pic₃ | ~Pic₅) * Pic₄)

Here, “~” denotes NOT, “|” denotes bitwise OR and “*” denotes multiplication.

Algorithm:

Phase 1:

Scan each pixel from left to right and top to bottom

- **if** $(Pic_1 * Pic_4 * Pic_5 * Pic_6 = 1)$ **AND**
 $(Pic_2 | Pic_3 | Pic_7 | Pic_8 | Pic_9 = 0)$
then
- **if** $(Pic_{43} | Pic_{44} | Pic_{54} | Pic_{55} | Pic_{56} | Pic_{66} | Pic_{67} = 0)$
then
- Mark Pic_4, Pic_5 and Pic_6 deletable.
- **end if**
- **end if**
- **if** a). $(A = 1)$ **AND**
 b). $(B \geq 3 \text{ AND } B \leq 6)$ **AND**
 c). $(M_1 = 0)$ **AND**
 d). $(M_2 = 0)$
then
- Mark Pic_1 deletable.
- **end if**
- Delete all pixels marked as deletable.

Phase 2:

Scan each pixel from left to right and top to bottom

- **if** $(C = 1)$ **AND**
 $(N \geq 2 \text{ AND } N \leq 3)$ **AND**
 $(M_3 = 0)$
then
- Mark Pic_1 deletable.
- **end if**
- **if** $(Pic_4 | Pic_5 | Pic_6 = 0)$
then
- **if** $(Pic_1 * Pic_2 * Pic_3 * Pic_6 = 1)$ **OR**
 $(Pic_1 * Pic_8 * \sim Pic_9 = 1)$
then
- Mark Pic_1 deletable.
- **end if**
- **end if**
- **if** $(Pic_1 * Pic_4 = 1)$ **AND**
 $(Pic_2 | Pic_3 | Pic_5 | Pic_6 | Pic_7 | Pic_8 | Pic_9 = 0)$
then
- **if** $(Pic_{43} | Pic_{54} = 1)$
then
- Mark Pic_1 deletable.
- **end if**
- **end if**

V EXPERIMENTAL RESULT AND DISCUSSION

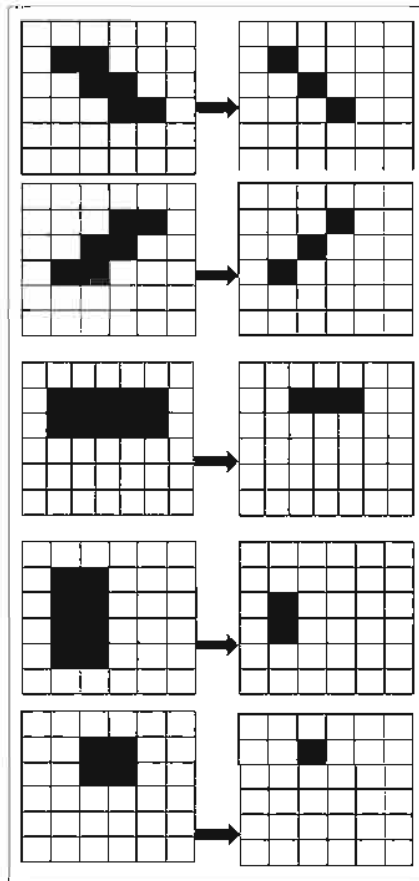


Fig 5: Thinning result of two pixel width images using the proposed algorithm

The programs are written in C++ using OpenCV 2.9 in Ubuntu 14.10. The proposed algorithm is tested on different kinds of images and we find our approach is robust and good enough to produce one pixel width skeleton. The proposed algorithm is tested on many different kinds of images but in this paper only a few of them are shown to demonstrate the performance of

this algorithm. Fig 5 shows the input image and corresponding output image produced by this algorithm for some of the two pixel width images where other algorithms have problems. Fig 6 shows the input image and corresponding output image produced by this algorithm for some other varieties of images.

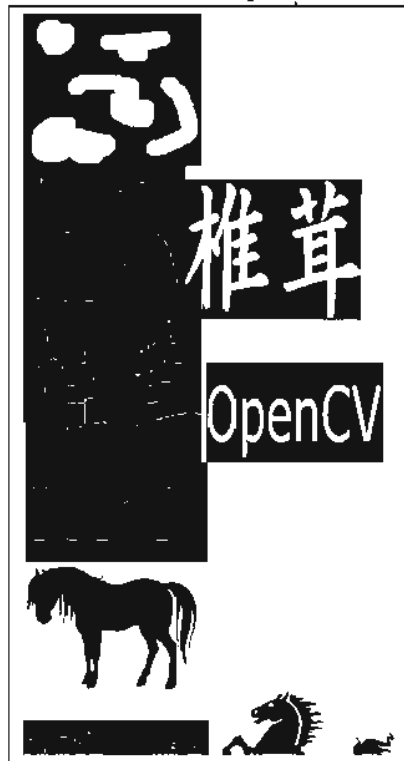


Fig 6: Thinning result of different images using the proposed algorithm

(a) Comparison result with other parallel algorithms

Our proposed algorithm is compared with other parallel algorithms: ZS algorithm [1], LW algorithm [2], HSCP algorithm [3], GH algorithm [5], Hilditch's algorithm [6], Jagna and Kamakshiprasad algorithm [7], Ben, Sider and Tari algorithm [8]. All of these algorithms are implemented using same platform using same language. Table 1 shows the comparison results. The parameters to measure the performance of the algorithm are represented by the number i to xi.

- (i) Connectivity
- (ii) Single pixel

- (iii) Medial line approximation
- (iv) Junction point elimination
- (v) Two pixel width slant line problem
- (vi) Two pixel width square problem
- (vii) Two pixel horizontal/ vertical line problem
- (viii) Unnecessary branches
- (ix) Coordinate position dependency
- (x) Redundant point
- (xi) Staircase effects

The algorithms are referred by their reference number in table 1. The proposed algorithm is referred as MS algorithm. “√” denotes yes.

Table 1
Comparison of other thinning algorithm with MS algorithm

	[1]	[2]	[3]	[5]	[6]	[7]	[8]	MS
i.	√	√				√	√	√
ii.				√			√	√
iii.	√	√		√	√	√	√	√
iv.				√	√		√	√
v.	√	√	√		√	√		
vi.	√	√			√	√		
vii.			√					
viii.							√	
ix.							√	
x.				√	√		√	
xi.				√	√		√	

VI CONCLUSION

This paper improves the performance of the existing iterative image thinning algorithms. The proposed algorithm performs very well in the extraction of skeleton with no diagonal line or square or horizontal /vertical line problem compared to previous thinning algorithms. The proposed thinning approach has a good potential to be used in different image processing applications to improve their performance. In future, we shall use this method as an important preprocessing step for thinning 2D image.

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Groundwater-Surface water Modeling: A Critical Review

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ABSTRACT

Surface water-Groundwater interaction is a complex process. Mathematical modelling is the emerging technique to understand the water head variation in the aquifer, flow of groundwater, recharge effect. This paper gives the critical review of this process. Many researchers developed mathematical model which simulates the flow of groundwater under different hydrological conditions. In this papers step by step overview of these models is presented. In addition to this the effect of recharge and discharge processes is also comprehensively outlined. The different methods for solving the partial differential equation are also pointed out. This article provides the overview of almost all mathematical models developed in this era. This overview concludes with a discussion of research needs and challenges facing this evolving field.

Keyword: Business Equation, Laplace Transform, Fourier Transform, Sloping Aquifer

I INTRODUCTION

Surface water groundwater are not separate entities but are the component of hydrological cycle. Groundwater bodies are often connected with surface water bodies and affect each other quantity and quality wise. In the past few decades, increased demand of water due to industrialization, population growth and excess withdrawal, has enable to think about the proper environmental management and aquifer recharge. Surface groundwater interaction plays an important role in catchment hydrology and base flow analysis. Hence prior knowledge of aquifer response to recharge and withdrawal is very important for planning and implementing the resource related project.

Mathematical modelling is the emerging tool for predicting water table behaviour in many complex geological situations. Many models were developed for water table fluctuation in aquifer but on restrictive assumptions that the aquifer base is horizontal (Moench and Barlow 2000). In a real-life aquifer base are often sloping and connected to each other with the leaky formation. Some of the publication adhere this topic of water table fluctuation in sloping aquifers but they are few. Moreover, effect of recharge and withdrawal on water table variation is not thoroughly studied by the researchers. It is important for any water managers all researchers to understand all facts of surface water groundwater mechanism.

The aim of this paper is to give systematic and critical review of the models developed for water table fluctuation when aquifer is lying on sloping base. The focus is on the estimation of water fluxes at the stream aquifer interaction. It is intended to provide overview of mathematical equations and boundary conditions used in the model based on sloping aquifers. The mathematical equation which

governed the water flow in horizontal and sloping aquifers are discussed.

II MATHEMATICAL FORMULATION OF GROUND WATER FLOW

Groundwater always moves from an area of higher hydraulic gradient to an area of lower hydraulic gradient. Hydraulic head is the driving force which helps groundwater to flow. Hydraulic gradient is approximately the slopes of water table in a simple unconfined water system. Water table contour lines essentially represent the water table elevation which is called hydraulic head as mentioned above. Water table contour lines, also known as equipotential lines, are used to determine the direction of water flow in the region.

Surface water is connected with ground in almost all types of geological formations. Hence the surface water bodies are part of groundwater flow system. Though the surface water is segregated from groundwater by an unsaturated region, percolation of surface water affects the quantity of groundwater. The exchange of these two water bodies through unsaturated zone affects both quantity and quality wise. The geological formations of rocks and aquifer are the major components affect the flow of surface-groundwater movement. Along this climate change, effects of precipitation and evaporation, removal of water, distribution of water are some of the important issue take in consideration while studying groundwater hydrology and hydro system.

The seepage flow in saturated subsurface zones is primarily governed by the principle of local hydraulic gradient, known as Darcy's law (Darcy, 1866). The law state that the rate at which the fluid flow in the permeable medium is directly proportional to the drop-in elevation, the cross-sectional area and inversely proportional to the distance between them.

Therefore, the total discharge ‘Q’ is given by the equation

$$Q = -KA \frac{\partial(h_1 - h_2)}{\partial t} \quad (1)$$

where K is proportionality constant, called hydraulic conductivity.

When the aquifer is isotropic, the hydraulic conductivity is same in all direction. So Darcy’s law can be expressed as,

$$q = -K \nabla h \quad (2)$$

where q is the Darcy’s velocity vector, K is hydraulic conductivity and ∇h is the gradient of hydraulic head. The basic equation of groundwater flow can be derived by applying the principle of mass conservation on a Representative Elementary Volume

(REV). The conservation of mass states that for a given increment of time, difference between the mass flowing across the boundaries, the mass flowing out across the boundaries and the sources within the volume is the change in storage. In other words

Mass inflow rate – Mass out flow rate = Change of mass storage with time

The equation thus obtain is

$$-\nabla \cdot (\rho q) = \frac{\partial}{\partial t} (n\rho) \quad (3)$$

In rectangular Cartesian coordinates, the flow equation is given by

$$\frac{\partial}{\partial x} \left(K_x \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(K_y \frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left(K_z \frac{\partial h}{\partial z} \right) = S \frac{\partial h}{\partial t} \quad (4)$$

Equation (4) is main equation of ground water flow in saturated media.

K_x , K_y and K_z are hydraulic conductivities along x-, y- and z-axes for anisotropic medium. It can be written in many forms that to apply different conditions, such as

a) Under steady-state-flow condition ($\partial h/\partial t = 0$) for anisotropic medium

$$\frac{\partial}{\partial x} \left(K_x \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(K_y \frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left(K_z \frac{\partial h}{\partial z} \right) = 0 \quad (5)$$

If the porous medium is isotropic ($K_x = K_y = K_z$) and homogeneous then the equation (5) is

$$\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial y^2} + \frac{\partial^2 h}{\partial z^2} = 0 \quad (6)$$

In this equation the hydraulic head is not transient and steady state condition is prevailing. Equation (6) is the known as the Laplace equation.

For isotropic and homogeneous medium, equation of groundwater flow can be written as

$$\frac{\partial}{\partial x} \left(\frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(\frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left(\frac{\partial h}{\partial z} \right) = \frac{S}{K} \frac{\partial h}{\partial t} \quad (7)$$

1) The flow equation with thickness of aquifer is ‘b’ is given by

$$\frac{\partial}{\partial x} \left(T_x \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(T_y \frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left(T_z \frac{\partial h}{\partial z} \right) = S \frac{\partial h}{\partial t} \quad (8)$$

Where $T_x = K_x \cdot b$, $T_y = K_y \cdot b$, $T_z = K_z \cdot b$

2) If the hydraulic head is constant in vertical direction, then the equation of flow in two dimensions is

$$\frac{\partial}{\partial x} \left(T_x \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(T_y \frac{\partial h}{\partial y} \right) = S \frac{\partial h}{\partial t} \quad (9)$$

III GROUND WATER FLOW EQUATION IN SLOPING AQUIFER

The nonlinear Boussinesq equation obtained by combining the Darcy's law with mass conservation principle has been the governing equation in many researches pertaining to subsurface seepage flow. Polubarinova-Kochina (1962), Jacob Bear (1972) presented an extensive analysis of subsurface seepage flow, addressing variety of fundamental issues of surface-groundwater interactions. In their research different modelling techniques is used along with the analytical and numerical solution under different boundary conditions. Wooding (1966) used the hodograph method to obtain the exact solution for groundwater flow over a sloping impermeable layer, the approximate solution so found using extended Dupuit-Forchheimer is in full agreement with exact results.

The landmark development in the contemporary literature was in 1971 when Child (1971) developed the mathematical approximation of groundwater flow over sloping impervious bed by using extended Dupuit-Forchheimer assumptions. Using conformal mapping, Wooding (1966) presented analytical solution of saturated seepage flow over sloping base. Later, several researchers used this approximation to analyse groundwater flow system under various conditions. A simplification of Child (1971) approximation was presented by Chapman (1980) who used a horizontal and vertical axes system to describe the groundwater flow. Along with Child Hunt (1971) presented an analytical solution for water table fluctuation in response to recharge from circular basin.

Chapman (1980) developed the above equation by considering assumptions as i) For small inclination of free surface stream lines are considering nearly horizontal ii) Hydraulic gradient is equal to slope of free surface and does not vary with the depth. The equation is as follows

$$\frac{\partial}{\partial x} \left(h \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(h \frac{\partial h}{\partial y} \right) - \tan \theta_x \frac{\partial h}{\partial x} - \tan \theta_y \frac{\partial h}{\partial y} + \frac{Q}{K} = \frac{S}{K} \frac{\partial h}{\partial t} \tag{10}$$

The above equation is second order non-linear differential equation, parabolic in nature often referred as Boussinesq equation. This equation is used when the subsurface drainage is over moderately sloping beds. If $\tan \theta_x$ and $\tan \theta_y$ are the downward bed slopes along the positive directions of x and y -axes, respectively.

Rao and Sharma (1981) have presented an analytical solution to describe water table fluctuation in finite aquifer system in response to recharge from a rectangular basin. Rai et al. (1994), Rai and Singh (1995) took an effort to develop analytical solutions by considering time dependent recharge rate. In these studies, the recharge rate is approximated by simple functions such as periodic and exponential functions. Manglik et al (1996) developed an analytical solution for water table variation in an unconfined aquifer induced by time varying recharge from a rectangular basin. Finite Fourier transform method is used to find the solution.

Koussiset al (1998) studied the subsurface drainage flow in a soil layer which is resting on sloping bed. The linearized one-dimensional Boussinesq equation is used as governing equation which is extended to allow the leakage through underlying base. Seepage on hill slope problem is further studied by Shukla et al (1999). In their study Boussinesq equation is solved for the drainage of sloping lands resting on impermeable layer.

Investigation related to hydraulic head and flow rate in a sloping aquifer, when the aquifer is in nearby contact bodies, have been done by many researchers such as Pinder and Sauer (1971), Zlotnik and Huang (1999), Verhoest and Troach (2000), Upadhyaya and Chauhan (2000,2002). Tartakovsky (2008) developed new model for falling water table between two drains laying on a horizontal and sloping impermeable barrier using finite difference scheme. Butler and Zlotnik (2001) presented a new solution for estimation of drawdown and stream depletion produced by pumping. Parlange et al (2001) suggested improvement in the solution of Boussinesq equation for a sudden drawdown in a saturated horizontal aquifer. Kim and Joon (2001) analyzed variation of a water table in a horizontal unconfined aquifer receiving uniform recharge mathematically by solving Boussinesq equation as a governing equation. Inclined ditch-drained aquifer by considering the temporally varying recharge rate is studied by Valentijn et al (2002) and introduced a solution of Boussinesq equation. The unique boundary condition like a steady state constant recharge rate is used as an initial condition. The solution is used for assessing the influence of a variety of hydrogeological factors on drawdown and stream depletion calculation and demonstrates the magnitude of error introduced by commonly used analytical methods.

IV ANALYTICAL MODELS

Many of the researchers used analytical method to solve groundwater flow equation.

Most of the governing equations are in the form of partial differential equations and can be solved analytically. The commonly used methods to solve PDE analytically are Laplace transform, Fourier Transforms, Melin Transforms etc. In case of nonlinear partial differential equation which does not admit the solution, Linearization is used.

It is worth mentioning that the work carried out by Aklyas and Koussis (2007) provides fundamental modelling tools for estimating surface-groundwater interaction induced by instantaneous stream-stage variation in the presence of bedslope and vertical sedimentary layer; however, the study does not shed any light on the flow mechanism when the rise and decline in the stream head is gradual. Indeed, the variations in stream stage because of rainfall and snow melt consist of a rising limb, peak point and recession limb which can be approximated by exponential decaying function (Teloglou and Bansal 2012; Bansal and Teloglou 2013). Simulation of stream stage using a sequence of piecewise linear segments of varying lengths and slopes is also possible. This technique was proposed by Manglik et al. (1997) for approximation of vertical recharge and subsequently used by Rai et al. (2006), Rai and Manglik (2012) and Manglik et al. (2013). However, use of exponential function in analytical modelling is more suitable for its mathematical simplicity and low computational cost. Mathematical modeling of surface Groundwater interaction over sloping Terrain. Lande et al (2013) used Laplace Transform technique to show the variation of water head in the aquifer, flow rate at the stream aquifer interface which is in contact with a constant Piezometric level at one end and a stream of time varying water level at other end. Later Bansal et al (2016) shows the Simulation of 2-d subsurface seepage flow in an anisotropic porous medium. In this study a new analytical solution to estimate the water table fluctuation in an anisotropic unconfined aquifer is developed. Parabolic non-linear Partial Differential Equation is solved using Fourier Transform Technique. The solution obtained in the study has ability to predict the recharged effect and it is seen in the form of water mound beneath the recharge basins and the cone of depression under the wells. Zlotnik and et al (2017) present an analytical expression for a transient and steady state groundwater mound in a sloping aquifer under MAR (Managed Aquifer Recharge) This studies consider general orientation of the recharge basins at arbitrary angle with x-axis. A technique is used developed for the orientation of the recharge source. Dupit-Forchheimer approximation and green's function method are used for finding the mound height. The solution reveals the effect of dip angle on the

elevation of mound. These findings help in determining proper rate of recharge and various MAR scenarios. Bhandari et al (2018) approximate the analytical solution obtained for stream-aquifer interaction assuming one-dimensional horizontal ground water flow in homogeneous and isotropic aquifer. Under the assumption of homogeneous and isotropic aquifer, the nonlinear Boussinesq equation with recharge is solved using variational homotopy perturbation method.

V NUMERICAL MODELS

One of the strong approaches of solving PDE are Numerical methods. Some commonly used numerical methods in the literature are Predictor corrector Method, Finite difference method, Finite element Method, Adomain decomposition, Perturbation method.

Kalaidzidou et al (1996) presented numerical solution using perturbation method. Jianping et al (2011) introduced a new analytical solution of linearized Boussinesq equation which describes groundwater table variation in a semi-infinite unconfined aquifer when the adjacent reservoir water drops down with a constant speed. The solution is verified by comparing it with a number of numerical solutions of the nonlinear Boussinesq equation.

Antangana and Botha (2012) used the homotopy decomposition method to solve the groundwater flow equations. Bansal et al (2013) used a fully explicit Predictor Corrector method to validate the efficiency of linearization. The results obtained shows the considerable changes in aquifer's water head profile mainly depends on the bed slopes, rise rate of the stream level and the recharge rate. Nania et al (2014) described the application of model for simulating dual drainage in urban areas. This model consists of four models which simulates rainfall runoff transformation, new evacuation by the inlets located in the streets, one dimensional flow routing on street network, flow interaction between surface water on the streets and underground stream water system. Later in 2015 Jiang and Tang (2015) proposed a general approximate method to predict the aquifer response subject to water level variations in a free water body. The proposed method decomposes the nonlinear PDE in to linear diffusion equation and two nonlinear correction functions. Solution is derived using general analytical method as well as adaptive - finite volume method. The analytical solution is applied to four different situations of water level i.e. constant, sudden rise/fall, linear and periodic change. Shaikh et al (2018) analyze the dynamic behaviour of tide induced water table variations in an unconfined aquifer system. Nonlinear Boussinesq equation is solved analytically to examine the effect of tidal oscillations on water table height. These equations are further linearized with a dynamic iterative scheme. The results can be used for

validation of numerical models and to understand complicated groundwater tidal wave interaction in complex hydro geographical coastal beaches.

VI CONCLUSION

Analytical modelling of subsurface seepage is an important aspect in groundwater hydrology as it provides useful insight into the groundwater flow mechanism. Mathematical models describing surface-groundwater interaction are gaining popularity due to their cost effectiveness and ability to handle varying hydrological conditions. In this review paper, we have started with the flow characteristic in horizontal aquifer. The study carried out by various researchers for horizontal aquifer is briefly presented. Furthermore, the flow equation on sloping aquifer is described and the essential tools to solve this equation are adequately discussed. A comprehensive survey of the relevant mathematical models for surface-groundwater interaction over sloping beds is presented in a chronological order.

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An Experimental Analysis: Thermal Performance of Underground Heat Exchanger System for Enhancing Comfort by Cooling & Heating During Winter & Summer Season

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ABSTRACT

Cooling the outdoor air through buried pipes by means of earth-air heat exchanger (EATHE) has been recognized from last 10 years have the capability for enhancing comfort of building and in the mean time decreasing demand of energy. This is due to one of the important thermal property of earth is that at the depth of about 1.5m to 2m, the temperature of ground remains almost similar all round the year. The temperature of earth interior remains higher than the surface temperature of earth in winter season and vice versa in summer. When atmospheric air is passed through buried pipe it comes in contact with soil temperature hence comes out from EATHE system having the temperature of soil is always constant. The conditioned air is allowed to enter into the room through outlet piping and duct system.

Key Words: Heat exchange, EATHE, Conditioned air, Earth temperature, Atmospheric Air.

I INTRODUCTION

Conservation of energy is one of the most significant global challenges now a day. The energy crisis of the mid 1970s dealt a harsh blow to developing and developed countries including India. The most energy beneficial outcomes of crisis are that it stimulated interest in the diversification of energy sources and renewable energy. Meanwhile, environmental concerns pushed this trend much further. In order to reduce greenhouse gas emission, which are considered to be cause of global warming and source of pollutions, the specific target is to reduce CO₂ emission.

Because of the high thermal inertia of the exterior climate are damped deeper in the ground. Further a delay arises between the temperature fluctuations within the ground and at the surface. Thus at a sufficient depth the soil temperature is lower than the outside air temperature in summer and higher in winter. When the fresh air is drawn through the earth tube heat exchanger the air is thus cooled in summer and heated in winter. In combine with another system and better thermal design of the building, the earth air heat exchanger can be used to preheat air in winter and avoid air conditioning units in building in summer, which result in a major reduction in electricity consumption of a building.

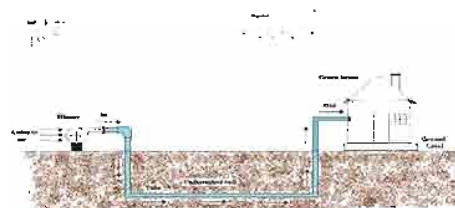


Fig.1 Systematic diagram of EATHE

II OBJECTIVE

The main objectives of the thesis are as follows:

- (a) To apply this technology suitable to Bhopal climate.
- (b) Finding out the variation in outlet air temperature with different velocity rate.
- (c) To develop a transient thermal network model for finding the transient temperature profile around an earth tube in order to determine the optimal depth of the earth air tube heat exchanger systems and the rapidly change of temperature of soil due to prolonged usage.
- (d) To perform an extensive literature review to identify the research and development status of

this technique and current guidelines for designing earth air tube heat exchanger system.

III DESIGN GUIDELINE OF EATHE

(a) Important Design Parameter:

- (i) Influence of the climate and soil composition
- (ii) Inlet air temperature varies with length of pipe
- (iii) Inlet air temperature varies with radius of pipe
- (iv) Inlet air temperature varies with depth of pipe
- (v) Inlet air temperature varies with air velocity inside pipe

(vi) Influence of the tube material

(b) Arrangement of EATHE:

(i) **Open loop type** -In open loop type system, ambient air delivered through tubes buried

in the ground for preheating or pre cooling and after that the heated or cooled air is entering the building. The inlet temperature changes as the outside temperature fluctuate.

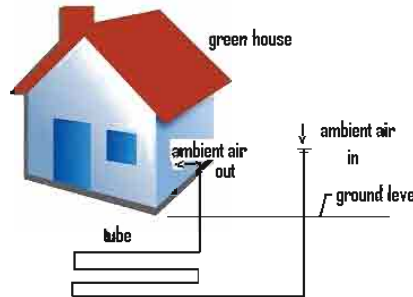


Fig. 2 open loop type EATHE

(ii) **Closed loop type**-In closed loop type systems, air delivered through tubes buried in the ground from inside the building for preheating or pre cooling purposes. Using a

closed loop effect in the best efficiency and reduces problem with humidity condensing inside the tubes.

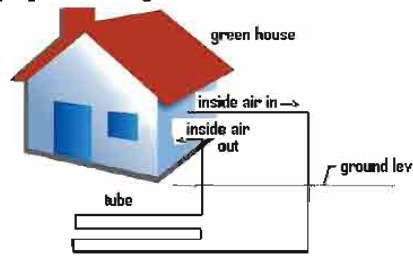


Fig. 3 Closed loop type EATHE

(iii) **Horizontal Closed loop type**- A horizontal closed loop placed a series which spread horizontally in the ground. A long horizontal Series heat exchanger, Parallel heat

exchanger, Trench heat exchanger and Slinky coil heat exchanger are placed horizontally inside the same trench.

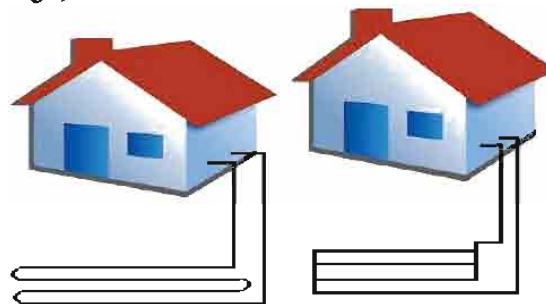


Fig. 4 Horizontal Closed loop type EATHE

(iv) **Vertical Closed loop type**-A vertical closed loop area is made up of pipes that run up and down in the ground. A long vertical Series

heat exchanger and Parallel heat exchanger are placed horizontally inside the same trench.

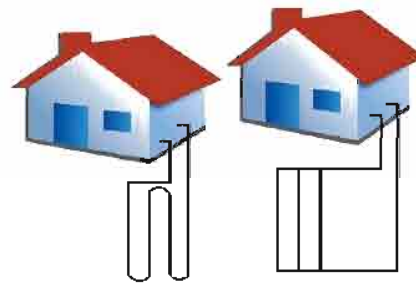


Fig. 5 Vertical Closed loop type EATHE

(v) **Experimental Set-up**-The installation of tube was done on an open field. The Soil at the site was tested and found to be sandy-silt (sand 47%, silt 42%, clay 13%). Wetness content at the time of dig was 12.43%.

Experimental set-up consists of an EATHE, fan house, temperature sensors and instruments.



Fig. 6 Air Outlet



Fig. 7 Air inlet



Fig. 8 Tube Placed Inside Earth



Fig. 9 Digital temperature Indicator



Fig. 10 Digital Vane type Anemometer



Fig. 11 Indoor/ Outdoor thermo/Hydro Clock Meter

(c) Fabrication:

(i) **Materials Used For Parts:** All the parts which are used in our Earth Air Tube Heat Exchanger system are made of mild steel.

There is one pipe of 8 inch diameter, four pipe of 6 inch diameter, one pipe of 3 inch diameter, one insulating pipe, seven bands and four flanges as shown in table.

**Table 1
Tube Details**

Components	Specification/Model	Units/mtrs/lit
6" pipe	M.S.	4
8" pipe	M.S.	1
3" pipe	M.S.	1
6" Elbow/Bend	M.S.	7
3" Elbow/Bend	M.S.	1
6×2.5" Reducer/Socket	M.S.	1
8×3" Reducer/Socket	M.S.	1
3×2.5" Reducer/Socket	M.S.	1
Nipple	G.I.	1

Plate (Flange)	M.S.	2
Plate (Flange)	M.S.	2
Nut and Bolt	M.S.	10
Drill Tool	H.S.S.	4
Paint	Black bituminous	10 lit.
Paint	White synthetic	1 lit.
Sand paper	100,80,60 no.	8 meter
Welding rod	-	270 nos.

(ii) Specification of Fabrication

Pipes:-

- 3 pipes for heat exchanging (6" or 152.4 mm)
 Inner diameter- 0.1554 m
 Outer diameter- 0.1584 m
 Length- 6 m
 Thickness- 3 mm
- 2 header pipe (8" or 203.2 mm.)
 Inner diameter- 0.2042 m
 Outer diameter- 0.2122 m
 Length- 3 m
 Thickness- 4 mm
- One insulation pipe (3" or 76.2 mm.)
 Inner diameter- 0.0762 m
 Outer diameter- 0.0822 m
 Length- 6 m
 Thickness- 3 mm
- Elbow/Bend
 Angle 90°
 Inner diameter- 0.1554 m
 Outer diameter- 0.1584 m
 Thickness- 3 mm

IV RESULT & DISCUSSION

The hourly variations of temperature for ambient air, greenhouse air once operating with earth air tube heat exchanger (EATHE) for typical summer day. It's seen that the lowest as well as peak temperatures for atmospheric air, greenhouse air with (EATHE) varied between 28.5–41.6, 28.2–46.3 and 28–44.3°C, respectively, confirming the considerable fluctuations of temperature within the greenhouse as compared to ambient air and greenhouse.

The temperature of ground on the above day at the depth (3 m) in which the EATHE system was installed was recorded to be about 20.6°C. By investigating closely the daily temperature profiles of greenhouse air, it was found that the delivery temperatures of EATHE were 7.5–16.2°C lower than the suction temperatures from 10:00 a.m. to 5:00 p.m. As a result of which, the temperatures of greenhouse air were maintained in the range of 28–30.9°C for providing healthy environment human comfort during summer period. The predicted values of greenhouse air have been validated with the experimental values for the above typical day and that showed fair agreement. After knowing the suction and delivery temperatures of EATHE as well

as the mass flow rate of the circulating air in the buried pipes, variation of cooling potentials offered by the system were also calculated. The curve in the figure represents cooling potentials obtained from EATHE. Further, the time periods above and below that line indicate the cooling potentials during a summer day.

Similarly the hourly variations of temperature for ambient air, greenhouse air with EATHE for a typical summer day have been depicted. The cooling potential obtained from EATHE. However, overall temperatures of greenhouse air were dropped by 8–12 °C than greenhouse with EATHE during daytime for cooling in summer period. The experimental and analytical value of the air temperatures in greenhouse predicts good results. The temperature of air around 8 – 10°C more than to undisturbed soil temperature is obtained at a pipe length of about 24 m from inlet irrespective of thermal conductivity of soil under steady state condition. The approximate 24 m length of the EATHE pipe required to obtain the maximum possible drop in temperature.

V CONCLUSION

- (a) EATHE is a type of horizontal open loop system consists of a 24 m long and 0.1554 m inner diameter with wall thickness of 3 mm and the pipe is made up of mild steel. EATHE is buried 3 m deep below surface. An industrial blower of 260 Watt was used to force ambient air through it. The air velocity was taken between 4-6 m/s.
- (b) As a result of an EATHE system which was able to drop the delivery temperature at of 7.5 – 16.2 °C and greenhouse temperature is maintain at 28 – 30.9 °C. The earth-air-tube model showed a good agreement with the work performed by others. The basic soil temperature in May was 26.6°C.
- (c) An underground earth tube with a lesser air velocity should result in reduction earth-tube inlet temperatures. Pipe length, pipe depth and air velocity inside pipe change to have more influence on thermal performance. However, pipe radius and air flow rate as well as cooling heat transfer rate also affect the performance of EATHE.
- (d) The total average COP in the experimental period is found to be range of 2.86 to 6.77. COP value was calculated as mean of 4.06, 4.34 and 5.28 for different air velocity like as 4 m/s, 5 m/s and 6 m/s respectively. Based on the outcome it

can be confirmed that EATHE holds considerable promise as a means to cool ambient air for a variety of applications such as the livestock buildings and greenhouses.

- (e) The difference between experimentally and theoretically value of an outlet air temperature are 2-3.19, 1.3-3.21 and 0.71-4.91 for different air velocity of 6 m/s, 4 m/s and 5 m/s respectively. The predicted and experimental temperatures of greenhouse air in the developed system showed fair agreement. It is completed that there is possible for EATHE systems to make a useful involvement to energy saving.

VI SCOPE FOR FUTURE WORK

- (a) Designing the system with solar panel system so as to obtain reduced electricity consumption.
 (b) Designing the pipe taking copper, silver and other highly conducting metals for improving heat conduction.
 (c) Modifying the design & material of blower fan blades.
 (d) Making the system fully automatic by using software, control panel and thermostats.
 (e) By changing pipe and blower dimensions.
 (f) By using the zigzag design of pipes

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Numerical Modelling of Chaotic System and Its FPGA Implementation

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ABSTRACT

Now a days Chaos based systems play an important role specifically in secure communication and cryptography. Chaotic systems have wide applications in random number generators, image encryption, Optical secure circuits, and quantum applications. The FPGA implementation has certain advantages over analog one as FPGA implementation of any system is having a more flexible architecture and have low cost testing cycles, nowadays more emphasis is given to realize different chaotic systems in FPGA. This paper demonstrates the steps for FPGA implementation of a chaotic system using Euler's algorithm. Top level, second level and third level designs are also presented. The design is implemented using Verilog and tested with Xilinx vivado v.2017.3 design suite in Artix-7 Nexys 4 DDR. Simulation results presented demonstrates the timing diagram and resource utilization.

Key Words – Chaotic system, cryptography, Euler algorithm, FPGA

I INTRODUCTION

Due to random behavior of chaotic signal, the chaotic systems play an important role in cryptography and secure communication. In the 1990's it is identified that chaotic system can be synchronized, this fact leads to wide application of chaotic systems

The analog based design of chaotic systems is rigid in architecture and acquires a larger chip area. FPGA implementation has certain advantages over analog one, so more emphasis is given to realize different chaotic systems in FPGA. The chaotic generator is an integral part of any chaotic system, hence it is interesting to analyze the behavior and resource utilization of different chaotic generators when implemented in FPGA. Literature published in beginning demonstrated that the chaotic system is represented by the set of differential equations containing quadratic terms and constant parameter which decides the behavior of the system and systems are very sensitive to initial conditions. A very small change in initial conditions produces a very different kind of waveforms [1-7]. For FPGA implementation of any chaotic systems, numerical modelling is required. There are several numerical algorithms (Euler, Heun and RK4) are available. In this paper Numerical solution of the equations describing the Pandey-Baghel-Singh system [8] are obtained and demonstrated the procedure of FPGA implementation by developing the top level, second level and third level designs. This paper also presented the simulation result obtained using Xilinx Vivado 17.3 design suite on Nexys 4 DDR Artix-7 FPGA logic family.

II DIGITAL CHAOTIC GENERATORS AND ITS IMPLEMENTATION

In the recent years, chaotic systems were designed on digital platform. The basic building block of any chaotic system is chaotic generator. The chaos generators are realized as digital chaotic generators by finding out the numerical solution of the differential equations by which the chaotic generator is described. In the digital chaotic generator the system variables are

realized using registers and by finding out the numerical solutions. In general the numerical solutions are implemented on digital platform as combinational blocks. The basic diagram of digital chaos generator in which numerical solution is represented by a combinational block is given in fig. 1

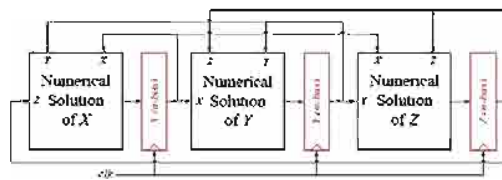


Fig.1 Basic diagram of digital chaos generator

For designing a digital chaos generator the selection of numerical technique is very important because the chaotic response of the system realized is highly depended on the numerical algorithm used.

III NUMERICAL ALGORITHMS

There are a number of methods available for the solution of differential equations. Some of them are only applicable for a limited class of differential equations. In general, for physical problem differential equations does not belongs to familiar type and we required to have numerical methods to solve differential equations. These numerical methods are becoming more useful when we realized differential equation using computers as they have reduced numerical work considerably.

There are a number of numerical methods available for solving the first order differential equations of the type [9],

$$\dot{y} = f(x, y), \text{ given } y(x_0) = y_0$$

These methods give the value of y in terms of power series of x through which we can calculate the value of y by direct substitution. The Picard and Taylor series methods belong to this class. In some methods solution of a differential equation is given in terms of a set of

values of x and y . The Euler, Heun and RK4 belong to this category in which we calculate the value of y in short steps for equal intervals of x and hence these methods are known as step by step methods. Nowadays, where computing time is largely reduced with the use of computers the numerical solutions of differential equations of these methods are more useful in engineering. The Euler, Heun and RK4 methods are used to find out the value of y over a limited range of x values.

In the Autonomous chaotic system the initial condition is defined and system is very sensitive to initial conditions. In the above equation the initial condition is defined at the point x_0 . The problems in which the initial condition are defined are known as initial value problems, but the problems involving the second and higher order differential equation in which the values for more than one point are defined are known as boundary value problems. In the paper, we deal with the initial value problems for which several numerical algorithms are available like Euler, Heun and 4th degree Runge-Kutta (RK4) to get the numerical solution of the equations defining the chaotic system.

(a) Euler’s Algorithm

This is a purely numerical method for solving the first order differential equation with initial conditions. Consider the equation $\dot{y} = f(x, y)$, with the initial condition $y(x_0) = y_0$ (1)

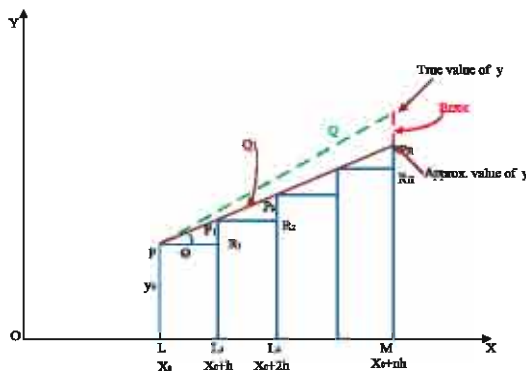


Fig. 2 Approximation using Euler method

As shown in fig 2 starting from the initial condition through $P(x_0, y_0)$ to find out value of y at another point Q the interval LM is divided into n subintervals with the step size of h . The step size should be small as possible otherwise the approximation error will be quite significant. For approximation in the interval LL_1 we approximate the tangent at point P is drawn which meets the ordinate through L_1 at point $P_1(x_0 + h, y_1)$ then

$$y_1 = L_1P_1 = LP + R_1P_1$$

$$y_1 = y_0 + PR_1 \tan \theta$$

$$y_1 = y_0 + h \left(\frac{dy}{dx} \right)_P$$

$$y_1 = y_0 + hf(x_0, y_0)$$

Which is the solution of the differential equation at point P_1 and let the tangent at P_1 meets the ordinate through L_2 at point $P_2(x_0 + 2h, y_2)$ then $y_2 = y_1 + hf(x_0 + h, y_1)$ If we repeat the process n times we reach to approximation MP_n of MQ given by

$$y_n = y_{n-1} + hf(x_0 + n - 1h, y_{n-1})$$

This is the Euler method for finding out the approximate solution of any differential equation as given in equation 1.

(b) Heun’s Algorithm

In Euler’s methods the curve of solution in the interval LL_1 is approximated by in *tangent at P* so that we have

$$y_1 = y_0 + hf(x_0, y_0) \tag{2}$$

Then *tangent at P1* is drawn find out the approximation

$$y_2 = y_1 + hf(x_0 + h, y_1) \tag{3}$$

In this way we got the solution of differential equation successively.

In a Heun method for better approximation the slope is taken as the mean of the slopes of the *tangent at P and P1* to get first approximate value as $y_1^{(1)} = y_0 + \frac{h}{2} [f(x_0, y_0) + f(x_0 + h, y_1)]$ (4)

As the slope of the *tangent at P1* is not known we take y_1 as

$$y_1 = y_0 + hf(x_0, y_0)$$

Inserting the above value in eq. (4) we get the first modified value $y_1^{(1)}$. The eq. (2) is called the *predictor* and eq. (3) is *corrector* of y_1

To find out the better modified value $y_1^{(2)}$ corresponding to L_1 again the *corrector* may be applied and we get

$$y_1^{(2)} = y_0 + \frac{h}{2} [f(x_0, y_0) + f(x_0 + h, y_1^{(1)})]$$

We repeat this process till two consecutive value of y is approximately same to the acceptable limit after this point is taken as the starting point from next interval L_1L_2

Once y_1 is obtained to desired degree of accuracy y_2 corresponding L_2 is found from the *predictor*.

$$y_2 = y_1 + hf(x_0 + h, y_1)$$

And a better approximation $y_1^{(2)}$ is obtained from the *corrector*

$$y_2^{(1)} = y_1 + \frac{h}{2} [f(x_0, h, y_1) + f(x_0 + 2h, y_2)]$$

We repeat this step until y_2 becomes stationary. Then we proceed to calculate y_3 as above and so on. The Heun’s method produces the better approximations compare to Euler’s method for same degree.

(c) Runge-Kutta (RK4) Algorithm

The Taylor’s series method of solving for a differential equation is restricted as it requires finding the higher order derivatives. The Runge-Kutta method eliminate the problem of finding out the higher order derivatives. This method agrees with the Taylor’s series solutions up to the term h^r where r called the order of the method. Euler method, Heun method and Runge method are the Runge-Kutta method of the first, second and third order respectively.

The fourth order Runge-Kutta (RK4) method is most commonly used and is often referred as Runge-Kutta method only.

In RK4 method the increment k of y corresponding to an increment h in x for the equation

$$\dot{y} = f(x, y), \text{ given } y(x_0) = y_0$$

is as follows;

Calculate successively

$$k_1 = hf(x_0, y_0)$$

$$k_2 = hf(x_0 + \frac{1}{2}h, y_0 + \frac{1}{2}k_1)$$

$$k_3 = hf(x_0 + \frac{1}{2}h, y_0 + \frac{1}{2}k_2)$$

$$k_4 = hf(x_0 + h, y_0 + k_3)$$

Finally compute $k = \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$

Which gives the required approximate value $y_1 = y_0 + k$ where k is the weighted mean of k_1, k_2, k_3 and k_4 . One of the advantages of this method is that the operation is similar for linear as well as nonlinear equations.

IV FPGA IMPLEMENTATION OF CHAOTIC SYSTEM

For FPGA implementation first the chaotic system should be numerically modelled using any of Euler, Heun and RK 4 algorithms. Top level, second level and third level design can be developed which shows the functionality of the system based on FPGA. The numerical model is coded in Verilog and simulated using any suitable simulation tool. In this paper process is demonstrated using Pandey-Baghel-Singh Chaotic System and Euler algorithm. Numerical algorithm is implemented using Verilog and tested with Xilinx vivado design suite v.2017.3 in Nexys 4 DDR Artix-7 FPGA family.

The Pandey-Baghel-Singh chaotic system has four static variables, two equilibrium points and generates typical chaotic attractors. The system is simpler than other systems because it contains a single multiplier term.

The chaotic system is described by following three ordinary differential equations where x, y and z are the dynamic state variables.

$$\dot{x} = y$$

$$\dot{y} = z$$

$$\dot{z} = -a x - b y - c z - dx^2$$

(5)

Where a, b, c and d are static parameters of the system. The system has six terms, including one quadratic nonlinearity term and four parameters.

For the numerical model using Euler algorithm initial value of $x(n), y(n)$ and $z(n)$ are taken as $x(t_0) = x(n) = 0, y(t_0) = y(n) = 0$ and $z(t_0) = z(n) = 0.1$, and the mathematical model of PBS chaotic system is described by the following Equation (6).

$$x(n+1) = x(n) + h.y(n)$$

$$y(n+1) = y(n) + h.z(n)$$

$$z(n+1) = z(n) + h.\{-a.x(n) - b.y(n) - c.z(n) - x(n)^2\}$$

(6)

The Top-level diagram using the Euler algorithms is shown in Fig.3. For the synchronization purpose one bit starts, reset and clock signal is used. A 32-bit input has been used and initial conditions are set in the beginning phase. The 32-bit signal are used as input parameter. There is three 32-bit output signals (Xn_out), (Yn_out) and (Zn_out) and ready signal is taken as one bit control signals for the proposed chaotic generator.

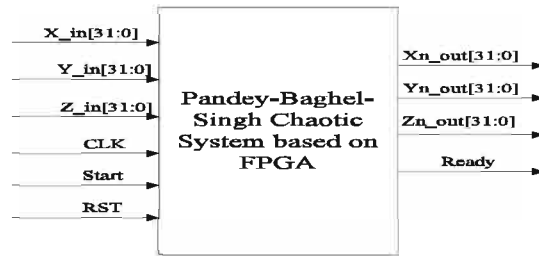


Fig.3 Top level diagram of Chaotic System based on FPGA

The second level block diagram of the chaotic generator is presented in Fig. 4 It has one multiplexer and a chaotic generator unit which is FPGA based. The multiplexer is used to provide initial condition signals. For successive operation, it is provided by the output signals. When enable is at logic high, the output generates chaotic signal.

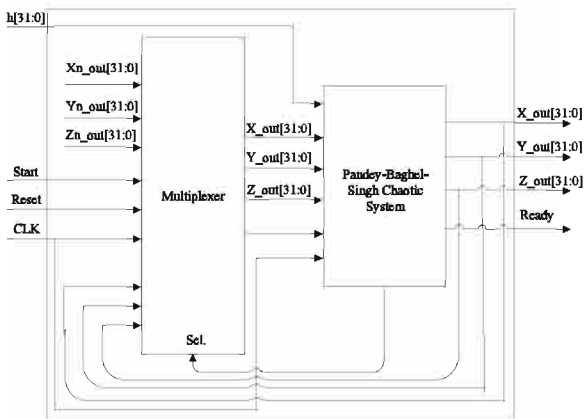


Fig.4 second level design of PBS chaotic system based on FPGA

IV SIMULATION RESULTS

The third level block diagram of the Euler based chaotic generator is given in Fig.5 The system consists of multiplexer, function f, multiplier, adder/subtractor and filter. The system equations are calculated in the f unit and the output is multiplied by h in the multiplier. In the adder unit previously generated signals by the generators and the signal obtained from the multiplier are added. The filter unit eliminates the undesired signal. The system works sequentially and it generates the first value after the end of 42 clock cycles.

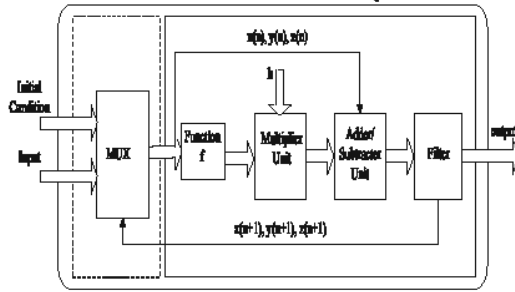


Fig. 5 Third Level design of Euler based Chaotic System

The Euler algorithm based numerically modelled Chaotic generator have been synthesized on Nexys-4 DDR XC7A100TCSG-1 (Artix7) from the Xilinx vivado design suite v.2017.3. The simulation results include timing diagram, resource utilization, power utilization and other chip related Parameters and clock speed of the system. Fig 6. shows the timing diagram and fig.7 presents schematic diagram and other simulation results.



Fig. 6 Timing diagram of Euler based chaotic system

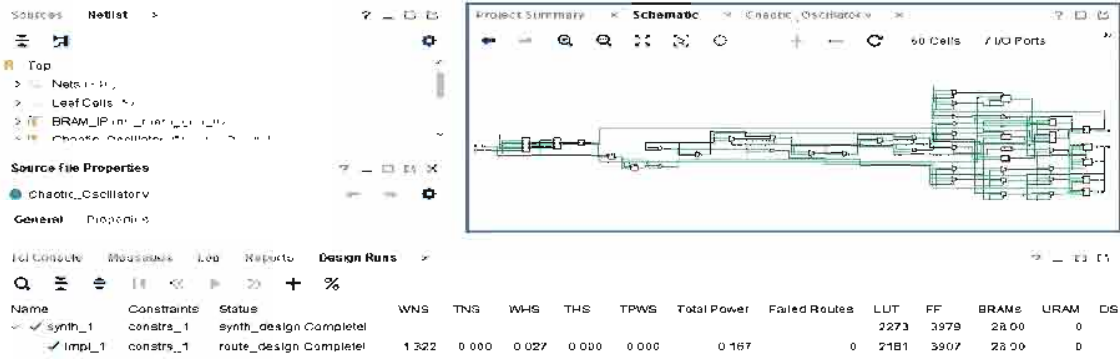


Fig.7 Schematic diagram and other simulation result of Euler based chaotic system

Table 1
Final report of the resources consumption

Parameter	Values
Maximum frequency (MHz)	359.71
No. of DSP	2
Number of 4 input LUTs	2181
Number of bonded IOBs	7
Number of Slice Flip Flops	3907
Total On-chip Power(W)	0.167
LUTRAM	71
BUFG	2
BRAM	28

V CONCLUSION

Any chaotic system which is described by ordinary differential equation can be numerically modelled using any one of numerical algorithms Euler, Heun and RK4. The performance of the system depends on the type of system and numerical algorithm selected. Numerical solution of the system is coded in Verilog and implemented in Nexys 4 DDR Artix 7 FPGA family in the environment of Xilinx Vivado design suite v.2017.3. The results show that any chaotic system can be numerically modelled and implemented in FPGA for secure communication and cryptography.

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Life Estimation of Piping Components of Nuclear Power Plant for Safe Operations – A Review

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ABSTRACT

In the present review paper, various researches results developed so far are discussed. Particular emphasis will be given to the prediction of the crack growth stages, stress intensity factor, J-integral, number of cycles for crack having a key role in the overall fatigue life prediction. All considered approaches (Leak before break, linear elastic fracture mechanics, elastic plastic fracture mechanics etc.) are applicable to life prediction of nuclear power plant (NPP) piping components, to enable us for enhancing the NPP piping component life for safe operation.

Keyword – NPP (nuclear power plant), stress intensity factor (SIF), fatigue crack growth (FCG)

I INTRODUCTION

Fatigue is a major source of product failure. Most products exposed to repeated cyclic loadings will eventually fail. Caused by repeated or otherwise varying loads, fatigue is a result of repetitive stress over time, as microscopic changes become cracks that cause malfunction.

As a result, making informed design decisions to improve your product's durability is increasingly important. Product failure can result in recalls, high repair costs, legal liabilities.

Fatigue analysis for nuclear components in the design phase uses covering (enveloping) loads and is conducted to demonstrate that the cumulative usage factor, CUF, is less than one. The loads, expressed in terms of fluid system pressure and temperature transients, are defined in the equipment technical specification, and consider a conservative prediction of the magnitude and frequency of these fluid transients to occur during various service conditions.

The major prerequisites for any subsequent fatigue assessment are the accurate component stress analysis and the identification of relevant cycles, using highly qualified and efficient cycle counting methods.

The main characteristics of cyclic loading are the frequency of occurrence and the amplitude. Both of these can remain constant or vary, the latter option describing much more realistically actual cyclic loading conditions than the former.

II FATIGUE CRACK

If the components are subjected to a fluctuating load of a certain magnitude for a sufficient amount of time, small cracks will nucleate in the material. Over time, the cracks will propagate, up to the point where the remaining cross-section of the component is not able to carry the load, at which the component will be subjected to sudden fracture. This process is called **fatigue**, and is one of the main causes of failures in structural and mechanical components. In order to assess the safety of the component, engineers need to estimate its expected lifetime. The fatigue life is the sum of the number of loading cycles required for a fatigue crack to initiate, and the number of cycles required for the crack to propagate before sudden fracture occurs.

The fatigue life of a structural component under cyclic loading can be considered to consist of two phases, which are the crack initiation life followed by a crack growth period until failure. This can be represented in a block diagram.

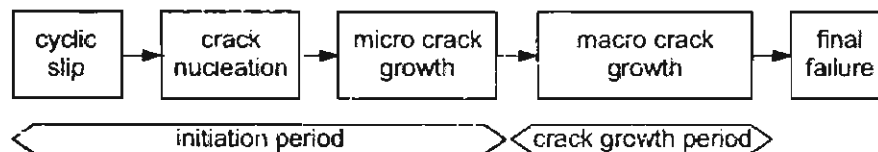


Fig. The different phases of the formation and growth of a fatigue crack

Crack growth is an atomic level breakage and breaking of the bonds linking the atoms and gathering of dislocations (imperfections in the atomic structure). Thus, new surfaces are created in the solid as the crack nucleates and continues to grow. It is not certain that the fatigue crack will continue to grow.

By assuming a small size for predicting the growth life, it is possible to neglect the initiation life for the fatigue life estimation. It is relatively easy to quantify the growth life because the crack growth rate has been shown to correlate with the stress intensity factor (SIF), and the experimental technique for

obtaining the material constants for growth prediction has been standardized.

For the analysis of fatigue crack growth, the Paris law has proved to be a simple, accurate and robust approach where knowledge of stress intensity factor is enough to predict the growth rate of edge and through-thickness cracks. In order to analyse the growth of surface cracks under cyclic loading, it has been generally accepted to apply the Paris law for the deepest and the surface points of the crack and then assume a semielliptical shape for the crack.

III NUCLEAR POWER PLANT PIPING COMPONENTS

Actual stress analysis of these components are required for reliable estimation of fatigue crack growth behavior, stress intensity factor and residual life, as most of the failures in the piping components are due to fatigue loading. An alternate fail safe design philosophy such as leak-before-break (LBB) based on fracture mechanics concepts is adopted to demonstrate that piping components will not fail to catastrophic manner. Investigation on fatigue crack growth (FCG) Of pipes and elbows with postulated part through flaws for the qualification of LBB design criteria.[2]

Fatigue is one of the principle modes of failure to be considered in the design of components and

$$\frac{da}{dN} = C(\Delta K_d)^m$$

Where C and m are crack growth constants (Paris constant) depend upon the material and $\Delta K = K_{max} - K_{min}$. The K_{max} and K_{min} are stress intensity factor values corresponding to maximum

$$dN = \frac{da}{C(\Delta K_d)^m}$$

ΔK_d = SIF range at deepest point of surface crack,
da = assumed increase in crack depth

$$dc = dN * C(\Delta K_c)^m$$

Where dc = extension of crack length and ΔK_c = SIF range of surface crack tip

$$a_{new} = a_{old} + da$$

$$2C_{new} = 2C_{old} + dc$$

The process is repeated until the crack reaches through thickness or K reaches fracture toughness of

$$dN = \frac{da}{C(\Delta K_d)^m}$$

structures subjected to repetitive types of loads. This work will be carried out for pipe components – pressure based straight Component (PBSC) and pressure weld straight components (PWSC), used in Indian nuclear power plants. The demonstration of LBB based on fracture mechanics requires information on the initial size of a defect, initiation of crack growth from the inherent defect and subsequent crack growth rates. The crack will grow and penetrate the wall thickness under fatigue loading. Thereafter, the crack will grow in circumferential direction under cyclic loading. Therefore various tests are required for the deformation of fatigue crack initiation, fatigue crack growth, fatigue resistance behavior of the component. Fatigue crack initiation and crack growth rate of the actual piping component will also be useful in the accurate prediction of the remaining life prediction of the component, which is of concern to most of the old nuclear power plants.

(a) Fatigue life calculation

Fatigue life (N_f), number of cycles to cause fatigue failure at specified stress level. Using crack growth laws it is possible to predict the life of pipe component subjected to fatigue under repeating load. The crack growth rate (da/dN) can be related to variation of stress intensity factor (ΔK). If ΔK remains constant Paris has expressed the relationship between crack growth (da/dN) and ΔK in the following form:

and minimum stress level in the fatigue load cycle. [3]

For assumed initial crack depth, the no of cycle required for the incremental increase in crack depth can be calculated as follows.

Then extension in the crack length at the surface can be calculated from following equation by putting the number of cycles:

The computation of crack propagation along two directions has to be carried out simultaneously, now new dimensions of crack geometry are calculated as

the material for every incremental increase in a crack depth, the life cycle are calculated using equation

IV REVIEW

Few of the works have been summarized here done by various researchers, scientists, engineers and designers on crack growth behavior and fatigue fracture of pipes containing surface flaws under different loading conditions in nuclear power plants.

In 1968, Dr. James Rice first proposed the J-integral as an elastic-plastic fracture mechanics (EPFM) methodology. It provided the basis for EPFM fracture mechanics methodology well beyond the validity limits of Linear Elastic Fracture Mechanics (LEFM). Since then, this parameter has become the predominant method to characterize elastic-plastic fracture in the nuclear industry. The J integral has been used to characterize the crack driving force, crack tip stress field and the strain energy release rate during crack growth under elastic plastic. Thus the J integral can be viewed as both an energy parameter and a stress intensity parameter for non-linear materials.[3]

Kang in 2005 discussed the effects of stress amplitude and mean stress on ratcheting and failure under uniaxial asymmetrical stress cycling. It was concluded that the material apparently featured cyclic hardening; cyclic hardening depends greatly on strain amplitude. It was also observed that the ratcheting strain rate (i.e., the increment of ratcheting strain in each cycle) decreases gradually with the number of cycles due to its cyclic hardening feature.[4]

S. Vishnuvardhan studied on pressurized piping components of power plants were carried out on TP304 LN stainless steel straight pipes of 168 mm outer diameter subjected to steady internal pressure and four point cyclic bending. The length and average thickness of the pipes were 2800 mm and 15 mm respectively. The thickness was reduced to 12 mm in the gauge length portion of 200 mm at the centre of the pipe. Post-yield two element rosette strain gauges were mounted at various locations within the gauge length to measure the longitudinal and circumferential strains. The pipes were filled with water and pressurized; the pressure was maintained at 35 MPa till the first through-thickness crack was observed. Number of cycles corresponding to through-thickness crack/s and final failure of the component were recorded. Study give valuable inputs necessary for designing the components and assuring the integrity of pressure boundary under design basis loads such as loads arising during an earthquake event.[5]

Piping elbows are one of the critical components of the cooling piping system in power plant. Nagapadamaja P. et. al. presented the details of fatigue crack propagation analyses based on code procedure and FEM and compared the result with experimental observation. The fatigue crack propagation was evaluated based on in elastic range J-integral, J_e which was obtained by applying plastic correction (from RCC-MR code) to the elastic J-

integral values from the code as well as from the elastic finite element analyses. The fatigue crack propagation was also studied directly using the elastic-plastic J-integral values obtained from finite element analyses. It was observed that the fatigue life calculated based on the modified J_e integral was close on the conservative side to the experiment results, then that from J-integral obtained directly from elastic-plastic finite element analyses[6].

The wall thinning that occurs due to erosion corrosion is exaggerated at elbows. Takahashi Koji et. al. conducted low-cycle fatigue test using elbow specimens with local wall thinning, which was machined inside the elbow in order to simulate metal loss from erosion corrosion. They did it in three different areas. Then the specimens were subjected to cyclic in-plane bending under displacement control without internal pressure. In addition they carried out 3-D elastic plastic analysis using FEM. The crack penetration area and the crack growth direction were successfully predicted by the analysis. The fatigue lives estimated by the analyses were close to those obtained by the experiment. They conducted whole experiment by STS410 (carbon steel pipe) in JIS (Japanese industrial standards), which are used in the class 2 piping of nuclear power plants in Japan. The software codes used in the analyses were Excel and Hyper Mesh for generating the FEM and element break down, ABACUS as the solver, and ABACUS VIEWER for post processing [7].

Dhakad S. K. et al. [3] presented fatigue crack growth behavior of surface cracked piping component were performed on the basis of LEFM principle with particular interest in its ability and accuracy, to predict full scale component tested experimental data. Especially the stress intensity factors available in literature were evaluated to predict growth behavior of the component using the specimen test material data. They concluded that the available SIF solution like ASM and Bergman for external surface crack straight pipes having the semi elliptical crack profile over predicts fatigue life of the component, when having constant crack depth profile in case of PBSE 8-3 pipe. Using Bergman solution the SIF results at the deepest point was higher as compared to solution of ASM handbook.[8]

Many studies were carried out at CSIR-SERC on nuclear power plant piping components subjected to monotonic as well as cyclic loading to assess the damage for crack growth due to low-cycle fatigue in circumferentially through wall crack pipes. Rohit et. al. worked on 304LN stainless steel piping components. They estimated J-integral for circumferentially TWC straight pipes subjected to monotonic and cyclic loading. They estimated monotonic J-integral by using Zahoor Kanninen approach, where as cyclic J-integral by using Dowling and Begley method [9].

The LBB concept has an effect on the safety design of fast breeder reactor (FBR) and thus into assessment has been one of the most significant issue. In the case of commercial scale FBR since the main loads are the thermal expansion to the thermal transient stresses, ferrite steel with a low-thermal expansion rate has been a candidate material. Moreover thin walled and large diametric pipes had been used to reduce the number of loops, which might also results in an economical advantage. Yeon-Sik Yoo et. al. proposed to apply the LBB assessment method to ferrite steel pipes with thin wall and large diameters [10].

3-D finite element analyses models were built for pipes with circumferentially cracked and the effect of thermal aging embrittlement on LBB behavior was analyzed by Chinese researchers Xunming LV et. al. they demonstrate that less conservative LBB assessment results will be produced, if thermal aging embrittlement and piping steel is not taken initial consideration. They chosen cost duplex stainless steel of Z3CN20-09M and the main ferrite content was 14.6%. They conducted that the fatigue crack propagation of surface cracks is less than 2% of the wall thickness during the entire life period also the un-aged and thermally aged pipes may fail with ductile fracture but thermal aging reduce the safety margins [11].

Extended Finite Element Mechanics (XFEM) is used to evaluate the SIF of a semi-elliptical part through thickness axial/circumferential crack by Kamal Sharma et. al. in his study [10]. They subjected internal pressure to pipe/pipe-bend having a crack on the outer surface. They found from these simulations that axial crack is more severe than the circumferential crack. They observed that the loading also significantly affect the SIF. These simulations also show that the modeling and simulations of cracks in XFEM is much easier as compared to FEM.[12]

After the accident at Fukushima Dai-ichi NPP in 2011, IAEA requires to consider the design extension conditions (DEC) for the safety management of NPP. Because piping systems are out of the components of NPP, and there is a possibility to failure at seismic events. So, Nakamura Izumi et. al. conducted an experiment investigation on failure modes and mechanisms of piping systems under excessive seismic loads. To clarify the failure modes under excessive seismic load, shaking table tests on different scale test specimens with different material or loading conditions were planned. They observed most of the failure modes were fatigue failure, other failure modes such as ratchet deformation, collapse and the fracture appeared under extreme conditions of fundamental plate tests. They used Carbon steel STS 410 as per JIS and stainless steel 304SS [13].

Sahu M. K. et. al. studied total three straight pipes which are used in primary heat transport system of Indian PHWRs (Pressurized heavy water reactor).

Fracture tests had been performed on these pipes subjected to constant internal pressure and monotonically increasing four point bending load. Different experimental and finite element results like load vs load line displacement, load vs crack mouth opening displacement (CMOD), crack initiation loads are compared found in good agreement. Then they used experiment results for calculation of fracture toughness i.e. J-R curves for all three pipes. They observed higher J-R curve of surface crack pipe is attributed to prevalent lower crack tip constraint and vice-versa is true for through wall cracked pipes[14].

Dhakad S. K. et. al. Investigated, the fatigue crack growth behavior of surface cracked piping, pressurized base straight component (PBSC 8-5) on the basis of linear elastic fracture mechanics (LEFM) principles. Stress intensity factor available in the open literature were evaluated to predict the crack growth behavior of the component using specimen tested material data. They had concluded that the SIF solutions of ASM and Bergmann for external surface cracked straight pipe case having the semi-elliptical crack profile predicts the fatigue life of the component, when having constant crack depth profile. They also concluded that the initial crack size, aspect ratio of crack, applied bending stress range, stress ratio, diameter of pipe are some of the factors affecting the fatigue crack growth life of the piping component.[15]

Fatigue crack initiation and growth rate studied by Raghava G., in different exposure and loading conditions were carried out on twenty six straight pipes made of type 304LN stainless steel, which is widely used steel in nuclear power plant piping components. The pipe dimension were in two categories OD-170mm, thickness 15mm and OD-324mm, thickness-28mm. The specimen contained preexisting flaws in the form of part through notch in one of the following locations: base metal, heat affected zone and weld metal. Notch length varies from 7mm – 12mm and notch depth varies from 3mm – 10.9mm. twenty one specimen were tested under four point in air environment, there under four point in water environment, and two under combined torsion and bending in air environment [16].

V CONCLUSION

Numbers of researchers, scientists, engineers and designers have studied crack growth behavior and fatigue fracture of pipes containing surface flaws under different loading conditions in nuclear power plants. Few of them have been summarized above. Many kinds of softwares also been used by them, still scope for the search of reliable, easy to use and cost effective method is there. Which can incorporate all kinds of results in less time.

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A Review of the Performance Characteristics of Open Graded Friction Course Layer

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ABSTRACT

Open Graded Friction Course is a pavement layer laid as a surface course over the base course in pavements. Uniform aggregate gradation, lesser quantity of fines and filler materials give it a porous structure with increased percentage of air voids. The bitumen content for OGFC layer is slightly higher than that for conventional dense graded layer. OGFC has been used in various developed countries with high volume of traffic and rainfall intensity because of enhanced infiltration properties exhibited by the layer. The present study aims at providing a detailed review of the various problems encountered during the service life of Open Graded Friction Course as well as the measures that have been taken in order to tackle these problems in the past. Various benefits provided by Open Graded Friction Course to the pavement layer have also been discussed meticulously. Utilization of different types of polymers that have been obtained from waste recycling plants in modification of bitumen can provide a viable solution to improve the performance characteristics of Open Graded layer in addition to decreasing the burden of waste disposal on landfills throughout the country and achieving the goal of sustainability.

Keywords: Percentage air voids, Drain down, Abrasion, Ravelling, Polymer modifiers

I INTRODUCTION

Open Graded Friction Course is a distinctive pavement mixture that is being used as a thin surface course over the underlying impermeable layer in many countries all around the globe. OGFC mixture differentiates from the conventional dense graded mixes as it utilizes a coarser, uniform aggregate gradation and very less quantity of fine materials and fillers. As a result of gap graded aggregates, an open structure with large amount of interconnected air voids is produced which facilitates quick and efficient drainage of water from the road surface? Open Graded Friction Course employs a higher binder content than traditional dense graded mixes to augment durability of the structure. OGFC layers are usually provided as 20mm thick surface layers; however, in some of the European Countries, the thickness of OGFC layer varied from 20mm to 50mm. Friction Courses are also termed as popcorn mix or porous asphalt mix due to its gap graded structure. OGFC layer is typically provided on high speed and high volume roads, especially expressways so as to achieve the desired attributes of enhanced frictional resistance on the surface, improved vision at night and minimized hydroplaning. The design of OGFC layer is such that the quantum of air voids on the surface after spreading and compaction is in the range of 18%- 25%. These air voids facilitate eradication of water from the road surface. Approximately 50%-60% of the coarse aggregates used are of the same size and the filler content is restricted to 2%-5%. Due to uniform grading of aggregates and less quantity of filler, drainage of asphalt binder occurs from the mixture under gravity while storage and freightage to the construction site and this circumstance is commonly referred as draindown of bitumen. Another common problem being encountered in case of OGFC a pavement is ravelling which occurs when aggregates separate from the aggregate matrix as a consequence of wear and tear due to moving traffic loads. Presence of air and moisture in the layer due to open structure of OGFC layer increase the rate of acceleration of oxidation process of mix. The exposure

of surface course to air and moisture results in premature aging of asphalt binder. As a result bitumen strips off the aggregates and the loose aggregates ravel to the surface. The phenomenon of ravelling goes on increasing exponentially, affecting the entire depth of OGFC segment over wide pavements. The following study provides a comprehensive view of the studies that have been carried out in the past to address these issues and the measures that have been taken to tackle these issues.

II PERFORMANCE OF OPEN GRADED FRICTION COURSE PAVEMENTS

The diverse advantages offered by OGFC pavements prompted highway engineers to use these mixes in many countries. These pavements provide added benefits during periods of longer storms by dissipating the pressure produced on road surface through voids present in the layer and thus maintaining a strong interaction between pavement and tire. Experimental studies have proven that an OGFC layer reduced water splash by up to 95% in comparison to that in dense graded layers. Furthermore, lesser thickness of Open Graded Friction Course layers lead to considerable amount of saving in the quantity of aggregates used in pavement construction.

However, use of coarser aggregate gradation results in high air content which aggravates durability issues, leads to pore clogging problems and demands special maintenance in colder regions. Depending on the weather conditions of area where OGFC layer is provided, the service life of pavements during which the frictional properties and texture are maintained varied from less than 6 years to more than 15 years. In contrast to the service life, the performance life of OGFC pavements during which characteristics like permeability and noise reduction remained intact ranges from 1-5 years. The performance life of these pavements can be increased by proper and periodic maintenance. The performance characteristics of OGFC

pavements can be divided into two categories: Functional performance and Structural performance.

(a) Functional Performance—The functional properties of OGFC layer are dependent on the performance of void structure. The stone-on-stone matrix facilitates noise reduction and water infiltration, but also makes the pavement vulnerable to small particles which may clog the pores on the surface. Thus, periodic maintenance of OGFC pavements is necessary so that the functional performance of pavement layer does not get affected. In addition to this, limiting the use of OGFC pavements to high speed roads is beneficial as it creates suction between the pavement and surface of tires and curbs clogging ability of smaller particles. Hence the permeability characteristics and noise reduction properties of the pavement layer can be prevented from getting exhausted by appropriate maintenance measures.

(b) Structural Performance—Typically OGFCs do not contribute to enhancing the structural capacity of the pavement. However, the durability of this layer affects the structural performance of the entire road structure. The main difference in the durability of traditional Hot Mix Asphalt and that of OGFC mix arises due to the open void structure of the latter as a result of which the water flows through the entire section rather than just on the top surface. Hence, the binder coating the aggregates gets oxidized by the oxygen flowing through the void structure and becomes brittle and strips off from the aggregates due to repeated wheel loads. In addition to this, another type of distress encountered in the OGFC layer is ravelling which occurs when aggregates still coated with bitumen get disintegrated from the pavement. Ravelling primarily occurs due to insufficient binder content and chemicals which may get ejected from vehicles. Ravelling can be identified as belonging to two different categories: Short term ravelling and long term ravelling (Molenaar and Molenaar, 2000). Short term ravelling occurs at the interface of tire and the pavement on newly placed OGFCs as soon as traffic is allowed on the pavements. This is mainly caused due to inappropriate mix temperature at the time of placement, draindown of binder during transportation and inefficient compaction. Long term ravelling occurs due to binder being drained down gradually over time. Thus the top of the wearing surface has lesser binder content than the rest of the layer and aggregates closer to the top surface get dislodged under traffic movements (Molenaar and Molenaar, 2000).

III LITERATURE REVIEW

The studies carried out by various researchers on OGFC are as below:

Hanson and Shuler (1990) tested Open Graded Friction Course mixes in the laboratory to determine the stripping potential of the mix. Mixtures containing three

different kinds of asphalts were prepared and subjected to a boiling test. These mixes were prepared with and without anti-stripping agents and hydrated lime. Further, the binders were modified with polymers and evaluated by boiling test. These mixes were prepared at Optimum Binder Content evaluated as per mix design procedure described by FHWA. Liquid antistripping agent was evaluated at two levels of concentration in each of the asphalts and modified by 3% copolymer by weight of binder. The analysis of test results was done by multiple or one-way Analysis of Variance (ANOVA). These test results indicated that mixtures containing liquid anti-stripping agents required lower binder contents. Polymer modified asphalt performed best when the mixture aggregate was treated with lime and least stripping of aggregates was observed. In comparison to other treatments, lime treated conventional OGFC mixture performed poorest and hence gave degraded field performance. However, addition of hydrated lime leads to an increase in the amount of binder content in OGFC mixture. Hence, further research has to be carried out to determine the sensitivity of mixtures to stripping depending on different binder contents.

Cooley et al. (2000) carried out study to evaluate the use of cellulose fibers in OGFC mixtures by entailing both field phase and laboratory phase. They selected six different OGFC pavements (with different binder polymer combinations) in Georgia constructed during 1992 and conducted visual distress survey during field investigation phase. Rut depth measurements were taken at each section along straight line and six cores were also excavated to obtain in-situ density and permeability. In the laboratory phase, number of moisture sensitivity tests was conducted on specimens prepared with both cellulose and mineral fibers. The mix design of these specimens was carried out according to Georgia Department of Transportation procedure for design of OGFC mixes. They used four different types of fibers: three types of cellulose fibers and a slag wool mineral fiber. They conducted four different types of tests: quantification of amount of water absorbed, Moisture Susceptibility by Diametral Tensile Splitting, Boil test and determination of rutting susceptibility by Loaded Wheel Tester after submergence at 60°C. Based on the results of visual distress survey, the authors concluded that OGFC section containing cellulose fiber and no asphalt binder modifier performed better than other OGFC mixes in terms of reflective cracking and ravelling. However, the results of laboratory tests indicated that both cellulose fiber and mineral fiber mixtures performed well in extreme loading and weather conditions. Thus, to overcome the demerit of water absorption by cellulose fibers in case of heavy rainfall, mineral fibers can be used to produce pavements with increased infiltration.

Hassan et al. (2005) carried out research on different types of OGFC mixesto check suitability for their use on steep sloped hilly areas in Oman. It was desired to conceive a mix that would help in enhancing frictional properties of pavements in mountainous regions. Four different types of mixtures were prepared: without any additives, mix with 0.4% cellulose fibers by weight of

total mix, 4% Styrene Butadiene Rubber by weight of binder and an optimum ratio of both the cellulose fibers and Styrene Butadiene Rubber. Various mixes were designed according to NCAT procedure at varying bitumen contents ranging from 4.5% to 6.5% and variations in percentage air voids, draindown of bitumen, unaged abrasion and aged abrasion were studied so as to come up with a mix which satisfies all the criterion as specified in NCAT procedure. It was deduced that the mixture with both SBR and cellulose fibers at 6.5% optimum binder content meets up with all the standards. They further conducted Indirect Tensile Strength test so as to assess permeability and susceptibility to moisture at optimum binder content. This research led to the conclusion that an amalgamation of cellulose fibers and SBR polymer produced pavements with high ravelling resistance. However, better resistance to draindown was provided by use of cellulose fibers alone.

Alvarez et al. (2008) compared three different types of tests to identify the test which would be most convenient for design and performance evaluation of Open Graded Friction Course mix. The three different types of tests conducted were Cantabro Abrasion test (both in Dry and wet conditions), the Wheel tracking test and the Overlay test. The authors conducted the study in two stages: the first stage involved testing on specimens with three different tests to check suitability for durability evaluation of mixes and the second stage focussed on appraising the preferred test to comprehend the results in terms of material quality, binder content and difference in mixture attributes after subjecting the compacted specimens to extreme conditions. They used two different types of asphalts: Type 1 Asphalt rubber (comprising minimum 15% by weight of asphalt of grade C crumb rubber) and Performance Grade Asphalt with minimum 1% dry aggregate lime and 0.2% cellulose fibers. The criterion used for identifying the appropriate durability test were specimen preparation, Air void content, equipment availability, testing time and variation in test results. Durability of PFC mixes is recommended to be tested by Cantabro test during mix design stage and production. Optimum Asphalt Content is to be determined by Cantabro test in a controlled temperature condition (25°C). It is also observed that the resistance of mixture to fragmentation is influenced primarily by the properties of aggregates. However, they concluded that an improvised method of mix design has to be developed to assess the endurance of PFC mixes as Cantabro test gives variable results at different temperature conditions.

Shankar et al. (2008) carried out a study to differentiate the attributes of Porous Friction Course mixes prepared with conventional and modified binders for three types of aggregate gradations and two specified binder contents. The criteria for evaluation of performance were stone-on-stone contact, air voids and hydraulic-conductivity of specimens. Aged abrasion loss and moisture sensitivity were used to investigate the structural durability. The binder types used were neat bitumen, bitumen modified with polymers (plastomer

and elastomer) and crumb rubber modified bitumen. Based on the analysis of results, it was found that the main cause of variation of response characteristics of PFC mixes is aggregate gradation and binder type. The mix with coarser gradation was found to exhibit lower bulk density, higher percentage air voids and better infiltration characteristics in comparison to other gradations. The results of Aged Abrasion Loss test indicated better resistance to abrasion for mixes prepared with CRMB modified binders. Dry and wet conditioned specimens prepared with polymer modified binders reported better Indirect Tensile Strength values in comparison to conventional and CRMB binders. Wet Abrasion Loss test values of CRMB mixes were lower as compared to the mixes prepared with other binders and hence indicated more resistance to moisture induced damage. Thus, based on above observations it has been concluded that Porous Friction Course mixes prepared with modified binders and coarser gradations result in long lasting and stronger pavements even at lower compaction efforts.

Kowalski et al. (2009) monitored three highway test sections to evaluate friction, texture and noise properties over a period of 4 years. These highways were constructed using dense graded asphalt, stone matrix asphalt and porous friction course mixes. These pavements were tested periodically, about three times per year. The air temperature at the time of testing was between 5°C and 34°C and the pavement temperature was between 5°C and 50°C. These tests were conducted on both cloudy and sunny days with relative humidity ranging between 40% and 80%. The friction properties and texture of the pavement section were evaluated using dynamic friction tester, the locked-wheel friction trailer and circular track meter. Sound Pressure Level produced by interaction of tire and pavement was measured using Statistical Pass-By method and controlled Pass-by method. It was observed that friction of the pavement surface increased on initial exposure to traffic due to binder wearing off from the surface of aggregate particles and then starts to decrease to reach a stable value. Variations in temperature and degree of surface contamination due to changing seasons also control the frictional characteristics of the pavement. Measurements of tire-pavement noise on field indicated that Porous Friction Course is the quietest pavement surface out of the three surfaces. The noise levels of PFC mix was found to increase as the cumulative traffic level increases. After four years of periodic observations, the authors have suggested that PFC layer can prove to be a viable pavement surface with good friction and reduced tire-pavement noise.

Belshe et al. (2011) studied the suitability of providing OGFC layer on concrete pavements and the effect it produces on the temperature gradient and curling stresses across the pavement thickness. They selected a study site at Interstate Ray Road in Phoenix. The pavement north of Ray Road had been laid with OGFC layer and South of Ray Road was laid simply with PCC. Sensors to detect temperature variations were placed at varying depths both in the lane and shoulders of the

road at six different locations. This data was collected in the month of June and December to account for extreme temperature conditions and the data obtained was subjected to three-dimensional finite-element analysis to study daily as well as seasonal temperature variations. It was concluded that providing an OGFC layer reduces temperature differentials between the top and bottom of the slab due to increased aeration effect as a result of open graded structure. Results of Finite Element Analysis also display reduction in curling stresses when friction course is provided over PCC pavement. A non-linear temperature profile was observed across the slab thickness in both summer and winter season. Thus reduction in temperature variation by providing OGFC layer can help curb the curling stresses which are damaging to the concrete pavements.

Bose et al. (2012) studied the influence of polymer additives like crumb rubber and reclaimed polyethylene on the properties of OGFC mixtures. They carried out a comparative study of polymer modified mixes and mixes prepared using conventional binders based on different properties like draindown, abrasion, permeability, resistance to rutting, moisture sensitivity and skidding. Two variations of Marshall Compaction were used to prepare mixes at four different binder contents; in the first type, mixtures were given 25 blows on each face and in the second type, only one face was compacted by giving 50 blows. The binder used was modified by different percentages of crumb rubber and reclaimed polyethylene. It was observed that when polymer modified binders were used to prepare specimens, they exhibited an increase in the Indirect Tensile Strength values and were less susceptible to variation in moisture content. Mixes prepared by compaction with 50 blows surfaced better when subjected to abrasive conditions. Use of Polymer modified binders increased the fatigue life of OGFC mixes by approximately 50% in comparison to traditional HMA mixes.

Chen et al. (2012) studied the top-down cracking performance of Open Graded Friction Course pavements and the effect of characteristics of interface conditions on this performance. Top-down cracking is one of the chief modes of distress of OGFC layer because of its low fracture resistance in comparison to conventional dense graded mix. The cracking performance of thin OGFC layer relies on the characteristics of the following three components close to pavement: OGFC, structural layer lying underneath and the interface condition between them. Hence to ensure an interface resistant to fracture, different types of tack coats were applied and tested using a newly developed composite specimen interface cracking test. They also employed X-ray computed tomography to analyse the interface characteristics. They prepared three sets of composite specimens all dense graded, OGFC on dense graded mix coated with Polymer Modified Asphalt Emulsion and OGFC on dense graded mix coated with conventional tack coat. Hot Mix Asphalt mechanics was used to quantify the structural effect of different types of tack coats on top down

cracking performance. The analysis of results clearly indicated that use of Polymer Modified Asphalt Emulsion as tack coat increases the fracture resistance of OGFC layer. This result was further verified by obtaining crack tip stress distribution from Two-dimensional plane stress FEM model of specimens.

Putman and Wurst (2013) studied the expediency of using Warm Mix Asphalt technology for producing OGFC mixes so as to eliminate the need of stabilizing fibers in the mixture. The two WMA technologies used were Evotherm and Foaming techniques. Three primary criteria, viz: Draindown, air voids and abrasion were used to draw a comparison between mix prepared using HMA technology and WMA technologies. Additionally, two additives i.e. hydrated lime and cellulose fibers were introduced to serve as anti-stripping agent and avoid excess binder draindown in HMA mixes, respectively. The results of these comparisons indicate that use of WMA technology eliminated the need of using fibers thus enhancing the permeability characteristics of pavements to almost twice as compared to HMA mixes. In addition to this, WMA mixes exhibited better durability than HMA mixes in both dry and wet conditions. Use of WMA technology also contributed towards reducing consumption of energy sources and emissions from paving mixes.

IV CONCLUSION

The major issues encountered in Open Graded Friction Course pavements are use of excessive binder due to draindown and loss of material due to ravelling. The Hot Mix Asphalt technology used for laying OGFC pavements has led to an increased energy consumption and emission of toxic gases into the surroundings. Various researchers all around the world have carried out work in order to identify measures to tackle these problems in different topographical and climatic conditions. Incorporation of polymer modifiers has contributed to a great extent in addressing the issue of lesser durability as they make binder stiff and prevent ravelling from pavement surface. Use of cellulose and mineral fibers have considerably solved the problem of binder draindown during transportation and placing of the mixture. In addition to polymer modifiers and fibers, using hydrated lime in small percentages can help in solving the issue of binder stripping off the aggregate particles. However, these measures have led to an increase in the cost of pavements by approximately 30% as compared to traditional dense graded pavements. Hence it is desirable to identify certain materials that could be helpful in overcoming the major issues encountered in OGFC pavements while taking into consideration the economics of construction of long lasting pavements and sustainability of the environment.

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Electrostatic and Actinic Light Ray Vertical Component within the Sky Layer before Earthquakes

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ABSTRACT

A few years ago, model, of the age of local electrical fields inside the air various days before earth-tremors and up to various days once the temperamental stun, was arranged. Inside the model, the age of the electrical fields occurs because of partner degree increased ionization force of the air inside the nearness of mist concentrates. The age of the electrical field is the after effects of the undeniable reality that the bigger mist concentrates, that square measure fundamentally charged, have a greater speed of fascination precipitation than the littler, that square measure principally charged pressurized canned products. The ionization in such environmentally locales are caused by component, the centralization of that will increment in seismic tremor arrangement districts. The arrangement, to a great extent apparently dispersed zones of electrical fields with powers of 3×10^2 to 3×10^3 Vm⁻¹ and, on the elective hand, enormous territories with expanded electrical conduction cause a progression of physical impacts, for example the occurrence of infrared discharges with a chose range, which can be examined exploitation earth-based, barometrically and satellite perceptions. This paper, the model of the age of local electrical fields is increasingly created, up to the layout of the power balance on the pressurized canned products inside the air. As of late an arranged research facility test is referenced, that regulated to demonstrate the on paper anticipated escalation of infrared outflows a few hours-days before seismic tremors. Other than the examination revealed, it'll be worked on Kamchatka in the near future to filter to a great extent apparently disseminated locales of electrical fields inside the climate all through seismic tremor planning times.

Keywords: Model, Electric field, Radiation, Element, Seismology.

I INTRODUCTION

As of now for one hundred multiyear, researchers endeavour to search out the best approach to anticipate quakes exploitation antiquated seismologic ways. We tend to trust that, fundamentally, the matter of the long haul forecast of seismic tremors is understood. Anyway to anticipate relate degree quake a few tenths of hours before the flimsy stun stays one among the chief fundamental issues of contemporary geo-material science. It's to be noticed that for a lucky brief time expectation it's not exclusively important to perform geophysics examinations, anyway conjointly multi-directional investigations of the material science of tremors. To boot, an extravagant of arranged more marvels associated with the seismic tremor planning must be comprehended (Liperovsky et al., 1992; Pulnits and Bo-yarchuk, 2006; Molchanov and Hayakawa, 2008; Meister et al., 2011).

In the present paper, previous outcomes on attractive power discharges and varieties of the semi consistent power field before solid tremors square measure outlined. At that point, a system is referenced, that depicts anyway infrared (IR) discharges might be created inside the environment before solid seismic tremors and the manner in which they could be utilized as earth-shake antecedents. A relating physical model arranged in Liperovsky et al. (2005, 2008a) and Mikhailin et al. (2010) is increasingly created and amended. it's clarified that research center works were started to demonstrate this model.

II ELECTROMAGNETIC EMISSIONS AND FORCE FIELD EARLIER THAN STRONG EARTHQUAKES

(a) Luminous and infrared phenomena

The presence of beats of daylight and of elective gleaming marvels, and in this way the age of unusual varieties of the electrical field by tremors are found out for a large number of years before tough shaky occasions (Derr, 1973; Fi-dani, 2010; Grigoriev et al., 1988; Hedervari and Noszticz-ius, 1985; Sobolev and Demin, 1980). Anyway sparkling marvels previously tremors happen once in a while in accordance with recorded sources, heartbeats of daylight, most much of the time enduring a few seconds, were found out all through the most recent multi year before seismic tremors with extents $M > 6$ regards to five percent of the cases (Papadopoulos, 1999). Examination balance warm and IR outflows higher than the middle Asian locale by satellites breaking down day by day, evening time, warm pictures inside the wavelength interim of ten.5– 11.3 μ m (satellite of "Tairis" arrangement, elevation of with respect to five hundred km), the presence of abnormalities was found out (Gorny et al., 1988). They frequently happened inside the crossing points of breaks (Eshov and Uzhenko, 1983). Be that as it may, to disentangle the matter of quake forecast, it's eye catching to take a gander at non-balance IR emanations.

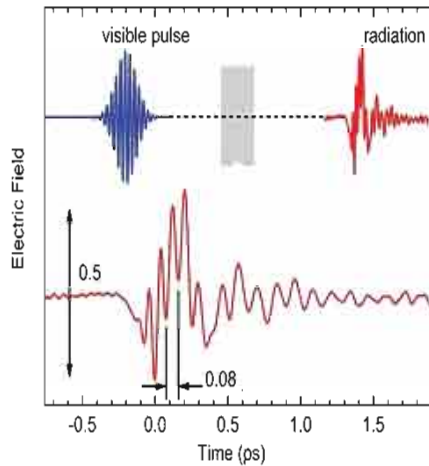


Fig.1 IR impacts inside the air before earth-shakes variation of electric fields with respect to time

It is harsh to search out the physical systems delivering shining and IR impacts inside the air before earth-shakes. This drawback was at that point referenced by Grigoriev et al. (1988), contemplating entirely unexpected theories. as to IR impacts, we tend to as of late consider, for instance, relate degree flimsy mass contribution of the geosphere gas into the environment (see, for instance, Shalimov and Gokhberg, 1998), rising liquids that reason the radiation of warmth gases (see, for instance, Gorny et al., 1998), rising ground water levels and changes inside the dirt wet (Chadha et al., 2003), diffuse CO₂-spread perpetrating an area air wonder (see, for instance, Qing et al., 1991). Further, Freund et al. (2007) exhorted that expanded IR outflows at the Earth's surface emerge from charged particles, claimed "p-gap charge transporters" (by stress broken at first electrically latent p-opening sets, for example intermediary joins (Si⁴⁺, Al³⁺) from the Earth's outside layer once shakes square measure presented to gigantic worries previously precarious stuns. P-openings will move with speeds of 100– 300 ms⁻¹ and that they rapidly diffuse to shake surfaces engender through layers between squares of rocks and through layers of water. The warm oddities happen due to the thermally of vibration partner energized O-O-states. Pulinets et al. (2006) assumed that gratitude to the enhanced component radiation and accordingly the air ionization by the component, the quantity of focuses of water vapour build-up will increment inside the air. All through the build-up, a larger than usual amount of warmth vitality is released offering ascend to warm oddities.

In the present work, it's conjointly expected that IR discharges square measure caused by radiating gases like component. Anyway to boot relate degree up spilling of air adds to the excitation of brief time drive field beats. Non-balance IR emanations happen because of these electrical fields. the central thoughts of the model were at that point offered well in Liperovsky et al. (2005, 2007a, b, 2008a, b) and square measure condensed in Sect. 3. The structure of the gleaming areas, spoken to by observers and summed up by Derr (1973), off and on again has the

state of a half-circle with a sweep of 10– 100 m reaching the Earth's surface. Elective structures were single light-weight beats, fireballs, groups, lights or sections of daylight. Inside the season of life, composing verification of gleaming impacts associated with seismic tremors was gotten. All to get her theories, it had been thought about that the clarification for the tremor lights is relating degree irregular power field.

(b) Variations of the semi steady power field.

unwelcoming edge zone further upper east, Performing test investigation works in regards to the peculiarities of the vertical power field in seismic tremor planning territories, it had been realized that enduring partner degree irregularities of the electrical field and vertical flows happen all through the essential hours the essential tenths of minutes before temperamental stuns at separations of up to two hundred metric straight unit from the epicentre even once unmistakable wellsprings of a barometrically nature square measure missing. There, an on the spot reliance of the force of the anomalous varieties from the parameters of the seismic tremor doesn't exist (Rulenko et al., 1996). anyway in accordance with our information, irregularities of the electrical field and of vertical flows demonstrating several days prior to seismic tremors square measure exclusively explored for a minor low number of occasions exploitation stationary establishments inside the close surface environment.

Rulenko (2000) found that it's shoddy to isolate the learned irregularities of the electrical field near the Earth's surface into 2 sorts. The essential kind compares with the decline of the force of the electrical field from costs that relate to shrewd or for all intents and purposes climate directly down to a smaller than expected max esteem Emin, and a following development to power esteems which almost measure up to the previous dimension. Thusly, here and there the value of Emin ends up negative. The trademark term of such partner degree peculiarity parallels 0.3– 4 h. The second kind is additionally spoken to as a bundle of motions with an exact scope of frequencies that abruptly happen before the ordinary or for all intents and purposes typical environmentally foundation drive field. The trademark span of this peculiarity is 0.2– 4 h, and along these lines the measure of motions is inside the interim between various seconds and 1.5– 2 h. The abundance of the motions is additionally over and over bigger than the foundation field. Examinations related with the estimating and investigation of the varieties of the semi consistent power field square measure spoke to inside the works by Mikhailov et al. (2004, 2005) and by Smirnov (2005). Normally the abnormalities of the electrical field previously and without a moment's delay the shaky stun square measure in regards to match of requests of size bigger than the foundation esteems. The preeminent likely cost of sound shaped varieties at heights of a few kilometres higher than the Earth's surface equivalent 100 – 300 Vm⁻¹. Their length keeps going 40– 200 min. Such trademark time sizes of non-stationary procedures have a place with Frenkel

mists (Frenkel, 1949), that square measure spoke to underneath.

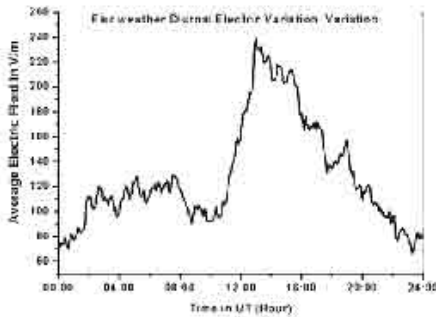


Fig.2 diurnal Variations of the semi steady power field (average electric field in V/m)

It is outstanding that the breakdown voltage amid a cloud approaches $3 \times 10^6 \text{ Vm}^{-1}$. Anyway at partner degree ionized air radiation, the electrical releases happen at lower fields. Here, radiation plays an occupation that frames minor semi vertical plasma channels, the asserted "parts of the plasma tree". All through a short time-interim, between the branches the vertical component of the electrical conduction will increment. Correspondingly the electrical field diminishes, and out of entryways of this locale the electrical field, in refinement, increments. It should be referenced that the probability of the rate of escalated air showers with energies higher than 1015 electron volt is monstrous. Amid a cloud with a ground space of 13 km2 it's in regards to 30 s-1 (Ermakov and Stoshkov, 2003).

(c) Model of the non-stationary Frenkel generator
The model of the non-stationary Frenkel generator of electrical fields arranged in Liperovsky et al. (2005; 2007a, b; 2008a,b) is predicated on the degassing of the Earth's centre, the infusion of component into the air relate degree an upward coordinated barometrically wind. The vertical molecule movement inside the climate is solid by the local warming procedures at the Earth's surface higher than the shaky areas, and it conjointly becomes because of water build-up at vaporizers,

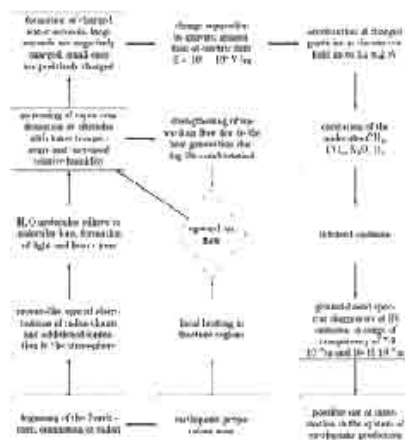


Fig. 3 Grouping of procedures prompting the age of infrared outflows inside the climate before quakes.

The centralization of that is expanded by the degassing. Thus, the model proposes a non-homogeneous, unusual ionization of the climate at elevations of 10- 20 metric straight unit higher than close within reach unsteady stoma. an electrical field with trademark measurements inside the request of numerous kilometres occurs and mosaic-likely disseminated, affirmed Frenkel square measure as of non-stationary electrical fields are designed inside the air higher than precarious areas. the electrical fields have time sizes of 30- 100 min. The Frenkel square measure the supply of non-balance propalstable IR discharges inside the wavelength area of 8- 15 μm . they'll be utilized in the arrangement of seismic tremor forecast. The substance of the spoke to procedures of the model is outlined in Fig 3.

In this way, in accordance with the model, it had been accepted that underneath the condition that the electrical fields the antecedents of earth-shakes inside the close earth climate square measure too small to even think about causing a leap forward (happening at $3 \times 10^5 \text{ Vm}^{-1}$) and in this manner the excitation of unmistakable outflows ($3 \times 10^5 \text{ Vm}^{-1}$), so they would conceivably all the equivalent be sufficiently durable to get non-harmony IR emanations. In any case, a general rule, all apparent to be harder. Enable us to consider a few subtleties of the model, and enable us to build up the model more.

In this way, in accordance with the model, the whole power field amid a Frenkel space is that the advertisement of the most foundation drive field $E_0 = 130 \text{ Vm}^{-1}$ and along these lines the further field E caused by the charge partition inside the mists (for example by a Frenkel generator).

III RECENT EXPERIMENTS TO PROVE THE NON-STATIONARY FRENKEL GENERATOR MODEL

(a) SRINP research laboratory works

As of late, at the exploration Institute of common rationality (SRINP) of the Russian capital Lomonosow State University, the examination of district wellsprings of IR discharges predicted by the model of the non-stationary Frenkel generator is performed by experimentation. IR spectra expected to be extraordinary before seismic stoma inferable from the activity of electrical fields of two 10^2 to 10^6 Vm^{-1} all through tremor planning times region unit examined. In elective words, changes of the power of district IR spectra inside the air higher than seismodynamic areas territory unit broke down underneath research centre conditions. Amid the lab tests, IR outflow spectra amid an expansive band of wavelengths predicted by the hypothetical model zone unit pondered. Stock of plasma-synthetic responses zone unit examined, explicitly component and component mixes. We will in general choose to examinations the shape changes of the retention and emanation spectra due to the vibration vitality dimensions of district stoma. Into the release chamber, totally extraordinary measures of texture containing component, gas relate corrupt carbon mixes region unit put into a proceeding with field of

power with a force of up to 10^5 Vm⁻¹. As after effects of the performed investigation, the otherworldly interims of the IR discharges at powerless changes of the difference in respectability of the air region unit decided.

To play out the test, an office for the enlistment of the assimilation and emanation spectra inside the wavelength interim between 0.3 μm and 16 μm is built up. The trial could likewise be performed at weights between 0.1 atm and 1.0 atm. The addition of the fluctuated gases, vaporizers and liquids into the working chamber and into the assimilation cell region unit controlled in the working chamber and inside the retention cell, that region unit loaded with area air and one in every one of the materials O₂, N₂, CO₂, O₃, CH₄, N₂O, NO₂, CO, H₂O, a release is started. In light of the consequences of the research facility tests, we will in general imagine to develop a simple exceptional IR crystal spectroscopy which can watch the IR outflows in seismo-dynamic locales on Kamchatka and in Tajikistan

IV DISCUSSION OF THE RESULTS AND CONCLUSIONS

Prior to quakes, the arrangement of mosaic-likely disseminated areas of increased ionization, strong semi stationary electrical fields, and IR-discharges inside the climate higher than seismo-dynamic districts wherever cracking happens is achievable. Inside the present work, it is demonstrated that the varieties of the electrical fields by each the thick powers of the air and furthermore the speeding up of the vaporizers inside the field of power could likewise be of steady request. Mulling over the upward wind currents inside the hypothetical model, one should see zones of IR-outflows at heights up to fifteen metric direct units.

The planning of the far off perception of the in principle predicted IR discharges inside the straightforwardness locales with wavelengths changes 7– 9 μm and 10.3– 15 μm. Examining perceptions of IR-emanations will be performed from 2 totally unique focuses having a separation of 10– 40 metric straight units from one an-elective. One expects the occurrence or escalation of IR outflows at interims the otherworldly groups of CO, CO₂, NO₂, CH₄ and O₃ inside the mosaic-likely appropriated radiating regions inside the climate higher than seismic tremor arrangement districts. The Frenkel space perception spoke to inside the blessing work might be a ground based one. Obviously, as electrical fields inside the D-layer could likewise be learned by satellites, the perception of the Frenkel regions should even be achievable by satellites similarly to the perception of D-layer unsettling influences by radiation belt negatron precipitation before seismic stuns (see, for example, Anagnostopoulos et al., 2011; Ouzounov et al., 2008). to separate the aftereffect of the Frenkel territories from that of radiation belt electrons, elective district parameters should be enrolled at consistent time simply like the file and radio recurrence waves delivering the precipitation.

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Consultative Selling: An Augmentative Selling Approach for Customer Satisfaction in Banks

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ABSTRACT

Complexity of financial services made the task challenging for both buyer and the seller to close a deal. Financial industries are experiencing a vulnerable phase to deal with the elevation of prevailing unethical sales practices resulting in the customer dissatisfaction. Consultative selling has been emerged as a problem solving selling approach. Researcher has undertaken this study to investigate the applicability of consultative selling on the customer satisfaction in banks. A conceptual framework model of consultative selling has been proposed and tested on 123 salespersons and 155 customers of select leading banks of Silchar city of Indian state of Assam. The proposed model is based on four dimensions of consultative selling and three important dimensions of customer satisfaction. Relationship among the variables has been tested using Pearson Correlation test. Results showed that all the four independent variables of consultative selling: Need identification, Knowledge & Expertise, Effective Communication & Problem solving have strong significant positive relationships with three dependent variables of customer satisfaction: Attentiveness, Helpfulness and Responsiveness. Study revealed that customer found consultative salespersons as attentive, helpful and responsive that helps to solve customer's problem and increases customer satisfaction level. Principle component analysis (PCA) has undertaken to extract the components that accelerate consultative selling in banks. Self administered questionnaire distributed among 123 salesperson of select private banks of the study area. Individual factor and Organizational factor have been extracted as two prominent components containing variables with high component loading that accelerate consultative selling in banks.

Key words: Consultative Selling, Customer Satisfaction, Bank, Problem solving approach

I INTRODUCTION

Banking reforms in 90's led to a dramatic change in the Indian banking industry. Deregulations, technological innovations, rise of customer expectations etc. made the Indian banking industry very competitive. Entry of private payers and foreign banks intensified the competition further. Banking sector reform committee under the chairmanship of Shri M. Narasimhan highlighted the intensification of competition in the banking industry due to the liberal entry of private payers (Mahalingam, S. 1998). In order to stay ahead of the competition and to get competitive advantage, private sector banks emphasised on personal selling. They brought the banking services at the door step of the customers with the help of their professional sales team. Sales has become an inevitable part of today's banking industry all over the world. "Selling is fast becoming the fundamental tenet for success in today's financial services market place. If you don't sell, your bank will die? It's as simple as that" (Letourneau, p. 105, 1997). It has been revealed in many researches that today's banking industry has been turned into a sales organization with special emphasis on personal selling (Schwepker & Good, 1999).

Over emphasised on sales target and lack of effective sales practices resulted in the negative impact on the customers of the bank. Many salesman adopted unethical sales practices to achieve the target and generate revenue for the bank. Intensive competition and high pressure on sales force resulting in negative impact on their ethical behaviour (Schwepker & Good, 1999). It has been revealed in many studies that traditional

transactional sales strategies which are still prevailing in many organizations led to the customer dissatisfaction. Transactional selling proposed that it is not the job of a salesman to understand the need of the customers through interactive discussion but to search new prospects in the market and generates revenue by selling the products (Shinn 1982; Futrell 1984). With the passage of time, many modern sales strategies such as consultative selling, adaptive selling, versatile selling, relationship selling etc. have been adopted by many organizations around the world.

Strategies adopted for marketing or selling of services would be different from those of physical goods. Sinha (P.84, 2015) stated that "The success of any service industry depends more on how they sell rather than what they sell. Selling of services is little difficult than that of selling of products because of the four distinctive features which make services different from that of products namely intangibility, inseparability, variability and perishability. Intense competition has created a challenge for the financial organizations such as banks to sell their services". There has been a paradigm shift in the sales strategies of the banks, from traditional transactional selling to modern consultative selling. Consultative selling consists of identification of actual need of the customer and providing adequate solution to the customers (Picarelli, 1989).

II REVIEW OF LITERATURES

Graham (1996) studied the attitude adjustment in American salesman. He highlighted the importance of consultative selling in the attitude adjustment of salespersons. He pointed out that consultative selling involves effective communication between sales person and the customers which helps in the identification of customers' need and providing of specific solution. Thompson (1989) studied the consultative selling practices in industrial sales. He studied the application of consultative selling tool in Monte Carlo Product portfolio analysis. Author proposed a Monte Carlo simulation approach to product portfolio analysis that overcomes the limitations of the process given by Coppett and Staples (1980). Kahn and Shuchman (1961) argued that consultative selling are suitable for firms those who are involved in selling technical products because technical selling needs in-depth knowledge of products, customers and market. Picarelli (1989) studied the four problem solving phases of consultative selling approach. The phases are Confirmation of objectives and establishment of rapport, search of information and determination of clients need, presentation of program, and handling of objections and closing of sales deal. Riso (1981) studied the application of consultative selling to the small businesses. Author revealed that consultative selling is an effective selling tool even for the small businesses. He further added that consultative salespeople must have the in-depth knowledge of market at each level of supply chain and he must be able to communicate that knowledge to add value to the customer. Verhallen, Greve and Frambach (1997) studied the consultative selling in financial services special emphasis on banking. Authors revealed that advisers did not focus on the client need identification rather focus on demonstrating alternative product solution. Advisers focus was more products oriented and less need oriented. Liu (2001) examined the customer satisfaction and the perceived credibility of consultative salespeople. Author found that sales personnel can increase customer satisfaction by enhancing their image with the customers. Customer satisfaction is the prime concern for every organization. Bielen & Demoulin (2007) revealed that Attentiveness, Helpfulness and Responsiveness are the most essential elements of customer satisfaction. Mistry (2013) studied the customer satisfaction measurement in banking sector. Author studied the SERQUAL model in banks and revealed that factors for customer satisfaction in banks are Reliability, Responsiveness and Assurance. Sabir *et al.*, (2014) studied the factors affecting customer satisfaction in banking sector. Authors revealed that there is significant relationship between service qualities attributes and customer satisfaction in banks.

III PROBLEM STATEMENT DEFINED

Spontaneous rise of complaints of unethical sales practices created a serious concern for today's banking industry around the world. It is revealed that many salespersons sell a product to the customer without analysing the need of the customer. It has resulted in the loss of customer's trust and lead to the customer dissatisfaction. This study has been undertaken to understand the applicability of consultative selling in banks and its impact on customer satisfaction. An attempt has been made by the researcher to identify the factors that accelerate consultative selling in banks.

IV OBJECTIVES OF THE STUDY

- (a) To investigate the influence of consultative selling on the customer satisfaction in banks.
- (b) To determine the factors that accelerates consultative selling in banks.

V CONCEPTUAL FRAMEWORK AND HYPOTHESIS FORMULATED FOR THE STUDY

(a) Consultative Selling

Consultative selling is a modern innovative sales technique. It is a selling strategy where a sales person performs the job of a consultant or expert and provides customized advice (Anderson and Dubinsky, 2004). In consultative selling, a customer view sales person as a business expert or industry expertise (Smith, 1991). So a consultative salesman must possess in-depth knowledge of the product and the market (Riso, 1981). A salesperson in consultative must undergo detailed discussion with the customer to identify his actual need and there must be a two way communication in consultative selling between customer and sales person. Financial services such as banking, insurance are complex in nature and they need personal advice to sell (Ashforth, 1986). Consultative selling method is highly suitable for the products which are very complex in nature that requires a match between customer needs and product features (Chevalier, 1993). Therefore, consultative selling is used as an effective tool in banking industry where bankers act as consultant for their customers.

Researcher in this study has attempted to understand the influence of consultative selling on customer satisfaction in banks. The following hypothesis has been framed by the researcher to achieve the objective of the study:

H1 = Consultative selling is positively related with customer satisfaction in banks.

Two variables have been identified for the purpose of the study: *Consultative Selling* as independent variable and *Customer satisfaction* as the dependent variable. Consultative selling again

categorised into four sub-variables for the purpose of the study: Need identification, Knowledge & expertise, Effective communication, Problem solving approach.

- (b) **Need identification:** A consultative sales person must possess the skill to identify the actual need of the customer. Consultative selling is a very effective sales method where the focus has been given on the identification of the need of the client and offering of the adequate solution for the satisfaction of the need (Picarelli, 1989). A consultative sales person has to identify the need of the customers and accordingly specific solution to the problem must be offered. There should be a match between customers' need and products features (Chevalier, 1993).
- (c) **Knowledge & Expertise:** In consultative selling, a customer viewed sales person as an expert (Smith, 1991). Hence it is very important for a salesperson to have extensive knowledge and expertise about company's products, knowledge of competitors and knowledge of market. Ko and Dennis (2004) highlighted that a sales person must have a "deep base of organizational, contextual, and domain knowledge". Riso (1981) pointed out that a consultative sales person must have extensive knowledge of the product and the market.
- (d) **Effective Communication:** Consultative selling involves two way communications between buyer and seller (Picarelli, 1989). In consultative selling, apart from being a good communicator, seller must also be the good listener. A seller must listen to the buyer and tries to identify the need of the buyer. Ingram et al. (2006) stated that traditional transactional selling involved one-way model of communication whereas consultative selling involves two way model of communication.
- (e) **Problem solving approach:** Consultative selling involves identification and solution of customers' problem. Salesman in consultative selling should focus on offering specific solution to the customer problem rather than typical product selling. A salesman should act as a consultant and give advice to the client for solving the problem currently facing them (Campbell, Graham, Jolibert and Meissner, 1988). Recognition and providing customized solution requires high involvement from both seller and the buyer in consultative selling (Pardo, 1997).

VI CUSTOMER SATISFACTION

Customer satisfaction has been considered as the dependent variable in the study. Customer satisfaction is the central theme of every organization. Customer satisfaction is the different between customer expectation and the actual performance.

Expectation > Actual Performance = Customer dissatisfaction

Expectation = Actual Performance = Customer satisfaction

Expectation < Actual Performance = Customer Delight

Tse and Wilton, (1988) defined customer satisfaction as "the consumer's response to the evaluation of the perceived discrepancy between prior expectations and the actual performance of the product perceived after its consumption". Customer is the supreme power in today's market and is considered as king (Prabhakaran and Satya, 2003). Studies revealed that the customer dissatisfaction is the prime cause for which customer shift to other banks (Manrai and Manrai, 2007). Customer satisfaction is the antecedent of customer loyalty (Kracklauer, Mills et al. 2004). Loyal customer spread positive word of mouth and increase repeat purchase (Bedi, 2010). Attentiveness, Helpfulness and Responsiveness are the important of customer satisfaction (Bielen *et al.*, 2007:188). It has been studied by Bielen and Demoulin, (2007) that a customer satisfaction enhances when he gets proper attention by the seller and the products or services offered to him is found to be helpful. Along with that seller must give quick response to the customers' queries & complaints all the time. Hence researcher considered these three sub-variables as essential elements for measuring impact on customer satisfaction.

In order to investigate the influence of consultative selling on customer satisfaction, it is important to determine the type of relationship exist between the two variables. Researcher proposed a conceptual model (Fig: 1) to indentify the relationship between consultative selling and customer satisfaction in banks. Four dimensions related to consultative selling have been identified such as: Need identification, Knowledge & Expertise, Effective Communication & Problem solving. On the other hand, three dimensions related to Customer satisfaction have been identified such as: Attentiveness, Helpfulness and responsiveness. Model depicts the relationships between each of the independent variables with each of the dependent variables. The strength relationships between the variables have been measured by using correlation coefficient "r". Pearson correlation coefficient has been conducted to identify the type of relationship exist between the variables.

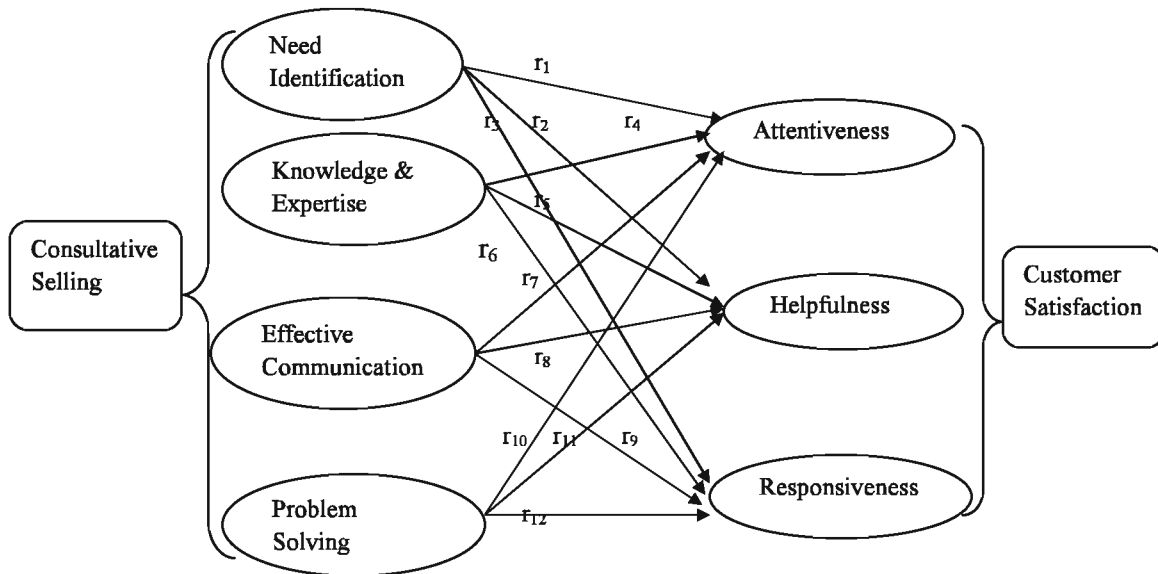


Fig. 1: Proposed Conceptual Framework Model of Consultative Selling and Customer Satisfaction

Source: Field Survey

VII METHODOLOGY

The study is based on descriptive research design. This study has been under taken by the researcher on the customers of select private sector banks of Silchar city of Indian state of Assam. The study has been undertaken in the period of February & March, 2018. Private sector banks have been considered for the purpose of the study because they have a proper sales force which is lacking in public sector banks of that region. Leading private sector banks such as HDFC Bank, ICICI bank and Axis Bank have been considered for the purpose of the study. One branch of each bank has been targeted for the study. Self administered questions are used to collect the responses from 155 target respondents using convenience sampling method.

**Table No: 1
Sampling distribution**

Bank Name	Number of customers
HDFC BANK	52
ICICI BANK	53
AXIS BANK	50
Total	155

Source: Field survey

Respondents were asked to rate their degree of agreement on five point likert scale where five indicates strongly agree and one indicates strongly disagree. Responses collected were tabulated and analysed by using SPSS software. Reliability of the instrument has been measured using Cronbach's Alpha test and it is found to be reliable at $\alpha = 0.910$. Pearson Correlation test has been conducted to test the relationship between the variables. Confidence level has been considered as 95% where level of significance is 5% i.e. $\alpha = 0.05$.

Table No. 2
Pearson Correlations

		Need Identification	Knowledge & Expertise	Effective Communication	Problem Solving	Attentiveness	Helpfulness	Responsiveness
Need Identification	Pearson Correlation	1	.801**	.910**	.905**	.750**	.849**	.784**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	155	155	155	155	155	155	155
Knowledge & Expertise	Pearson Correlation	.801**	1	.752**	.724**	.704**	.773**	.761**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	155	155	155	155	155	155	155
Effective Communication	Pearson Correlation	.910**	.752**	1	.809**	.698**	.739**	.711**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	155	155	155	155	155	155	155
Problem Solving	Pearson Correlation	.905**	.724**	.809**	1	.645**	.795**	.737**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	155	155	155	155	155	155	155
Attentiveness	Pearson Correlation	.750**	.704**	.698**	.645**	1	.688**	.629**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	155	155	155	155	155	155	155
Helpfulness	Pearson Correlation	.849**	.773**	.739**	.795**	.688**	1	.694**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	155	155	155	155	155	155	155
Responsiveness	Pearson Correlation	.784**	.761**	.711**	.737**	.629**	.694**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	155	155	155	155	155	155	155

** . Correlation is significant at the 0.01

Source: Field Survey

Result showed that each variable has a strong positive correlation with other variables. *Need Identification*, an independent variable has positive strong correlation with the dependent variables Attentiveness ($r_1=0.750$), Helpfulness ($r_2=0.849$) and Responsiveness ($r_3=0.784$). The significance (p value) is 0.000 in the respective cases and which is less than alpha value ($\alpha=0.05$). Similarly in case of other independent variables such as *Knowledge & Expertise*, correlation with dependent variables Attentiveness ($r_4=0.704$), Helpfulness ($r_5=0.773$) and Responsiveness ($r_6=0.761$) with the significance value (p value) 0.000 and is less than alpha value ($\alpha=0.05$). Independent variable *Effective Communication* has the strong positive relationships with the dependent variables Attentiveness ($r_7=0.698$), Helpfulness ($r_8=0.739$) and Responsiveness ($r_9=0.711$) having significance value (p value= 0.000) which is less than alpha value ($\alpha=0.05$). Independent variable *Problem solving* has the strong positive relationships with the dependent variables Attentiveness ($r_{10}=0.645$),

Helpfulness ($r_{11}=0.795$) and Responsiveness ($r_{12}=0.737$) having significance value (p value= 0.000) which is less than alpha value ($\alpha=0.05$). In all the cases the significance value (p value) is less than alpha value (0.05). Hence null hypothesis framed earlier has been rejected and alternative hypothesis has been accepted.

It is found that independent variables Need identification, Knowledge & Expertise, Effective Communication & Problem solving that constitute *Consultative selling* has strong significant positive correlation with the each of the dependent variables Attentiveness, Helpfulness and responsiveness that constitutes *Customer satisfaction*. Significant positive relationship between the consultative selling and customer satisfaction indicates that with the increase of applicability of consultative selling in banks there will be a simultaneous increase in the customer satisfaction.

VIII FACTORS OF CONSULTATIVE SELLING

It has been established that consultative selling has positive influence on customer satisfaction in banks. So it is very important to determine the factors that accelerate consultative selling in banks. On reviewing literatures, it has been found that there are numbers of factors that are essential for consultative selling in an organization such as knowledge & skill of the sales person, experience, ethical value of the sales person, training provided to the sales person etc. A sales person must have extensive knowledge about the market that includes about the company's products, policies, competitors, Govt. policies etc. (Ko and Dennis 2004). In consultative selling customer considered salesman as expert (Smith, 1991. Hence a salesman must have knowledge about company, customer and competitors. Salesman must act as consultant or adviser in consultative selling (Anderson and Dubinsky (2004).

In consultative selling, it is very important for a salesman to communicate with the customer effectively to understand his problem and solve his problem. A salesman must possess effective communication skill and problem solving skill in consultative selling. Picarelli (1989) pointed out that there must be a two way interactive communication between salesman and customer in consultative selling. It would help a salesman to understand customer's problem and offer his a customised solution (Pardo, 1997). Hunt and Vitell (1986) highlighted the ethical value of the sales person. Ethical value of the salesperson determines his ethical behaviour in sales. A high ethical value indicates the high ethical practices in sales whereas low ethical value indicates unethical practices in sales. In order to impart ethical value and enhance knowledge and skill of the salesperson, he must undergo different types of training provided by the organizations such as

ethical training, product training, skill training etc. Ramsey *et al.*, (2007) argued that ethical values can be imparted through sales training apart from product training. Organizational culture is another essential variable in consultative selling. Organizational culture is a set of shared values and norms among the employees of the organizations. It shapes the individual behaviour in the organization (Maignan & Ferrell, 2004). A consultative culture must be created in the organizations among the salesperson. Supervisor also played an important role in consultative selling. Supervisor should monitor the sales process adopted by the sales people in the organizations. He should take the initiative to implement the practice of consultative selling in the organization. He must encourage the salesperson to practice consultative selling in the organization.

On reviewing different research studies, researcher has pointed out some of the possible variables that might accelerate consultative selling in an organization. These are Experience, Knowledge, Skill, Ethical value, Consultative nature, Training, Organizational culture, Supervisor role. As there are large numbers of possible variables, hence it is important to reduce these variables into possible factors. Researcher has attempted to conduct principle component analysis (PCA) to indentify the underlying components.

IX PRINCIPLE COMPONENT ANALYSIS (PCA)

Self administered questionnaire were distributed among the 123 salespersons of select private sector banks (HDFC Bank, Axis Bank & ICICI Bank) of the study area using convenient sampling. Respondents were asked to give their degree of agreement on five point likert scale, where 5 indicates strongly agree and 1 indicates strongly disagree. Responses collected were analysed using Principle component analysis (PCA).

Table: 3
Communalities

	Initial
Knowledge	1.000
Skill	1.000
Ethical Value	1.000
Training	1.000
Organizational Culture	1.000
Supervisor Role	1.000

Extraction Method: Principal Component Analysis.

Source: Field Survey

Table: 4

Total Variance Explained

Component	Initial Eigen values			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.236	53.932	53.932	2.672	44.541	44.541
2	1.275	21.249	75.181	1.838	30.640	75.181
3	.775	12.914	88.095			
4	.598	9.969	98.064			
5	.087	1.446	99.511			
6	.029	.489	100.000			

Extraction Method: Principal Component Analysis.

Source: Field Survey

Table 3 depicts the communalities extracted from PCA method and table: 4 indicate the total variance. Total variance (Table:4) help us to identify the actual number of components extracted using Eigen Values, Percentage of variance and Cumulative percentage. Eigen Value is higher than 1 in case of component 1 (E=3.236) and component

2 (E=1.275) and the percentage variation is 53.932 and 21.249 respectively. It revealed the percentage of variability that can be accounted for each factor. Two principle components have extracted from the analysis (Component 1 & Components 2) and rest all other components are not extracted as they are insignificant in nature.

Table: 5

Rotated Component Matrix^a

	Component	
	1	2
Knowledge	-.033	.878
Skill	.272	.687
Ethical Value	.289	.669
Training	.942	.056
Organizational Culture	.914	.263
Supervisor Role	.890	.273

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Source: Field Survey

Rotation component matrix depicts the variables with high loading under each principle component extracted. It has been found that first three variables- Knowledge (0.878), Skill (0.687) and Ethical Value (0.669) have high loading under component 2 whereas next three variables Training (0.942), Organizational Culture (0.914) and Supervisor Role (0.890) have high loading with component 1. It can be concluded that first three variables (Knowledge, Skill and Ethical Value) formed one component and next three variables (Training, Organizational Culture and Supervisor Role) formed another component.

Knowledge, Skill and Ethical value are related to individual attributes of an individual; hence component loaded with these variables can be termed as *Individual factor*. On the other hand, other variables Training, Organizational Culture and Supervisor Role related to organizational attributes; hence component loaded with these variables can be termed as *Organizational factor*.

X SUGGESTIONS & CONCLUSION

Consultative selling involves two way communications between seller and the buyer. It helps the seller to identify the problem faced by the buyer and offer customized solutions. Researcher developed a proposed conceptual model of consultative selling to investigate the effect of consultative selling on customer satisfaction. This model has been tested on the customers of select banks in the Silchar city of Indian state of Assam. Four variables of consultative selling and three variables of customer satisfaction have been identified. Study revealed that there are significant positive relationships between all the four variables of consultative selling such as Need identification, Knowledge & expertise, effective communication & Problem Solving with the three variables of customer satisfaction such as Attentiveness, Helpfulness and responsiveness. It can be concluded that consultative selling can be used to enhance customer satisfaction in banks. PCA methods have undertaken to extract the principle components that accelerate consultative selling in an organization. Six variables have been identified for the purpose of the study. Using PCA method, two principle components have been extracted with higher loading of variables. One factor related to the individual attributes of the salesperson and the other factor is related to the organizational attributes. It can be concluded that both individual factors and organizational factors are very crucial for the consultative selling. These accelerate the growth of consultative selling in the organization. Further researcher advised all the banks and other financial institutions to give their prime focus on consultative selling as their sales practices. It will increase customer loyalty and customer retention by enhancing customer satisfaction in banks. It will also reduce the prevailing problems of mis-selling.

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Training and Private Life Insurance Company's in India

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ABSTRACT

In today's scenario, insurance companies are seen to be moving from 'selling' insurance to 'marketing' an essential financial product. Hence, having a robust, well oiled & trained taskforce is paramount to the development, growth & spread of Life Insurance in India. There are currently 23 private players in the Indian Life Insurance Industry. This write-up is basis a close observatorial study on a few of these prominent private players and the training and enablement in these Private Life Insurance Companies (PLICs). While studying the Training Needs Identification, the one factor found standing out in each of these PLICs, has been their respective Cost-Benefit Analysis. While researching the various Training & Learning Models in vogue at most of these PLICs, specifically found the use of a) The Six Disciplines of Breakthrough Learning [Roy V. H. Pollock, Andy Jefferson & Calhoun W. Wick]; b) Four Levels of Training Evaluation [Donald L. Kirkpatrick, James D. & Wendy]; & c) Return on Investment (ROI) [J J Philips] in practically every case studied. Finally, the government's push towards 'Universal banking' has made most of the banks warm up to the 'fee based Income' avenue in a big way. No wonder if one looks up the list of Insurance Companies as existing today, 18 of the 23 Life Insurance companies have a Bank tie-up for distribution purposes, and this 'banc assurance' number is going to get prolonged further. The open question then is, Are the Private Life Insurance Companies (PLICs) manpower ready to bear the huge push towards Training & Development in these times of mass tie-ups in Bancassurance?

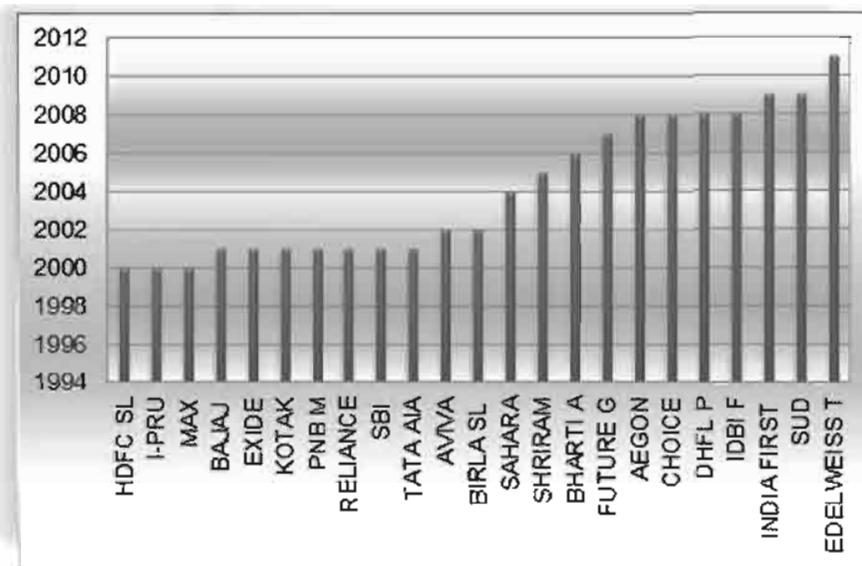
I INTRODUCTION

Insurance as a subject finds mention in the Seventh Schedule of the Constitution of India and is listed in the Union List. Having a robust, well oiled & trained taskforce is paramount to the development, growth & spread of Life Insurance in India. In today's scenario, insurance companies are seen to be moving from 'selling' insurance to 'marketing' an essential financial product. The distributors have to accordingly become trusted financial advisors for the clients and trusted business associates for the insurance companies. It is thus imperative for

organizations in this sector to continually train their work force and keep them updated with business-critical information.

II STATUS REVIEW

There are currently 23 private players in the Indian Life Insurance Industry. As mentioned in the Insurance Regulatory & Development Authority of India (IRDAI) website, the first licence was granted in 2000 with 2011 being the year since the last License approval was rolled out.



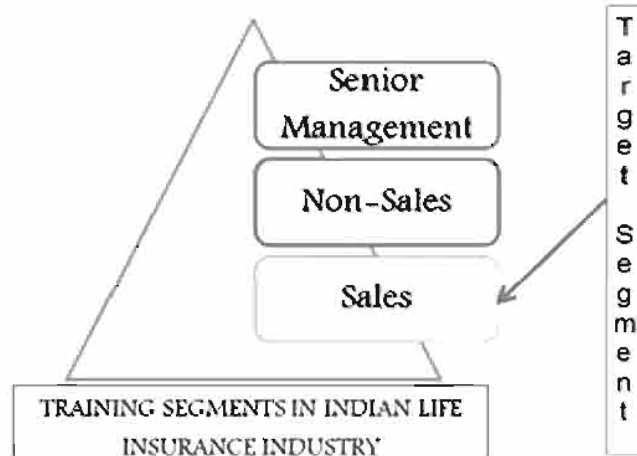
[Source: IRDAI Journal & website]

The current private players in the Indian Life Insurance Industry with year of incorporation.

All roads lead to 'Bancassurance' is what one would be led to believe while on the distribution strategy that exists in most of these Private Life Insurance Companies, today. According to a Credit Suisse report (released in June'17),

"The private sector has significantly regained lost market share."Bancassurance has now emerged as the primary distribution channel, with 53% share in FY16 from 21% in FY10 among private insurers."

While on the Sales Training aspect in these organisations, there is observed to exist distinct Target segments. Broadly speaking, the segments are the Sales Force, the Non-Sales Segment & the Senior Management team.



[Ideated from IRDA Journal Feb 2010]

ORGANIZATIONAL LEVEL/ DEPARTMENT	TRAINING MODULES ADMINISTERED
Sales staff/agents	Sales effectiveness , Product knowledge, Communication, Using IT, Problem solving
Non Sales staff	Business environment, Operational Policies, Product concept and design, Underwriting, Actuary, After-sales service, Compliance, Settlement process and fraud investigation
Senior Management	Solvency, Capital requirements, Corporate Governance, Regulatory/audit Compliance, Risk Management

[Source: http://www.irdaindia.org/journals-10/irda_feb10.pdf]

Also in most of/all the Private Life Insurance Companies, the Department of Sales Training reports into the Chief Distribution Officer/Head of Distribution & Sales/Director (Sales) - [Source : Market Intelligence].

Accordingly if one were to look into the Learning & Developmental aspects that go into the profile of a Sales Trainer in these organisations, more often or not it is basis 'Sales', despite the fact that the department is known as Sales Training.

What then makes a Sales Trainer in such organisations?

While researching with the Training fraternity attached to these PLICs, observe a detailed presence of the following -

III TRAINING AND DEVELOPMENT NEEDS IDENTIFICATION

The purpose of Training Needs is to bridge the gap between the participants - Desired capability and the Current level of capability..Keeping this in mind, we can understand it from fig 1

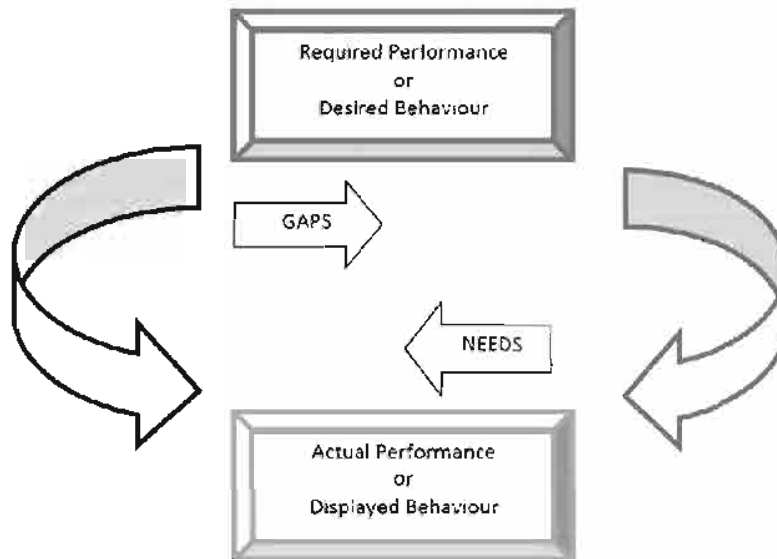


Fig. 1 Training needs identification

In majority of these Private Life Insurance Companies, Training Needs Identification is an actionable which is carried out, but more often than not falls short of short of getting implemented.

Having monitored and observed the Training Needs Identification being taken up, can safely put forward the steps being followed while Identifying the Developmental Training needs in such organisations as given in fig 2



Fig. 2- Development Training Needs

If one looks up the typical distribution verticals that exist in the Private Life Insurance Companies today, one comes across varied training needs that's typical to each one of them – be it the Tied-Agency Vertical, or the Corporate-Agency one, be it the Broker vertical or the Direct Sales Force be it the MLM/Mass Market or even the Bancassurance one.

IV COST-BENEFIT ANALYSIS

As we have already noted, in the 23 Indian PLICs (Private Life Insurance Companies), training is always a 'support' function. As such it is ordained to be a 'cost' centre than a 'revenue' one. Accordingly, the concept of 'profit(ability)' is practically non-existent here.. One the other hand, 'Evaluation of

training' remains a distinct measurable in terms of the 'impact' the training is seen to have generated..

While acknowledging the importance of Training, the CBA (Cost-Benefit Analysis) here certainly gains prominence amongst the vast multitude of beneficiaries when also measured in terms of the ROI (Return on Investment) the training generates.

Connecting with Sales Trainers in a few of these Private Life Insurance Companies, and also looking up the Benefit/Cost Ratio [BCR = (Total Monetary Value of Benefits) / (Cost of Training)] in J J Philips in his book – 'ROI in training & Performance Improvement Programs' enables us to draw up the following specifics when it comes to Training Costs & Returns as depicted at table 1

Table 1
Training Costs & Returns

Training Type	Relative Cost
On-the-job coaching and mentoring	₹
Self-directed study	₹
Video presentations	₹
Job shadowing	₹
Satellite distance learning (e-learning)	₹ ₹
Seminars	₹ ₹
One-to-one tutoring	₹ ₹
General Management Programs	₹ ₹ ₹
Group workshops (external)	₹ ₹ ₹
Consultant training (in-house)	₹ ₹ - ₹ ₹ ₹

Legend: ₹ - Least Expensive, ₹ ₹ - More Expensive, ₹ ₹ ₹ - Most Expensive

Not for nothing then, most of these organisations, push for On the Job Coaching & mentoring, Job shadowing with electronic Learning thrown in by a large measure when it comes to training & developing the front-line sales force.

V RESEARCH METHODOLOGY

The Research methodology followed here emanates from mixed sources. While substantial time has been devoted by the author personally in the field (as an observer and analyser) - the same can be anointed as the primary source of the submission here. There also have been concerted efforts in looking up the various company websites, connecting with relevant acquaintances', gathering feedback via market intelligence to come up with the secondary sources of submission.

As in all types of training, Sales Training is associated with Positivity – to bring about a positive change in behaviour. While rudimentarily, Sales Training in these PLICs delves into the realm of Knowledge, Skills, Attitude & Habit (famous as the KASH acronym), Sales Training also has many other facets like Behavioural Training, Skills Training, On the Job Coaching, Motivational Training and the like.

Going by all that one observes & gathers in such organisations, is the inherent 'training culture' that exists – holistically one can safely assume a lot of unstructured follow-ups & specific POS support becoming the typical order of the day in the life of a Sales Trainer, here..

If one were to lay-bare the factors specific & external to & Impacting a Trainers Performance in these PLICs, one can come up with these mentionable/s which play a pivotal role in the life of a Sales Trainer in such organisations, viz:-

- (a) Overbearing of Sales
- (b) Word of Mouth (WOM) rather than actual Feedback
- (c) (Hint of) A culture of Favourite-ism
- (d) Perception ruling supreme

Looking up the Training departments in these 'new-age' Private sector Life Companies today, one observes in all cases, Sales Training is but a Support function and hence subservient to front-line Sales. Also 'Sales' Training rather than 'Management Development' is the order of the day.

A Story typically heard from one of the Sales Trainers at one of the Private Life Insurance Company.

“At the start of a 'behavioural' workshop, I made a commitment to my audience – the Front-Line Sales (FLS) participants.

I said that at the end of the workshop, I would introduce them to a person who would help them bring about the change that they wanted to bring in themselves.

This created enough curiosity & all my participants waited anxiously for the workshop to get over so that they could meet this mysterious person.

True to my promise, at the end of my session, I informed the participants that the person I had spoken at the beginning of the workshop - earlier in the day, had indeed arrived and was waiting to meet each of the participants one by one in the adjacent room.

Rise in din & commotion ensued inside the training hall.

Before I let the participants go inside the adjacent room, one by one, I put down a simple condition for them to follow. I forbade them from talking to other participants and advised them to strictly maintain silence.

One by one each participant went inside the adjacent room and came back deep in thought.

When all had met the mysterious visitor & had come back to the Training Hall, I addressed all of them again with - 'Was the wait & visit worth it?'

There was a pin-drop silence in the room and everyone nodded in agreement.

So who was in the adjacent room?

A mirror.

This made me conclude the session with these words - "Change, like contentment, comes from within. You cannot seek it without.

You are the catalyst of change - You cannot outsource it - You cannot wait for the spark to come from somewhere, someone or something - No one else can do it for you!"

VI RESULT & DISCUSSION

While researching the various Training & Learning Models in vogue at most of these PLICs, can specifically mention the following being in use:-

- (a) **The Six Disciplines of Breakthrough Learning** (given to the world by Roy V. H. Pollock, Andy Jefferson & Calhoun W. Wick)



Exploring further, we also observe that D6 is the Discipline currently in vogue - Document the Impact from all training interventions - While Define, Design & Deliver form the back-end preparatory frame-work, Drive, Deploy & Document are the front-enders. Without an Impact, no training can be construed to have taken place in the first place!

Looking up, we have each of the Disciplines practical & enumerated as.



- Link program objectives to business needs
- Describe what participants will do differently
- Agree on definition of success



- Include all four phases of learning
- Plan and manage learning transfer process
- Redefine finish line as on-the-job results



- Make relevance and utility of content clear
- Provide time for practice with feedback
- Use methods that make learning memorable



- Recognize transfer as a critical part of the process
- Treat learning objectives as business objectives
- Put in place systems and processes to support transfer



- Engage participants' managers
- Provide job aids and performance support systems
- Ensure availability of feedback and coaching



- Measure what matters to sponsors (D1 outcomes)
- Use insights to drive continuous improvement
- Market the results to key stakeholders

(b) Kirkpatrick's Four Levels of Training Evaluation [given to the world (and nurtured) by Donald L. Kirkpatrick, James D. & Wendy]



Level 1 Level 2 Level 3 Level 4
 Reaction Learning Behavior Results
 While the above forms the base of any Training Delivery, these days increasingly (more so in these

PLICs), and categorically find the add-on concept of ROI being talked-up & measured. [Ref: Return on Investment in Training and Performance improvement Programs by Dr Jack J Philips]

(c) While on the Return on Investment (ROI) It is observed in some of these companies, ROI is determined through the twin factors of 'Investment made' (or cost incurred) and 'Value/Gain' (or return) accrued.



Fig.3 Kil patrik's 4 levels & J J Philips 5th level

In most organizations under review, keeping the SMART specifics in mind, we can note the observations (heavily leant on Kilpatrick's 4 levels & J J Philips 5th level) as..

- (i) Level 1: Reaction - is generally measured by taking feedback from the learners & participants. Every Trainer is observed to be maintaining a well-designed & complete Feedback Form which mandatorily forms part of every Instructor Led Delivery session.
- (ii) Level 2 : Learning – is measured through the Assessment Tests/Quiz/Evaluations carried out at the end of each Classroom Training which is to be mandatorily undertaken by every participant.
- (iii) Level 3 : Behavioural Change – is measured by the Trainers hand-holding, Demonstrating & Observing the trainees Real Time on field to follow it up with further one-o-one or related coaching towards enabling the desired change.
- (iv) Level 4 : Results (Business Impact) – is generally measured through improved TATs, faster closures, Improved Quality controls & checks , reduction in re-works and getting higher number of work assets first time right.
- (v) Level 5 : Return on Investment (ROI) – this being the most critical measure of training as observed in these Private Life Insurance Companies (PLICs), the measure generally coming from the calculation of business impact gains converted monetarily.

With the NITI Aayog coming of age and the various measures undertaken by the government for leap-frogging India to the premier countries of the world stage, the current buzz around the corridors of power at the North Block reverberate on the topic of 'Banks integration & merger'.

This indeed is bound to be a water-shed scenario for the Current Private Life Insurance Companies in India as well.

Only a couple of years back, the Insurance & Regulatory Authority of India (IRDAI) had opened up the LI industry into the concept of 'Open Architecture' where in each Insurance Company could have a distribution tie-up with more than One Life Insurer.

While Bancassurance (Selling of Insurance through the Banks) had its roots in France in 1980s and spread its wings across continental Europe fast & wide, it's really caught on in India since the last decade..

With the government's push towards 'Universal Banking' made most of the banks warm up to the 'fee based Income' avenue in a big way. No wonder if one looks up the list of Insurance Companies as existing today, 18 of the 23 Life Insurance companies have a Bank tie-up for distribution purposes, and the number is going to get prolonged further.

Re-produced at fig 4 is an excerpt from Towers Watson on New Business Volumes through Bancassurance. This succinctly corroborates what was mentioned in the study, earlier.

What we can learn from this paper, then is, while looking up the Public Sector Life Insurance Companies today, 'Knowledge' dissemination is but a very small part in the overall curriculum under Sales Training with Demonstration 'Skills' of the trainers coming distinctly to the core, not to forget the very heavy undertone of the participants 'Attitude' being thrown in by a good measure..

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A Study of Work Life Balance and Job Satisfaction amongst Private Sector Bank Employees in Panchkula

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ABSTRACT

Due to change in socio-economic and increase in global competitiveness the working culture of employees becomes difficulty to balancing the personal and professional life it results to job-dissatisfaction. Work life balance is about the people having measure control when, where, how they work to increase the effectiveness and job-satisfaction as well. So the present study examine the "A Study of Work Life Balance and Job Satisfaction amongst Private Sector Bank Employees in Panchkula" The paper in hand present a summary of the literature of work life balance and job-satisfaction. The primary data should be collected through questioner in Panchkula city. The result should be presented with help of graphical representation. The study revealed the most of employees satisfied with policy the of which work life balance offered by private banks.

Work-life and personal life are the two sides of the coin. Traditionally reading and managing a balance between the work-life was considered to be a women s issue. But increasing work pressures, globalization and technological advancement have made it an issue with both gender, all professionals working across all levels and all industries throughout the world Achieving "work-life balance" is not a simple as it sound. In India, it is taken for granted that economic activities are exclusively the prerogative of male with while domestic work, children and child rearing are the sole occupation of women. Historically, women in India have not enjoyed a good status in workplace setting whether in managerial or operative roles .since times immemorial; women have been burdened with work of all sorts all through their lives. From reproduction to all household chores and outside, their role as worker is significant unique and burdensome. With the changing societal trend, such as a increase in the number of women entering the workforce combined with an economy that requires dual income support an average standard of living, contribute to work –life conflicts .but while spending more time in office, dealing with clients and the pressures of job can affect the personal life, sometimes making it impossible to even complete the household chores. On the other hand, personal life can also be demanding if you have a kid or aging parents, financial problem or even problems in the life of a dear relative. It can lead to absenteeism from work, creating stress and lack of concentration at work .Thus, work-life balance can be understood as the balance can be understood as the balancing point on the seesaw, one side of which is working people irrespective of their gender.

There is no agreed definition of work-life balance but it does appear that the right balance but it does appear that the right balance for one person may differ from other. Work/life balance, in its broadest sense, is defined as a satisfactory level of involvement or fit between the multiple roles in a person's life.

2003 Frone—Low levels of conflict and high levels of inter-role facilitation represent work-family balance.

2006 Greenhouse & Allen Define work-life balance—the effectiveness to which an individual's effectiveness and satisfaction in work and family roles are compatible with individual's life-role priorities at a given point in time.

2007 Grzywacz & Carlson—as accomplishment of role related expectations that is negotiated and shared between an individual and his/her role partners in the work and family domains.

II JOB-SATISFACTION

Job-satisfaction is a momentous concept in any environment so attention is a paid by many researchers. Job satisfaction has various definitions. One definition of job satisfaction is "the sense of achievement and arrogance felt by employees who get pleasure from their employment and complete it well "or it could define as encouraging emotional condition resulting from the work. There are different approaches that define this job satisfaction in different manner. An individual common thought toward his job is also called job satisfaction .The attitude can be positive or negative. The individuals who have positive attitude towards their jobs are more satisfied than the individual who have negative attitude. We can say that the individuals are dissatisfied with their jobs that have negative attitude towards it.

III INDIAN BANKING SECTOR

Nationalization of banks in two spells in 1969 and 1980 was a watershed in the annals of banking sector in India .Banks were required to saunter along a new path . Instead of remaining as mere mobilizes of deposits and purveyors or credit, they began to be used as catalysts for bringing about socioeconomic

transformation of our country—a goal considered hitherto to be outside the banking arena class banking yielded place to mass banking.

Thus, the jobs of service sector are turning more stressful on account of intense competition, unleashed by globalization. It is the fear of transfer in the minds of employees specially the women folk to continue to languish in lower Cades. Along with this the gender gap is decreasing day by day in almost all the sectors thus moving on the path of raising equal roles and responsibly for the both males and females .Thus the polices regarding balancing work and personal life have become the necessity rather than luxury for all the organizations.

Work-life balance is a concept including proper prioritizing between “workaholic “ (career and ambition) on the one hand and lifestyle (health, pleasure, leisure, family and spiritual development) on the one other. It is the term used to describe practices in achieving a balance between the demands of employee’s family (life) and work lives. The expression work-life balance was first used in the late 1970 to describe the balance between an individual s work and personal life in the U.K (New ways to work and the working Mother s Association in the United Kingdom).In the United states this phrase was first used in 1986.As the separation between work and home life has demised, this concept has become more relevant than ever before. In the past decade, work-life balance has emerged as a key theme in the policy and academic literature on employment, labour force participation, workplace management and regulation and the organization of work (guest, 2002, Dex 2003).

It is achieved when an individual right to a fulfilled life inside and outside paid work is accepted and respected as the norm to the mutual benefit of the individual business and society. Striking a balance between professional and personal commitments is a common dilemma for many of today worker. These kinds of approaches have already entered in the Indian; some of them already started some measures for the balance in work as well as personal life.

IV LITERATURE REVIEW

Tasnim Mayesha,Hossain Zakir Muhammed,Enam Fabiha (2017)examined the reasons which create work-life imbalance. Since in perceptive of Bangladesh, a female employees face more difficult to balance between work and life than a male employees. Among all respondents 57.5 % were married , 42.5% were unmarried , 40%married working women with children’s and 55% working women who do not had children’s. Findings indicated that the work –life balances issue has become significant problem for the working women of Bangladesh. Maintaining a balances between work

life become relatively difficult because of long working hours, job-rigid, work-overload, responsibility to child care, biasness at work place, lack of supervisor support dominant managerial style scarce family support.

Adikaram D.S.R, Dr Jayakilake V.K Lakmini (2016) analyzed the impact of work life balance on employee’s job satisfaction in private sector commercial banks of Sri Lanka .The data was collected keeping in consideration of independent and dependant factors. Primary data was collected through questionnaires total 150 respondents participated from different commercial banks. The data was analysis using SPSS, applied is correlation and regression. Study revealed that work –life balance is significantly positively correlated with job satisfaction. Banking sector should increase employee’s job-satisfaction by increasing work life programs for employees, which was likely to help them manage their job-life.

Aghak , Azmi .T,Irfan .A (2017) examined the work-life balance, teaching and job-satisfaction of teachers and explore the relationship between work–life, teaching satisfaction and job-satisfaction in the higher education institutions in Oman. The independent variables was work Interface with personal life, Personal life Interface with work, Personal life Interference with work, Work Personal life Enhancement with dependent variables Job-satisfaction. Both Public and Private institute covered in this study. The data was collected through postal mails, e-mails(1200) and personal visit (1269).The finding of the study revealed that while work interference with personal life interference with work had a negative relationship with job-satisfaction, work and personal life enhancement had a positive relationship with job-satisfaction.

Myint San San ,Leampreacha Nanthwon,Pooncharain Nathachit and Rurkwaruruk Warawude (2016) studied the job satisfaction of Private banks in Myanmar could be classified into four factors supervisor, co-workers, Compensation and job-satisfaction. The study found that job-satisfaction remains not changing in the beginning of services tenure but highest a 15 years of services. Low position employees and longer length of services greater satisfaction with supervisors more educated person dissatisfaction with compensation. The primary data was collected from 364 employees working 12 twelve banks in Kagon and Mandalay of Myanmar The test was used in study principal Component Analysis, ANOVA and independent sample t-test were used to analysis the study.

Azeem Mohammad Syed , Akhtar Nadeem (2014) examined the effect of perceived work life balance and job satisfaction on organizational commitment among healthcare employees .The variable was used in study was work-life balance, job-satisfaction,

organizational commitment. The sample was taken from Uttar Pradesh. The sample size was is 275. The result shows that respondents have moderate level of perceived work –life balances, job satisfaction a regression analysis revealed that 37% variances in organizational commitment and job-satisfaction was attribute to work life balances.

V OBJECTIVES OF THE STUDY

- (a) To study the work life balance among private sector bank employees in Panchkula.
- (b) To study the Job Satisfaction among private sector bank employees.
- (c) To study the relationship between work life balance and job satisfaction among private sector bank employees.

VI RESEARCH METHODOLOGY

In present study both Primary and Secondary data is considered. Primary data is collected through questionnaire and distributed to the 30 private sector bank employees in the Panchkula using five point Likert Scale. In addition to this, the secondary data was collected from various newspapers, magazines, books, websites, and research journals etc.

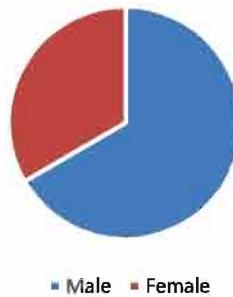
VII DATA ANALYSIS AND DISCUSSION

The collected data was analysed with the help of Pie charts and Column graphs.

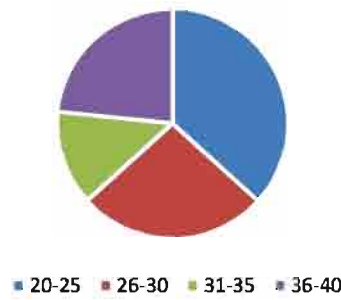
Table-1
Profile of respondents (based on questionnaire in the area of Panchkula)

Variable	Categories	No of Respondents	Percentage%
Gender	Male	20	66
	Female	10	33
Age	20-25	11	36
	26-30	8	26
	31-35	4	13
	36-40	7	23
Education	Graduate	12	40
	Post-Graduate	17	56
	Others	1	3
Marital status	Married	19	63
	Un-Married	11	36

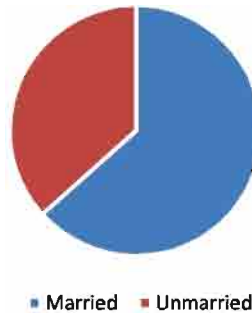
On the basis of Gender: Among the respondents, 66 % are male whereas 33% are female



On the basis of Age of the respondents: Among the respondents 36% belong to the age category of 20-25 years followed by 26% in 26-30 years category, 13% in age group 31-35years and 23% belong to 36-40 age group.



On the basis of Marital Status: Among the respondent's 63% were married whereas 36% were unmarried



On the basis of Education Qualification of the respondents: Among the respondents 40% of the bank employees are graduate whereas about 56% respondents are post graduate and 3% employees

holding the diploma and certificate courses. It is observed that most of the bank employees are post-graduate.

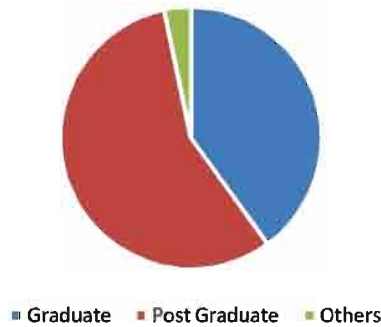
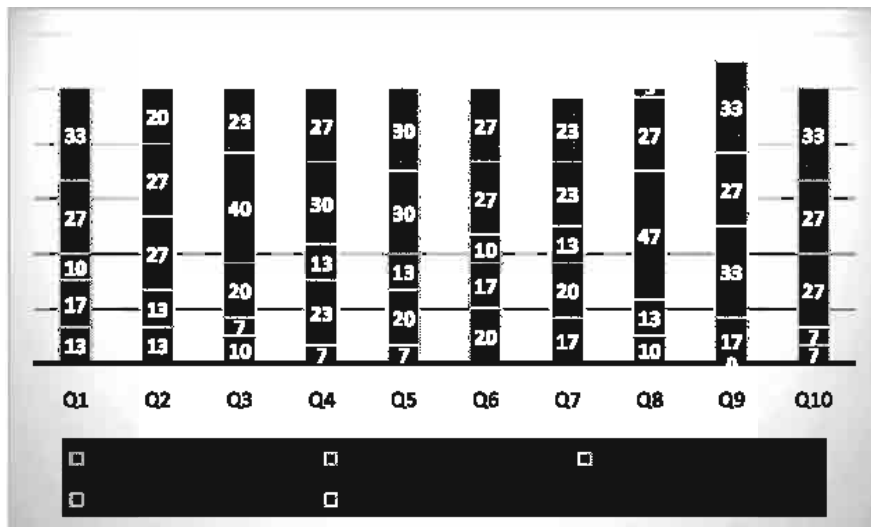


Table-2
Work Life Balances of Respondents among the Private Sector Banks of Panckula Region

1.	I leave on time on most of the days from work/office
2.	Long working hours are taken for granted by employers
3.	I often take my office work at home
4.	My performance targets set by management are reasonable
5.	I can devote sufficient time for household responsibilities.
6.	Employees are treated with equal fairness
7.	Management can be trusted to do things that employee want to do in their own way.
8.	Management tries to cooperate with employees
9.	I miss personal activities because of work
10.	I feel exhausted at the end of the day work

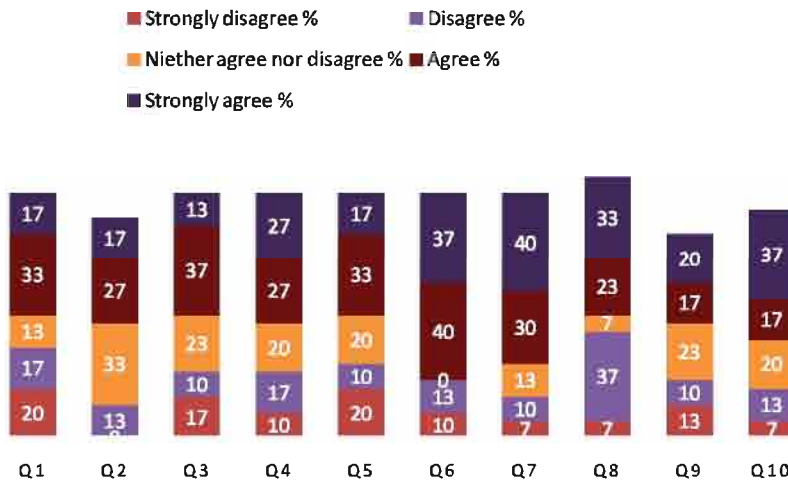


It can be seen from table 2 that most of the respondents are satisfied by the work life balances policy offered by the private sector banks in Panckula. Offered work-life balance policy are- leave office at time and targets are reasonable, management

trusted employees and equal fairness to all employees and they can give proper time to household responsibility. In bar graph response of every question should be mentioned in Percentage.

Table-3
Job-Satisfaction Level of Respondents among the Private Sector Banks of Panckula Region

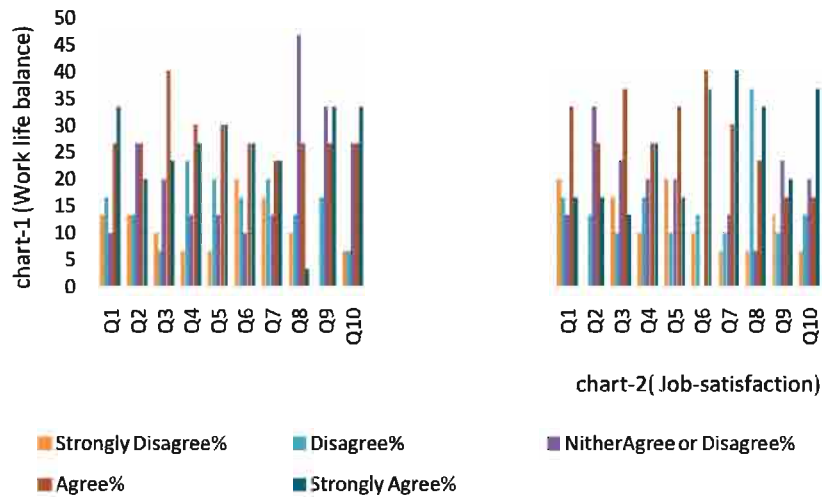
1.	The amount of job security I have
2.	The amount of pay and fringe benefits I receive
3.	The amount of personal growth and development I get while doing my job
4.	The degree of respect and fair treatment I receive from my boss
5.	The overall quality of the supervision I receive in my work
6.	The chance to get to know other people while on the job
7.	The amount of support and guidance I receive from my seniors
8.	The degree to which I am fairly paid for what I contributed to the organization
9.	The amount of independent thought and action I can exercise at my job
10.	The amount of challenge in my job



According to table 3 it was analysed that majority of employees satisfied with their jobs. They also satisfied with the policy offered by the banks. But

some of respondents not agree with fair remuneration paid by the banks.

Table-4
The Relationship between Work Life Balance and Job Satisfaction among Private Sector Bank Employees



In table 4 chart-1 represent the work life balance and chart-2 depict the job- satisfaction of the private sector banks employees. There is a positive relation between the work life balance and job-satisfaction through the study it was analysed that the employees are satisfied with work life balance policy it has the positive impact on the job-satisfaction of the employees

among the gender of employees. The study also revealed that management cooperate with employees and they also get support for the seniors.

VIII SUGGESTION FOR FUTURE RESEARCH

This study examined the work life balance and job-satisfaction of private sector bank employees of Panckula city. This study can be replicated with sample on other region and on another industry also or as comparison between private and public banking sector employees. It is suggested that research should focused on other factors in future study.

IX CONCLUSION

The goal of this study is to augment the knowledge of work life balance and job- satisfaction on bank employees. The study focused on what type of work life balance policy offered by the private banks if the employees really satisfied with these policies and also know the job-satisfaction level of the employees. Through the study it was analysed that the majority of employees really satisfied with work life balance policy and work life policy have positive impact on the job-satisfaction. The limitation of the study is the some employees are little interest to fill the questioner and some of the employees responses neither agree nor disagree they give neutral answer. The study did not explore the level of satisfaction

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Green Marketing Model for Pigment Industry

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ABSTRACT

Due to pollutions in synthetic pigments industry, the entire world is shifting towards the manufacturing of natural pigments. The present article contains application of different natural pigments, which has huge demand in domestic as well as in foreign market. It is hoped that entrepreneurs, technocrats, existing units institutional libraries will find this article very useful.

Keywords: Green, Marketing, Model, Pigment

I INTRODUCTION

Madhya Pradesh pigment industries have come a long way. Today, Madhya Pradesh has a significant presence in production of basic organic, inorganic and natural pigment segments. Thus, by virtue of its diversity, the pigment industry bears a close correlation not only with the quantum of overall economic growth but also with the contents and quality of growth. On the one hand, the ranges of products of the industry's constituent segments are used in most productive activities, and on the other hand, the pigment industry's diversity relates to the pattern of demand to the changing standards of living.

To mainstream the environment is necessary to use the natural resources rationally. This would require improving the environmental governance by integrating green considerations into the development process. The government's reducing monopoly over the control of natural resources to ensure better public participation. Systems of governance need to be decentralized. The states and local bodies are given greater authority and responsibility with measures that assure accountability transparency and efficiency. This would require mainstreaming of the environment in the process of policy making. It is ensuring greater community participation.

A natural pigment can be defined as highly coloured substance used to impart colour to an infinite variety of materials like textiles, paper, wood, varnishes, leather, ink, fur, food stuff, cosmetics, medicine and tooth paste. The pigment is generally prepared by boiling the crushed powder with water.

II REVIEW OF LITERATURE

Pigment manufacturing was started in India in 1902 with only one pigment industry. After independence in 1947, the production of various pigments, such as titanium dioxide, ultramarine blue, chrome pigments, phthalocyanide blue, Prussian blue, zinc chrome basis lead sulphate and metallic pigments such as aluminum paste has already been started in India. In 1966 there were more than 50 major factories and more than 200 minor ones. In 1967, the total installed capacity was only 50,800 tones per year. In 1972, the

production touched 70,000 tones per year and today the Indian pigment industry can be said to be on a par with the pigment industry world wide. The large numbers of products manufactured in India are now marketed in other countries.

Industries can be broadly classified into non-hazardous waste and hazardous waste. Non-hazardous waste can be either biodegradable or non-biodegradable. The major industries in urban areas that generate substantial amounts of biodegradable solid waste are fruit processing, cotton mills, paper mills, sugar mills, and textile factories. The major generators of non-biodegradable industrial solid waste are thermal power plants producing coal ash, integrated iron and steel mills producing blast furnace slag and steel melting slag. Such non-ferrous industries as aluminum, zinc, and copper which produce red mud and tailings. The fertilizer and allied industries which produce gypsum. Some of the wastes generated by industries are deemed to be hazardous wastes because they contain substances that are toxic to plants and animals or are flammable, corrosive, explosive or highly reactive, chemically.

Natural pigments find use in the coloring of textile, drugs, cosmetics & food products. Natural pigments are environmental- friendly, for example turmeric (haldi), the brightest of naturally occurring yellow pigment is a powerful antiseptic which revitalizes skin, while indigo (Neel) gives a cooling sensation. Henna (Mehendi) was used even before 2500BC, while saffron (kesar) is mentioned in the bible. Some of the well- known ancient pigments include madder (Manjiph), a red pigment is made of the roots of the *Rubia tinctorum* L. blue indigo (neel) from the leaves of *Indigofera tinctorial* (Indian Indigo), yellow from the flower of the saffron plant (Kesar, *crocus sativus* L.) and from turmeric (Haldi, *curcuma longa*L).

III RESEARCH METHODOLOGY

Sample Area: Pithampur Industrial Area, Indore

Research Design: Exploratory Research

Type of research: - The present study is carrying a blend of descriptive and exploratory research.

Sampling plan: - Systematic Convenience sampling method will be used.

Sampling size: - Sample size would be 25 from Pithampur industrial area. The sample size is estimated on the basis of research area and topic.

IV OBJECTIVE

Study of shifting from synthetic pigments to natural pigments. (For making country independent and pollution free)

V PIGMENT SYNTHETIC VS NATURAL

Pigments are insoluble powders of very fine particle size i.e. as small as 0.01 micron which is used in paints, plastics, rubber, textiles, inks and other materials to impart colour, opaqueness and other desirable properties to the product. Pigments are both natural & synthetic in origin and organic and inorganic in composition. The oxides of iron, chromium, lead and other metals give a limited range of colour with good light fastness. However many of these, change colour with sulphur compounds found in urban atmosphere today, making them unsuitable with the growth of dyestuff industry. A range of pigments giving bright colours of good fastness properties were discovered. A new chromophoric system of phthalocyanine pigment was introduced in 1935.

Pigments find application in aqueous and non-aqueous paints, printing inks, paper coating, leather finishing, plastic products and other similar processes. The pigment may be used alone or incorporated with a white pigment such as zinc oxide, titanium dioxide or white lead as a means of controlling the opacity and the depth of shade required. Most of printing inks contain pigments and are used for the printing of metal foil, tin-plate, cardboard wrapping materials and so on. Pigments are extensively used in printing and textiles in combination with a resin binder. Pigments are incorporated in cellulose pulp to obtain colour paper. Similarly mass colouration of synthetic fibers, plastics and rubber is carried out. Pigments are also used in cosmetics, soap, wax, chalks, crayons, artist's colours.

(a) Natural pigments can be sorted into three categories:

Natural pigments obtained from

- Plants
- Animals
- Minerals.

(i) Natural pigments, obtained from plants- Almost all parts of the plants like roots, bark, leaf, fruits, wood, seed, flower etc produces different colors like red, yellow, blue, black & brown. It is interesting to note that over 2000 pigments are synthesized by various parts of plants of which only about 150 have been commercially exploited. Nearly 450

plants are known to yield pigments in India alone, of which 50 are considered to be the most important, ten of these are from roots, four from barks, five from leaves, seven from flowers, seven from fruits, three from seeds, eight from wood and three from gums and resins. Pigments for lipsticks are still obtained from annatto seeds (latkan, Bixa orellana) and those for eye shadow from indigo (Neel). Lycopene a carotenoid pigment responsible for red colour in tomato, watermelon & carrot.

- (ii) Natural pigments obtained from animals- Cochineal (kirmaz) is a brilliant red pigment produced from insects living on cactus plants. Lac (Lakh) the encrusted twigs which are host to the larvae of the insect coccus lacca, were cut into pieces.
- (iii) Natural pigments obtained from minerals- Ocher is a pigment obtained from an impure earthy ore of iron or ferruginous clay, red (hirmaji, hematite) or yellow (ramraj, ralimonite).

VI SOURCES & APPLICATION

(a) Cosmetic

- (i) **Extract** - Aloe Vera, amla, apple, ashwagandha, arnica, avocado, beet, brahmi, bhringraj, cabbage, calendula, carrot, capsicum, chlorophyll green, cucumber, grape, ginger, green tea, henna, hibiscus, jatamansi, lemon, litchi, lotus, manjistha, methi, neem, orange, papaya, peach, pineapple, pomegranate, rose, rosemary, saffron, seabuckthorn, shikakai, spinach, strawberry, soy protein, sun flower, tomato, tulsi, turmeric, watermelon, wheat protein, yoghurt.
- (ii) **Powder** - Cream, calcium caseinate, gum Arabic, honey & sodium caseinate.
- (iii) **Oil** - Aloe Vera, amla, arnica, asiatica centella, bhringraj, brahmi, calendula, capsicum, carrot, grapes seed, hibiscus, jojoba, lemon peel, neem, shikakai, sweet almond, wheat germ.

(b) Food -

- (i) **Powder** - Aceroala, Aloe vera, amla, aniseed, annatto, norbixin, ajwain, Apple, apricot, arrow root, banana, basil, bay leaves, beet root, besan, bishop seeds, bottle gourd, cabbage, cardamom, carrot, cashew kernels, castor, cheese, chickoo, cinnamon, cloves, coriander, cumin, cuisine, custard apple, date, fennel, fenugreek, fig, garlic, ginger, green chili, green grape, guava, honey, lemon, mango, marjoram, methi, mint, mushroom, mustard, nutmeg, onion, orange, papaya, pineapple, posper, pumpkin, ragi, rosemary, sesame, spinach, tamarind, tomato, turmeric, vanilla, vermicelli, whey.
- (ii) **Oil** - Sun flower

(c) **Health-** Adaranga, adrak, agni-mantha, aja moda, ajowan, akarkara, akhrot, akola, aksbei, Amarpoi, amba haldi, ambergris, ambar, amla, amrul, amtavait, anchhu, anola black musale, aparajita, arakha, arjun, arjun bark, arjuna myrobalan, arkapatri, arni, assafoetida, asdhia, ashoka, ashwagandha, atis, ayapan, baboolseed, babul, bach, bada gokshura, baer, bagha tentuli, baheda, bakul, bana maricha, bandhuk puspi, Bansa, banslochan, bala simuli, balkanda, Barberry, bastard teak, bay- berry, bebati, Bengal currants, bhala bhadrina, bhant, bharangi, bhargi, bhataur, bhiringraj, bhui amla, bhui mandar, bhujpatra, bhunikusmanda, bhusanga, bidafil kand, bihidana, birhatta, birun, bishop's weed, bitter guard, black berries, black catechu, Blue berry, boaban, boka sangha, bol, bramhi, bonducella nut, brahmamanduki, brahmi, brihati, brungraj, bubaitulasi, butterfly pea, cacus grass, camphor, caraway, carrot, chalta, chamomile, chatium, Chatta, chhota dudhi, chhota nakh, chilla, china root, chironji, chita paru, chitosan, chitra, chitraka, chitrak root, chob chini, chorota, chukka, chunchu, cikura, coconut, cohiria, common fumitory, common milk hedge, coral, coriander seeds /dhania, corkwood, corn, country borage, cowrie, cucumber, curd, cuscus grass, dandelion, daruhaldi, devil's cotton, dhanantari, dhatura, dhub, digitallis, dikamali, dill, elephant or wood apple, dita bark, dodder, dog grass, doorva, drum stick / sargava, dudal, dudhi, energy brow, febrifuge, fenugreek, four- o- clock flower, fox gloves, foxnut, French marigold, gandha palas, gandha tamal, ganga, garmalu, genda, gendul, ghikanwar, gigantic swallowwort, ginger / sunth, girish Indian acalypha, gold thread, golden seal, goma, gooseberry, goraka / kokam, gorakh anli, gotaghanba, gotha great leaves, green tea, groundnut, guduchi/ giloy, gugal, guggul, guhalo, gular big, Gulcakri, gulkhairo, gulsakari, gum gulgul, gurmara, hakum, hansapasdi, harmal, harsighar, harjori, hasi sundi, hasti hatapuccha, karana palas, helio trope, hembane, henna, Himalayan silver fir, hingra, hohoba, holy basil / tulasi, Indian aconite, Indian alces, Indian beeci, Indian bread-shot, Indian cyperus, Indian filbert, Indian gamboga, Indian hemp, Indian kamala, Indian laburnum / amaltas, Indian madder, Indian mulberry, Indian night shade, Indian penny wort, Indian rhubarb, Indian senna, Indian sorrel, Indian sweet fennel, Indian white rose, indrajav, indramarish, ispaghula, issugul, jaggery palm, jaiaputa, jaiphal, jalpapra, jamun, jangliswan, jatamashi, java glangal, jawasa, jethimadhu, jhabuk, jhanjhania, Jibanti, jira, jivanti, juani, jungali madan mastak, jungle aushbali, jujebe fruit, kabab chini, kaitha, kaiphal, kakamachi, kakhrona, kalasaka, Kalihari, kalmegh, kamalgundi, kamini, kanchan, kanda, kandari, kandurikabewl, kaniar, kantakari, kanta marish, kapas / cotton, kapur, karabir,

karad, karamarda, karanja, karanji, karchi, karela, karjiri, karpas, kasha marda, kasaturi, katha, kathkal, katkaranj, kawanch, khorasani, khurasani ajvayan, khus khus, kokam, kelendula, kelikadamba, ketaki, khair, khas, khunkharaba, king of bitters, kirikiri, korehijhar, kosum, kulthi, kumbhi, kurchi, kurum, kutki, labanga, lal chitarah, lavang, leavedalangium, Liguorice, lin seed tisi, liquorice root / mulethi, lobelia, long pepper / pipla, madhumalati, mahua flower, mahua gulli, mahul patta, maida, makhna, malanga, malabar nut, mamijava, mamira, mango / amra, manjistha, manjit, maqnkanda, marigold, marina shell, marsh mallow root, methi, mint, mitha zahar, mohta roots, morpankhi, moti, mudar, mugani, munga, musk dena, musk mallow, muskroot, mulathee, myrrh, naga feni, nagarmotha, nagkesar, nal, narangi, narakoli, nata karanj, neel, neerbrahmi, night jasmine, nilagiri, nilofar, nirbishi, niruri, noni, noni juice, nut grass, oembinatoin, olat kambhal, orange, palas, palmyra plam, panibela, papaw, passion flower, patherchur, pearl, pellitory, peppermint / pudina, pilijari, pit, pita jahni, pita papada, papara, pitapapara, pola, pomegranate / anardana, popaiyah, potato, prickly pear, psyllium husk, pudina, pushkarmool, quince, ranga bana, Rangoon creeper, rakta pichhuli, rasna, rau, red creeper, red leadwort, red mango, red sander / lal chandan, revand chini, riha, rukuna, sada bihar, safed dhatura, safed musli + ashwaganda sugar free, safflower, sage Indian sarsaparilla, salap, salsaz, sana, sankhapushpi, sapra ghandha, sarivan, sata patri, saunf, schund, senna sopheta, serpentina chota chand, sevar, shankhapushpi, shatapuspai, shiajira, shikari, shalparni, sharifa, siris, soanjina, somlata, sorrel, sowa, spirullina, sthala padma, sudarshan, sugandha bala, sugar apple, sunflower, sunusunia, Superb Lily, surba chala, surya mukhi, suvaga, sweet flag, sweet basil, sweet scented oleander, sweet wood, sweta siris, sweta sunarchhana, Syrian rue, tal, talimusli, talispatra, talmakhana, tejaraj, telugu kulanjan, thal sukhri, thelko, thornapple, thutia, thyme leave, tikora, tuta, true lemon grass, turmeric / haldi, two- flowered Indian madder, ulatkambal, urni, uturuli, velvet leaf, vidanga, vijasar, vilayti imli, white mulsberkry, wil cowrie fruit, water lily, wild mustard, whey annatto bixin , white leadwort, yam, yohimbe bark curcuma starch, zaminkand, zupha Indian atees.

(d) **Essential Oils, Aromatic Oils & Oil Resins –** Absolute lavender, Ajowan, almond oil bitter, almond oil sweet, amber attar, amber attar-II, amyris, angelica, anise, ansi seed, apricot, armoise, avocado, banzoin siam, basil, bay, benzoin extra, bergamote, betel, big eucalyptus, black pepper, blue chamomile, borage calamus, camphor, camphor powder, camphor tablets, capsicum oleoresin, caraway, cardamom green,

cardamom oil small, carrot seed, castor oil cosmetic grade, castor oil pharmagrad, castor oil tech. grade, cedarwood, chamomile oil – (roman, blue, germen) clary sage, clove, clove bud, coriander, coriander seed, curry leaf, cypress, dill seed, elemi, eucalyptus (citriodora), elemi oil Us, evening primrose, eucalyptus oil globulos, eucalyptus oil citriodor, fir needle, frankincense, german chamomile, garlic, glycerine, , ginger, ginger grass, grape fruit, grape seed, galangal, galbanum, geranium, ginger, celery seed, ginger grass, grape fruit, harsingar (parijat), hedychium (ginger lily), henna attar-II, heeng, holy basil, hyssop, jamrosa, jasmine sambac abs, jatamansi, jojoba, juniper berry, kalaunji, Kapoor kachri, karanj seed, kewra attar –I, khus (ruh), lavender, lavandin (Grosso), linalool ex-(basil, citerata), lemon (grass, eucalyptus, verbena), lichen, lime terpeneless, litsea cubeba, lotus Indian (attar), mandarin red, marigold, mitti attar (ruh-e-jannat), Melissa, menthe (arvensis, citrate, piperita), myrrh oleo, N-crude menthe, N – dementholised, N- menthol bold crystals, n – menthol fine flakes, n – menthol melted flakes, menthone 99%, methyl chavicol, motia II nutmeg, nagar motha, narakachur, neem, neroli, niaouli, olibanum, oil fatty, orange (bitter, sweet), oregano, palmarosa, parsley seed, patchouli, peppermint, petitgrain, pimento berry, pimento leaf, pimento berry, pine, pomegranate, pumpkin, red thymeoil 50%, rose, rose essential, rosemary, rosewood, sandalwood, spearmint, spikenard (jatamansi), sugandh (kokila, mantra), sweet fennel seed, tagetes, tea – tree, thuja oil, thyme, tomar seed, T.p.liquid oil 99%, turmeric, valerian, vetiver oil- I, wheat germ, winter green, yara yara powder, yarrow, ylang ylang, zafri astrar.

- (e) **Organic Crude Herbs** – Agar, ageda, ajmobar, ajmod, ajowan seeds, akkalkara mul, aloes, amaltas, ambahalder, ambachhal, amla, amruta guggaal, anantmool, ankdo, annatto seeds, anuir, apamarg, apiumgraveoens, apple, aprioht, aritha, arjun bark, arni mool root, ashok bark, atibalachikana, ativish, babchi, babul bark, babul pods, badiyan, baheda, bakayan (fruit), bala, banafshah, baru mool, beal fruit, beal mul, bealhal, belladonna leaf, bharangi mool, bhava, bhella, bhui – amla, bhoi-pathri, bidhara, bijasar, black piper, blackteal, chandan (swet), chavak, chitrak mool, chopchini, cinchona officinale, cinnamomum zeylanicum, curry leaf, dalchini, darbha daruhalder, dashmool, devdhar, dhamasa, dhana, dhatura phool, dhayati, dikemari, dudal, duudhi, elaiichi, ephedra, eranda root, ethyl acetate, euphorbia, gahula, galo, gandhprasarini leaf, garlic, garmola, ginger, glycyrrhiza, godambi, gokhru, Gorakhmundi, green chilli, guduchi, guggal gurma, haldercucurma longa, harde, haritaki, harrir, henna leaf, hing, indrajav, jambu seed amla, jarduha jatamanshi, jaypal, jivanti, jungle- mehti, jungle piyaz, jyatishmathi,

kada chhal, kadu, kakad, kakmachi, kakuani, kali draksha, kalihari, kali musli, kalmegh, kankari, kapilo, kapur kachri, karela seed, kasni seed, karanja, kateli, kawach, kayphal bark, khadir bark, khadyanag, kher, khurasani, khus valo, kovarya seed, kuchla seed, kulinjan, kurchi, kusm phppl, kuth, kokhala, kutki, lajwanti, lashun, lemon, limbodi fruit, lindipiper, lobela, lodhra, makoi, male fern, mamejvo, manjistha, meda, methi seed, mochras, mulethi, musta, nagarmotha, nagkesar, neem bark, neem leaves, nirgundi leaf, nishot, nux vomica, ohtton seed, onion, orris, papaya beej, pashanbhadra, patanga, pimlimul, pitpapdo, podophyllum, pudina, punamava, pushkarmula, putranjiva, rakta chandan, rakta rohida, rasna root, ratanjyot, rohitak, rose-wood, ruma mastaki, safed aghedo, saghurgota, sallai gum, sallaki, salmali, sandal, saptparana bark, sarpunkha, satodi, sau variali, scilla Indian, seena (pod, leaf), senega Indian root, shankpushpi, shatapushpa, shatavri, sherdi mool, shikakai, shwagandha, sisam, somlata, stramonium leaf, suragavo bark, swet musli, tagar beej, tandalja mool, tejbai, trikatu, umbar bark, uplet, utkanta, valerian, vardharo, vavading, vidang, vidari kand, wild violet.

- (f) **Speciality Ingredients & Syergise Extracts** - Azadiritin, beta- carotene, colchicine, Curcumin – 95%, sennosides.

VII EMERGING HERBAL HUB OF INDIA

With 11 agro climatic zones out of the total 16 in the country, Madhya Pradesh is well suited for cultivation of large number of herbal plants. With nearly 91% area of the state under forest cover MP provides an excellent habitat for wild herbs. Madhya Pradesh has more than 300 species of wild herbs. Further the state forest has ample biodiversity of wild plants whose pigment potential is yet to be established and thus provides excellent research resources for the herbal industry. The key herbal collection centers of the state are situated at Shivpuri, Betul, Katni, Neemuch and Lalitpur. Together, along with Dhmttri (Chhattisgarh) these collection centers meet nearly 40% demand of the entire domestic herbal industry.

Ample availability of land for the cultivation of various herbs and already the mass cultivation of a number of species has been stated in the state. Herbal industry is labour intensive in nature and MP has ample availability of economic power. The strategic central location of the state facilities cost effective logistics and distribution function. The proximity of the state with key port enables exports of raw goods and finished product across the globe.

VIII CONCLUSION

Nowadays, fortunately there is increasing awareness among people towards natural products. Due to their non-toxic properties, low pollution and less side effects, natural pigments are used in day to day food products. Although the Indian subcontinent possesses large plant resources, only little has been exploited so far. More detailed studies and scientific investigations are needed to assess the real potential and availability of natural pigment yielding resources and for propagation of species in great demand on commercial scale. Biotechnological and other modern techniques are required to improve the quality and quantity of pigment production.

Due to lack of availability of precise technological knowledge on the extraction and pigmentation technique, it has not commercially succeeded like synthetic pigments. Also, low colour value and longer time make the cost of pigmentation with natural pigments considerably higher than with synthetic pigments.

It is time that steps are taken towards documenting these treasures of indigenous knowledge systems; otherwise we are bound to lose vital information on the utilization of natural resources around us.

To conclude, there is an urgent need for proper collection, documentation, assessment and characterization of pigment yielding plants and their pigments, as well as research to overcome the limitation of natural pigment.

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Nifty 50: Caused by FDI, WPI and Exchange Rate?

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ABSTRACT

The Indian stock market does not move in isolation and its returns are dependent upon economic parameters. The later play a pivotal role in influencing the returns for markets. An investor who plugs his money in the stock market may take into account the fluctuations in such factors and accordingly plan his/her portfolio. Index returns may have a causal association with many factors in the economy; inflation rates, interest rates, foreign direct investment flows, exchange rate mechanism, gross domestic product, monetary policy of central bank, crude oil prices to name a few. All of them may together contribute towards volatility in stock returns. Thus, while designing strategies of investment due relevance must be given to them. This relationship has been tested in various time frames by taking a combination of different exogenous factors in short run and long run. The present study is emphasized to establish association between change in the four variables and their causal linkages in the short run. It has been observed using Granger Causality that all the variables have causal relationship during the short run.

Keywords: Granger causality, Nifty 50, FDI growth, Inflation & Exchange Rate.

I INTRODUCTION

National Stock Exchange (NSE) was established in India with its headquarters at Mumbai. It is the most popular stock exchange out of the 23 stock exchanges in India. Though it was started after Bombay Stock Exchange (BSE) but due to the ease, convenience and other facilities NSE became more popular amongst investors than BSE. The main index which reflects the performance and growth for this exchange is Nifty 50. The daily closing values of this index and their returns may be dependent upon many factors. These could be macro, micro or company specific. The number of scrips included in this index generally remain 50 but presently there are 51 scrips which are the base for evaluating the performance.

The aim of the present study is to find out whether Nifty 50 is caused by macroeconomic factors during the short run. This analysis has been carried with the help of Granger Causality test which was first proposed in the year 1969. It examines whether a particular variable let's say X causes the other variable Y or not.

II LITERATURE REVIEW

(Elly & Oriwo,2012) The study investigated using regression analysis impact of macroeconomic variables (lending rate, inflation rate, 91 days T-bills rate with Nairobi Stock Exchange index. There was a weak positive relationship between inflation and market performance. On the other hand 91 days T-bill depicted a negative correlation during March 2008-2012 (monthly).

Srinivasan &Karthigai (2014) The domestic gold prices were not found significant in forecasting stock prices in India. There was no causal linkage between gold prices and stock prices or vice versa in the short run. Using autoregressive distributed lag bounds testing approach and granger causality test from June 1990 to April 2014 (monthly) it was concluded that

there were no significant association between variables.

(Aggarwal &Saqib, 2017) Nifty 50 was found to be significantly affected by US GDP, S&P 500, gold prices, Indian WPI, fiscal deficit and exchange rate. Multiple regression results from 2001-2016 (monthly) showed the impact of macroeconomic variables on the Indian stock market.

(Dharmaraj, 2010) S & P CNX Nifty index movements were found to be influenced by FIIs during 2006-2009 (monthly). However, the stock market volatility showed lesser impact from FIIs. Using linear regression model and pearson correlation results were found indicating dependence. The study had broken the data into different structures based on bull phase, recessionary phase, swinging phase to name a few to minutely locate the impact of FIIs.

(Mishra & Singh,2012) The study analyzed the data of monthly stock returns from BSE and NSE as dependent variables with inflation, exchange rate, IIP, FII and interest rates as independent factors. It was depicted that from November 1998 to July 2008 (monthly) GAM (Generalized Additive Model) was better fitted than OLS (Ordinary Least Square Method) for predicting returns of stock markets from the selected macroeconomic variables.

(Liu & Shrestha, 2008) Macroeconomic variables (money supply, industrial production, inflation, exchange rate and interest rates) were tested for co-integrating relationship between indices of China's stock market during January 1992 to December 2001 (monthly). It was found using JJ,OLS and GARCH model that the variables were move together in the long run. IP and MS had positive relationship but rest of the variables showed negative relationship.

(Lee et al., 2001) Malaysian stock market was tested for both short and long run relationship with macroeconomic variables (interest rates, money supply, industrial production, inflation, exchange rates and trade balance). It was found that both stock market index was co-integrated with other variables

in both short and long run using co-integration analysis (VAR model) during 1987-1997.

(Gallagher & Taylor, 2002) The study analyzed stock price behavior with demand and supply macroeconomic shocks during 1949-1997 with appropriate structural breaks. VAR model had been used to conclude that the demand shocks resulted into temporary effects while supply side showed a permanent impact.

(Schwert, 1989) The association between monthly stock returns with other variables (bond returns, inflation, interest rate, industrial production and money growth) were tested between 1857 to 1987 using squared standard deviations (similar to ARCH model). It was found that during the Great Depression (1929-1939) stock market volatility went unusually high.

III RESEARCH METHODOLOGY

Primarily, in this study Granger causality between variables has been analysed with the help of EViews software. The precondition for testing this causality between variables is that the data should be stationary. The process for testing stationarity was completed with the help of Augmented Dickey-Fuller test (unit root test) with intercept, with trend and without trend at level, first difference and second difference at 5% level of significance.

The data for the study included monthly data from January 2009 to March 2018 (thus, taking the data

after recession was over in the year 2008). The monthly data for Nifty 50, foreign direct investment, wholesale Price inflation and exchange rate was taken from the websites of National Stock Exchange, Department of Industrial Policy and Promotion and Reserve Bank of India. This data was further converted into growth series to assess for change/increase in the variables. Granger causality test was then applied to find out causal relationships between variables in EViews.

IV ANALYSIS & INTERPRETATION

The analysis and results have been divided into two segments. The first segment explains the test for stationarity at level, first difference and second difference with intercept, with trend and without trend and the second segment explains the results of Granger Causality. As the data was found stationary at $I(0)$ i.e. the problem of unit root was not present, Granger Causality test was applied to check for causal linkages moving between the variables in the short run.

(a) Unit root test

The monthly data for growth in FDI, increase in WPI, change in Exchange rate and Nifty 50 returns with 108 observations was tested for unit root using Augmented Dickey-Fuller test in EViews as a precondition to check Granger Causality. The results have been discussed with the help of following tables and interpretation:

Table 1

Augmented Dickey-Fuller Statistics (at Level with intercept)

Variable	t-statistic	Prob.
FDI	-8.961	0.000
WPI	-10.143	0.000
Ex R	-7.931	0.000
Nifty 50	-9.255	0.000

The table above shows the t-statistic for all variables and their corresponding p-values which reflect that the null hypothesis (Variables contain a unit root)

may be rejected. Hence, it may be said that the variables were stationary at level.

Table 2

Augmented Dickey-Fuller Statistics (at first difference with intercept)

Variable	t-statistic	Prob.
FDI	-9.555	0.000
WPI	-10.109	0.000
Ex R	-9.414	0.000
Nifty 50	-7.867	0.000

The above table shows the results for unit root test at first difference with intercept. It may be said that as per the statistics and p-values that data was found to

be stationary at first difference also. Thus, null hypothesis may be rejected in this case.

Table 3
Augmented Dickey-Fuller Statistics (at second difference with intercept)

Variable	t-statistic	Prob.
FDI	-8.010	0.000
WPI	-8.759	0.000
Ex R	-7.549	0.000
Nifty 50	-7.060	0.000

Table 3 shows the results of unit root test at second difference with intercept indicating absence of unit root. As a result, null hypothesis may be rejected.

Table 4
Augmented Dickey-Fuller Statistics (at level with trend)

Variable	t-statistic	Prob.
FDI	-8.941	0.000
WPI	-10.451	0.000
Ex R	-7.851	0.000
Nifty 50	-9.364	0.000

The above table shows the statistics for unit root test performed at level with trend with their corresponding p-values. It explains that the null

hypothesis may be rejected and it may be said that the data was stationary.

Table 5
Augmented Dickey-Fuller Statistics (at first difference with trend)

Variable	t-statistic	Prob.
FDI	-9.51	0.000
WPI	-10.06	0.000
Ex R	-7.765	0.000
Nifty 50	-7.972	0.000

The table 5 above narrates the results of unit root test performed at first difference with trend showing the

absence of unit root in the data. Therefore, null hypothesis may be rejected.

Table 6
Augmented Dickey-Fuller Statistics (at second difference with trend)

Variable	t-statistic	Prob.
FDI	-7.958	0.000
WPI	-8.713	0.000
Ex R	-7.601	0.000
Nifty 50	-7.021	0.000

Table 6 above explains the results for unit root test at second difference with trend. It indicates that the null

hypothesis may be rejected and it may be said that the data was stationary.

Table 7
Augmented Dickey-Fuller Statistics (at level without trend)

Variable	t-statistic	Prob.
FDI	-14.144	0.000
WPI	-10.189	0.000
Ex R	-7.842	0.000
Nifty 50	-8.692	0.000

Table 7 above explains the results of unit root test at level without trend. It shows that the data was stationary and the null hypothesis may be rejected.

Table 8
Augmented Dickey-Fuller Statistics (at first difference without trend)

Variable	t-statistic	Prob.
FDI	-9.605	0.000
WPI	-10.158	0.000
Ex R	-9.461	0.000
Nifty 50	-7.895	0.000

The table above shows the results of unit root test at first difference without trend. It may be observed from p-values which in all variables have been found to be less than 5% meaning that null hypothesis may be rejected and data was stationary.

Table 9
Augmented Dickey-Fuller Statistics (at second difference without trend)

Variable	t-statistic	Prob.
FDI	-8.062	0.000
WPI	-8.806	0.000
Ex R	-7.592	0.000
Nifty 50	-7.104	0.000

Table 9 above narrates the results of unit root test and their corresponding p-values. It indicates that the null hypothesis may be rejected at 5% level of significance meaning that the data was stationary.

(b) Granger Causality test

This segment explains the results of Granger Causality test carried in EViews at 5% level of significance to determine the causal linkages between all variables in the short run. Primarily the following equation may be produced to check the causal effects of FDI, WPI and Exchange Rate with Nifty 50 returns.

$$Nifty\ 50 = f(FDI, WPI, EXR)$$

- where, Nifty 50 = Returns on market index
- FDI = Increase in foreign direct investment
- WPI = Change in Wholesale price index
- EX R = Change in Exchange Rate

The table below demonstrates the results with each variable among the other. It may be observed from the results that in the short run Nifty 50 may not be caused by the three variables taken in the study (FDI, WPI and Exchange Rate). Thus, null hypothesis (X does not cause Y in the short run) may not be rejected while testing causal links among all variables except one being all the corresponding p-values are greater than 5%. In case of testing whether Nifty 50 can cause WPI, it was observed that the p-value was 0.015 meaning that the null hypothesis may be rejected at 5% level of significance. Thus, it may be said that some linkage existed during short run. Thus, it may be said that there is a possibility that in the short run these variables may be having weak associations or no relationship in the short run but in the long run they may resume to equilibrium. This calls for further testing them in the long run. It may be done with more macroeconomic variables and other benchmark indices may also be included in the study.

Table 10
Granger Causality Results

Null Hypothesis	F-Statistic	Prob.
FDI does not Granger Cause Exchange Rate	1.070	0.347
Exchange Rate does not Granger Cause FDI	0.434	0.649
Nifty 50 does not Granger Cause Exchange Rate	0.491	0.613
Exchange Rate does not Granger Cause Nifty 50	1.162	0.317
WPI does not Granger Cause Exchange Rate	1.058	0.351
Exchange Rate does not Granger Cause WPI	0.150	0.861
Nifty 50 does not Granger Cause FDI	0.245	0.783
FDI does not Granger Cause Nifty 50	0.583	0.561
WPI does not Granger Cause FDI	0.476	0.623
FDI does not Granger Cause WPI	0.492	0.613
WPI does not Granger Cause Nifty 50	0.183	0.833
Nifty 50 does not Granger Cause WPI	4.371	0.015*

V CONCLUSION

To conclude, it may be said that in the short run the variables in the study (Nifty 50, FDI, WPI, Exchange Rate) may not be in equilibrium. Though few linkages were found between Nifty 50 and WPI but they may not be strong enough to forecast Nifty 50 returns from WPI or vice versa. It may only indicate that these variables may become strongly associated in the long run. It may be deduced that in the short run it may be difficult to form any linkages between the variables and thereby forecasting them with each other. This may call for another study which can take a holistic view of these variables in the long run. More variables from the economy that may influence stock market returns may be taken under consideration and may be tested for association in the long run.

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Relative Study on the Environment Related Leadership Hold by Strategic Business Units: Specific Contribution to Industrial Organizations

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ABSTRACT

In the last two decades, entrepreneurs and academia from the management area have been dealing with inquiries about how and why companies should integrate environmental issues into strategic decision-making. Thus, the concern with the environmental issue has made all ports rethink their relations with the environment. This article aimed at verifying that environmental management activities in small and medium-sized companies of the metal-mechanic segment of the central Madhya Pradesh (M.P.) region are in line with their business strategies. For that, it was carried out a study of collective cases in four companies of this segment business. The data were analyzed by means of the inductive content. The results revealed the existence of strongly committed to environmental management and environmental practices aligned with their strategies, contrary to the pessimism of literature. In addition, research evidenced that the characteristic of the formality, understood like registry and horizon of strategic planning, maintained a contradictory relationship with the adoption of proactive environmental management in the SMEs studied.

Keywords: -Strategy formation, business decisions, environs, business venture, business environment.

I INTRODUCTION

Global environmental issues, such as changes in the climate, and requiring urgent solutions have increased the awareness of society on the impacts of industrial operations on the natural environment. Since the publication of the "Our Common Future" report by the World Commission on Environment and Development in 1987, business leaders and management academics have been dealing with inquiries about how and why companies should integrate environmental issues into strategic decisions. Thus, it is considered that a paradigm shift has been underway in the field of strategic business management since the 1990s, since many past economic and organizational practices need to be reformulated since they are not environmentally sustainable. This has made companies rethink their relationship with the environment; therefore, concern with the environmental issue has become increasingly relevant in organizational theory and practice Townsend (2006).

In this debate, however, the segment of small and medium-sized enterprises (SMEs) deserves special mention, since some researchers argue that environmental management is still far from the reality of most organizations of this size. Darabaris (2008) argue that SMEs do not have all the resources and skills needed to implement environmental management activities. In the same line, other scholars appear Antweiler (2014); Victoria (2003); Ledgerwood (2002) mentioning that SMEs show poor environmental performance and that their environmental management activities - where they exist - are predominantly reactive and do not constitute guidelines for strategic changes in this business segment. On the other hand, the results of the research of show that, unlike the prevailing approaches in the literature, even SMEs can adopt proactive environmental practices and that these

practices can lead to superior economic performance through specific organizational skills and based on unique strategic characteristics of SMEs. Townsend (2006) supports this argument by concluding that SMEs can become greener through organizational and strategic changes.

Notwithstanding this impasse with regard to environmental aspects in SMEs, it is still necessary to keep in mind that smaller companies have specificities in their management that differentiate them from large organizations. This means, among other things that SMEs cannot simply employ, on a small scale, solutions developed by and for large organizations to address the various environmental pressures that shape their organizational landscape. According to this author, investigations that bring own answers and a better understanding about how small companies deal with their environmental issues should be considered of extreme relevance. Complement this view by arguing that the strategic differences between small and large companies and the lack of previous studies show the importance of giving detailed attention to the strategic behaviour issues of SMEs in their interface with the environment.

Considering the lack of knowledge about environmental management in SMEs, specifically on the relationship between strategy and environmental management in smaller companies, the following concerns were addressed: "How environmental issues are part of the process of strategy formulation in SMEs? "

This article aimed to verify if the environmental management activities in the metal-mechanic segment of the Madhya Pradesh (M.P.) region are in line with their business strategies. For that, a study of collective cases was carried out in four companies in this business segment.

II BUSINESS ENVIRONMENTAL MANAGEMENT

The studies in the field of environmental management usually have certain classifications in order to facilitate the understanding of the environmental variable in the company. It is important to note that different levels of environmental management are identified, which makes it possible to perceive environmental evolution processes within organizations. Often, classification models with three, four or five levels are used to characterize the companies' concern with environmental aspects, especially the three-level classifications Jorgensen (2002). For Molthan (2017), these stages are illustrative of the different typologies designed to classify companies according to their environmental management practices. The main characteristics of these evolutionary stages of environmental management in the company are discussed below.

- (a) Pollution control: the approach to pollution control is defined as a reactive posture of companies facing environmental issues; it is through this attitude that the organizations focus, through punctual solutions, their attentions on the negative effects of their products and productive processes. The interventions focus on establishing practices to prevent the effects of pollution generated by a given production process. This form of pollution control is usually carried out by localized actions and little articulated with each other and objectively, in most cases, meeting the requirements established in the command and control instruments to which the company is subject and the pressures of the community Welford (2009). The technological solutions typical of this approach seek to control pollution without intervening in the production process itself Hung (2012). Thus, pollution and waste are reduced after they have been generated, by adding filtering or pollution-removal devices to existing equipment in the company. Thus, it is not necessary for the firm to develop competencies or skills in the management of new environmental processes or technologies. These pollution control technologies are often referred to as end-of-pipe technologies (end-of-pipe) and aim to combat the unwanted outputs of waste from the production process Hung (2012) to capture, store and treat pollution before it is released to the environment. Examples of such technologies are: effluent treatment plants; cyclones; electrostatic precipitators; purifiers; incinerator filters; purification filters; water and sewage treatment networks, among others.
- (b) Pollution prevention: The concept of pollution prevention, also called pollution-reduction technology or clean technology, uses methods such as the replacement of materials and

processes in a closed loop, minimizing or avoiding the generation of pollution and waste from the production processes at their source Higgins (1995), that is, before they are produced and released into the environment. For this, changes are needed in the company's processes and products. At this stage of environmental management may also be present the technologies of cleaner production. Cleaner production consists of the continuous application of a preventive environmental strategy integrated with processes, products and services to increase overall efficiency and reduce risks to humans and the environment. Cleaner production can be applied to processes used by any company, to the products themselves and to various services offered to society. A pollution prevention / reduction approach generally includes minimizing, changing or eliminating emissions and effluents through good housekeeping practices (organization of the workplace, cleaning, systematic packing and standardization), materials replacement, recycling or process innovation. It also implies inventory control, improved material handling, leak and spill prevention, and improved preventive maintenance. The reduction at source focuses on the production process itself, not on waste management. It is the concept of avoiding the creation of waste rather than managing them once they are generated. Efforts to reduce pollution at source are not only beneficial to the environment, they are also economically viable. Reducing waste production means using less raw material or using it more efficiently, and also reuse or recycle the waste produced, preferably still in the industrial plant, turning it directly to the production process, and, if treatment of waste that cannot be reused, recycled or disposed of United states (2000). In the latter case, leftovers are collected, treated and disposed of through pollution control technologies, since there is no fully efficient process Welford (2009).

- (c) Strategic approach: companies that use the "pollution prevention" strategy have a very weak integration of environmental issues in corporate strategy and limited participation of environmental managers in strategic planning. However, many organizations are finding that the environment has become a strategic issue of utmost importance. Thus, these companies are responding to the challenges posed by the natural environment by integrating them into their strategic management processes Piasecki (1995). By incorporating environmental factors into its strategies, policies and targets, the company begins to consider the environmental risks and impacts not only of its production processes, but also of its products. In general, the top management commitment is formalized through a corporate policy statement that

integrates environmental issues into the company's business. The intention of this formalization is not only to spread the involvement in the search of environmental solutions to the own organization, but also to encourage a commitment of the whole company United states (2002). This strategic importance of environmental problems grows as the interests of public opinion on the environmental issue, as well as stakeholders such as workers, consumers, investors and environmentalists increase Welford (2009).

In this context, the environmental posture shows that the introduction of environmentally correct technologies becomes part of the business objectives of the companies and is no longer seen as an additional cost Jorgensen (2002); Ottman(2001). Thus, the ability to integrate the natural environment into a company's strategic planning process offers the opportunity to develop a valuable, potentially rare, and difficult to imitate organizational competence. Moreover, integrated management of environmental assets is seen as fundamental to long-term business survival.

According to Ottman (2001), marketers tend to adopt the strategic approach to environmental management when price is not the prime factor of competition and when differences between products are perceived as significant. Mention that green differentiation can be an effective strategy only if:

- (i) A product has genuine environmental advantages and warrants a higher price, and
- (ii) The company is able to communicate such advantages to the public.

III STRATEGY FOR SMALL AND MEDIUM-SIZED ENTERPRISES

Strategic issues are not phenomena found exclusively in the realm of big business. It would thus be obvious that SMEs also face problems of strategic importance for their survival and future growth. According to author, approximately 80% of the problems of small companies are strategic in nature and only 20% refer to the lack of resources.

Centralization is a hallmark of SMEs. The leader appears as the only decision maker and, therefore, his system of beliefs and values characterizes the decision making process. However, the PME leader does not have the necessary skills, nor does he have the time to make decisions based on a more analytical and strategic attitude. Decision processes are, above all, individualistic and emphatically emphasized among those responsible for SMEs. The manager is routinely required to make all kinds of decisions without any formalized procedures Mazzarol (2011). For Birkinshaw (2005), the low use of strategic tools by SME managers is a natural consequence of the lack of knowledge that these

leaders have about such methods when compared to managers of large organizations.

Overall, SME owner-managers are not systematically engaged with strategic planning, since planning is done in an ad-hoc way, based on problems. In this business segment the emphasis of strategic management is focused on short-term results Hitt (2017), being regularly updated and operationally oriented Stokes (2002).

Informality is a basic feature in the process of formulating SME strategies. Details are imprecise and communications are verbal rather than written Cobbenhagen (2000). For Mazzarol (2011), the informal and intuitive character of the strategy is related to the fact that the manager is close enough to his employees to explain to them any change of direction at the right time.

Author point out some particularities of the strategic behaviour of SMEs:

- (i) Lack of professionalism in management, resulting in a poorly structured strategy;
- (ii) Less ability to create a strategic response due to lack of information on the environment;
- (iii) Reactive management in the face of environmental changes

All these characteristics can contribute to a low economic and financial performance of SMEs. However, this situation does not occur in all SMEs, since groups of SMEs with a prospective strategic orientation are known, which enables the creation of sustainable competitive advantages based on characteristics such as flexibility and innovation.

The results on small fast-growing firms have shown that as firms grow, the planning processes used tend to be more formalized, structured, and participatory, in order to ensure continued organizational effectiveness.

In sum, it can be said that few SMEs make use of formalized strategic planning. Consequently, an attempt to push the leaders of these companies to transcend their informal management styles and to adopt formal methods of strategic analysis and strategy formulation can be considered utopian Birkinshaw (2005).

IV METHODOLOGICAL ASPECTS

In order to meet the objective of this research, four companies of the metal-mechanic segment of the central region of the State of (M.P.) were investigated, classified as small and medium-sized companies by the criterion of number of employees, as shown in Table 1. It was considered, on the one hand, that the companies in this segment are numerically relevant in the industrial sector of this region and, on the other hand, that the industrial companies of the metal-mechanic segment have a medium-level environmental impact. The

combination of an extensive number of companies with the average level of environmental impact may

represent a very significant total of industrial pollution in this region.

Table 1
Classification of company size

TYPES OF INDUSTRY	NO. OF EMPLOYEES	TRADE and SERVICE
Company A - small	50	09
Company B - small	79	10 to 15
Company C - average	100	20
Company D – medium	300	40

(No. of employees may extends with the company’s requirement)

This research adopted the qualitative method as a way of approaching the problem and had exploratory purposes, since the knowledge about environmental management in SMEs is still incipient. The strategy of the study of collective cases of Denzin (2013), essentially qualitative author, was chosen for the accomplishment of this work. The data collection merged two instruments:

- (i) semi-structured interviews with the main leaders of each SME;
- (ii) Analysis of documents made available by the companies themselves on their websites.

In turn, the data collected in the field were analysed using the technique of inductive content analysis Hansen (2009). Thus, first, the interviews were transcribed in their entirety and then a process of immersion in the data was performed, which represented several detailed readings of interview transcripts so that one could get a sense of the whole. Subsequently, the text was divided into units of meaning that were condensed, abstracted and labelled with a code. During condensation and labelling with codes the whole context of each interview was considered. The generated codes were compared on the basis of differences and similarities and grouped into categories, which represented the manifest content of the text. Finally, the underlying meaning of categories, that is, latent content was formulated in themes. It was these themes that brought the answers to the guiding question of this work. However, although this description points to a linear procedure, it is important to keep in mind that the process of inductive analysis involves a back and forth movement between the whole and the parts of the text.

V RESULTS

(a) Brief Characterization of Companies

The companies of the metal-mechanic segment of the State of (M.P.) are obliged to comply with pollution control regulations, and this environmental inspection is under the responsibility of Madhya Pradesh Pollution Control Board (MPPCB). This means that these companies are classified, at least, at the initial stage of corporate environmental management.

Company A started operation in 2000 and currently has 50 employees, which classifies it as a small business under the Madhya Pradesh Micro, Small & Medium Enterprises (MPMSME). The main activity of the company is the casting of ferrous metals. The organization chart of the company is composed of directories of production, finance, and sales and marketing. The company has three partners, all with a higher education in the engineering area (each one is responsible for a board of directors), and there is equal hierarchy among the owners. The finance and production departments have two more vertical levels, and the sales department has just one more.

Company B was founded in 1986 and currently has 79 employees, so it is framed in the size of small company by the criterion of MPMSME. The main activity of the organization is the manufacture of household utensils, and the organization has its own aluminium casting. The organization chart has three hierarchical levels below the presidency and is divided into three departments (commercial, administrative and production). The management of the company is familiar, that is, the children of the owner-manager are the managers responsible for the departments of the company.

Company C has 100 employees, so it reached the size of the average company, according to MPMSME classification. Its main activity is the manufacture of thermal valves for industrial purposes. The owner of the company is the main manager, who has a degree in Physics and specialization in Business Management. Company C is divided into four hierarchical levels: presidency, management, leadership and operational level. The departments are composed of the areas of human resources, quality and environment, marketing and sales, and production.

Company D currently has 300 employees, being classified as a medium-sized company by MPMSME criteria. The company has been in the market since 1992 and its main activity is the manufacture of equipment for supermarkets. The two owners of the company are the main leaders, both of whom concentrate various administrative functions.

(b) Environmental Management

The environmental practices of company A range from the proper disposal of waste in landfills, through the use of recyclable products, to measures for the reuse of waste. In its production process recyclable materials, in this case scrap, represent approximately 95% of the total metals used in the smelter. Company A uses equipment that allows the reuse of up to 80% of the sand used in foundry moulds. This percentage varies according to the level of phenolic resins, which remains in the sand. When this concentration is higher reuse decreases and vice versa.

In addition to the main input of the company A form scrap, the organization achieves a 100% reuse rate of the metal refills, that is, leftovers from the company's final product. This is relatively simple to do, since it is sufficient to reintroduce this material into the induction furnace used for the melting of the metals.

In company B, only measures are taken to comply with environmental legislation, which is regulated by MPPCB. These practices are basically actions to control the pollution that has already been generated by the company's production process. In this case, we can mention the installation of purifying filters in the chimneys of the company's factory and the correct conditioning of the textile waste that aggregates the dust resulting from the sanding and polishing process of the aluminium used for the manufacture of domestic utensils. This powder adhering to the surface of the sanding wheel and polisher should be packed in appropriate bags for collection and subsequent transport to landfills. The leftovers of paper, cardboard, plastics, etc., are conditioned for later sale to recycling companies or cooperatives. It should be noted that,

In addition to complying with the requirements of environmental legislation, Company B performs the reuse of refractories resulting from aluminium cutting. To do this, simply place them in one of the company's ovens used for casting metals. This procedure is quite common in the metal casting industry.

Company C obtained the ISO 14001 certification integrated with ISO 9001 in the year 2008. Due to the requirements of this standard, the organization has managed to reduce the consumption of water and electricity every year. Currently, the company has sought to develop thermal valves that allow a significant reduction in the cost of thermal energy generated by steam. In this way, the product provides several environmental benefits by saving energy, reducing the use of raw materials and mitigating pollution in the atmosphere, hydrosphere and lithosphere.

The work on the environmental issue is carried out seeking a holistic approach. Company C is always committed to achieving the commitment of all employees to environmental management. Therefore, the company is seen as part of an external environment in which it is inserted. This happens

from the moment the inputs are consumed, through the transformation process, to the final result, represented by the company's products and services.

The building in which the headquarters of the company D is located was designed so that if it had great use of sunlight and, with this, reduction with expenses in electric energy. The company also uses collection boxes to take advantage of the rainwater and in the paving of its surroundings with the objective of facilitating the return of the water to the ground. In addition, there is an area of vegetation preserved in the company's land.

The production line of company D is largely automated and this has led, according to the leader, to a reduction in energy consumption. For the manufacture of refrigerated cabinets, the company has sought to use non-oxidizable rather than oxidizable materials, because as these cabinets are exposed to humid environments in supermarkets, the purpose of this replacement is to increase product life, delaying remanufacturing and recycling.

Company D also has an ecological line of equipment. Example of these products is the ecological check-out (supermarket box) that is made of stainless steel, with rounded edges and does not use welds and rubbers. This allowed the product to be simplified by removing components derived from non-renewable natural resources. Although the company continues to manufacture products similar to those of the old line, which uses welds and rubbers, the leader has emphasized the sale of products of the ecological line, thus seeking to increase the share of these products in the total billing.

The environmental practices mentioned above show that company A is located in the stage of environmental management called pollution prevention. Regarding company B, although the materials used in the production process are reused, this isolated environmental action is not enough to characterize the environmental management of the company under the pollution prevention approach, since this practice is common in the foundry sector. Thus, it can be said that company B is still in the initial stage of environmental management, that is, pollution control. For company C, environmental practices point to the strategic approach to environmental management. ISO 14001 certification and the company's performance in the development of products with environmental technologies leave no doubt about this. Finally, the results show that the environmental activities of company D, like company C, are classified at the stage of the strategic approach to environmental management. What this inference shows is that the company invests in environmental technologies to develop an ecological product line.

(c) Business Strategy

In company A, the three directors of the company (financial, production and sales) are responsible for the development of the strategy, but each head of industry can also give opinions on the direction that the company should follow. The hallmark of the strategy formulation process of company A is informality, because although the company has a strategic plan, it is informal, not written and its fulfilment does not follow a time horizon. In ascertaining the strategic vision and mission of the company we see that they are focused on the quality policy, not aiming at attending to any motivations focused on the environmental issue.

In relation to company B, the strategy is elaborated by the manager and the managers of the three departments. The company has a documented strategic plan with a time horizon of one year, but this plan is not very detailed. The strategic vision of the organization is to diversify its branch of industrial activity within the metal-mechanical segment, such as the area of injectors and extrusion.

When examining the strategy of company B, we do not see aspects related to environmental management. According to the leader himself, the organization will only be more concerned with the environmental issue when it is a requirement of the internal market or bring some kind of economic benefit. In the view of the leader, the latter could not be reached at the time, with the implementation of new environmental management activities, such as prevention of pollution or even certification under ISO 14001. Currently, despite ISO standards 14000 are requirements of some companies from developed countries for import, the leader of company B argues that their products could not enter such markets because aluminium is not used in domestic utensils in these countries.

Company C has a preponderant formalization characteristic and the process of elaboration of the strategy counts on the participation of some of its managers, which includes the area of finance, sales and marketing, and production. The company has a documented strategic plan, with a five-year time horizon, based on the balanced score card. Disclosure of the most important aspects of this plan to the rest of the company is made through the bulletin board. Another important point to highlight is the fact that environmental issues are also observed in the process of strategy creation. Both in the mission and in the strategic vision the topic of environmental sustainability is present.

Company C's pro-activity on environmental issues can be easily noticed when analysing its business strategy. The management of the environment is present throughout the product formation context, and the slogan of the company's innovation process is the simplification, but simplification that is related to

the reduction of the necessary inputs to the transformation process. A final product is expected to be beneficial to the environment by directly or indirectly reducing the use of non-renewable or renewable natural resources and also by reducing or even eliminating polluting waste that contaminates soil, water and the environment. air. Thus, for the leader, company C has achieved advances in environmental management from the simplification of products.

The planning process in company D has a characteristic of informality, given that the strategic plan is not documented, despite having a time horizon of 15 years. In the elaboration of the strategy of the company, besides its two directors, the six main production managers participate.

Company D has the concern to remain at the forefront of the technologies for its area of operation. The philosophy of the company, according to the leader, has always been focused on evolution and this encompasses business, human, technological and sustainable evolution, among others. In addition, the entrepreneur has a project to create a research centre connected to the area of energy recovery and transfer. This shows that the strategy of company D is based on the pillar of innovation in all areas, including in the field of sustainability.

VI DISCUSSION ON RESULTS

The results showed the existence of SMEs (C and D) that adopt environmental practices that place them in the most advanced stage of environmental management, including company C and achieved ISO 14001 certification, which contradicts the arguments of Darabaris (2008), Victoria (2003) as these authors argue that small and medium-sized enterprises are still at a preliminary stage in relation to their environmental practices. On the other hand, the progress of the environmental management in the company's C and D corroborates the results of the researches by identifying proactive environmental practices in the SME segment.

With regard to the business strategy, it can be mentioned that the companies studied are quite heterogeneous among them, a striking feature in all SMEs. This would explain, in part, the fact that companies with formalizing preponderance (B and C) and others (A and D) with features of informality in the process of strategy formation, as was also pointed out Cobbenhagen (2000). It should be noted, however, that the degree of formalization of the companies surveyed was not directly related to their size as to the number of employees. In other words, even company D being the largest in the sample in terms of number of employees; it presents features of informality in its strategic planning, see Table 2.

Table 2
Formalization of the strategy x n° of employees

COMPANIES	NO. OF EMPLOYEES	STRATEGY
A	50	Informal
B	79	Formalized
C	100	Formalized
D	300	Informal

As for the insertion of environmental issues in the business strategy, only in the C and D companies the environmental theme was considered in the process of formulating the strategy. Company C explains the weight that sustainability has in its mission and vision of the future. However, although the data collected in the field point to the integration of environmental management with the company strategy, it is important to highlight the absence of the person in charge of the area of quality / environment in this planning process. This characteristic of the organization contrasts with the strategic approach of environmental management in which the company is located, because at this stage the person in charge of the environment should have an active voice in the context of strategic planning. This fact may be an indication that some issues in the company remain centralized in the figure of the leader,

On the other hand, in company D the environmental question appears integrated to the philosophy of constant evolution of the organization, being represented by the pillar of the innovations in environmental technologies. In this way, environmental management is aligned with the

company's strategy through innovations in the field of sustainability. It is worth noting that D, despite being at the highest level of environmental management, has an informal and intuitive strategy. Thus, it can be inferred that this characteristic quite common in the SME segment is not an impediment to a proactive and holistic environmental management, that is, that encompasses the entire company and its interaction with the external environment.

The other two companies investigated, A and B, did not present any kind of integration between environmental practices and business strategy: company A has its focus on quality management policy; the company B is very incipient in the environmental field, among other reasons because the manager does not recognize the existence of benefits related to a more effective environmental management. This seems, however, to be a feature of companies in which environmental management is seen only as legal imposition.

The Figure 1 shows the character of the strategy, as the formalization, the investigated companies and alignment between environmental management and strategy.

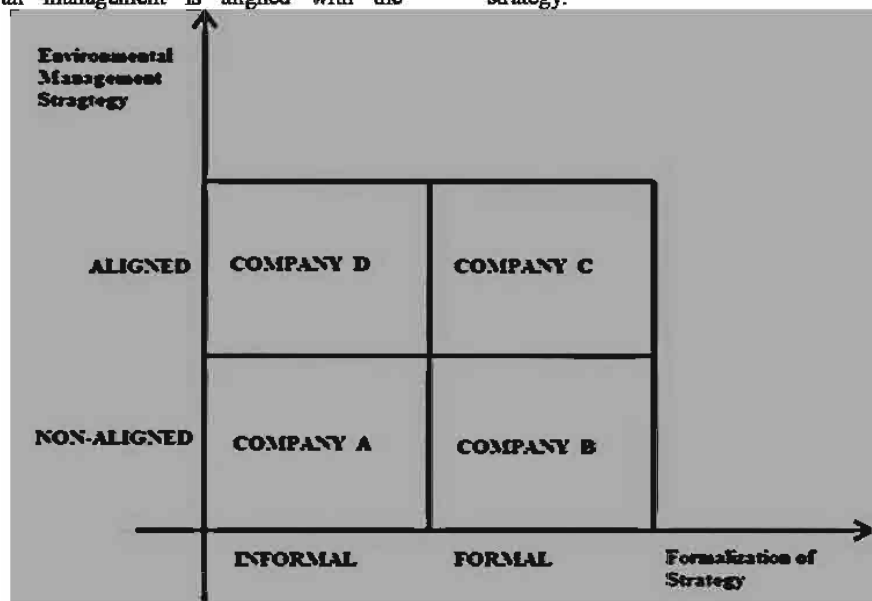


Fig 1 Formalization of Strategy and Alignment with Environmental Management

The company's C and D, with environmental management aligned with the business strategy, are the largest number of employees among the four SMEs surveyed. Another characteristic common to

these two companies is that they were the only ones that innovated from the point of view of environmental technologies in products. However, it should be noted that the formalization of the strategy

had no influence on the integration between environmental management and company strategy.

VII FINAL CONSIDERATIONS

This study was conducted in order to verify if the activities of environmental management in SMEs of the metal-mechanic segment of the central (M.P.) region are in line with their business strategies. The results of the research in four SMEs showed that only two of these organizations incorporate environmental issues into their business strategies.

Investigating the perspective of the alignment between environmental management and business strategy is relevant, since this alignment is directly related to a proactive environmental management. In turn, the proactive and systemic management of environmental issues brings a greater possibility of reconciling actions aimed at upgrade the environment with a higher economic performance of companies. In other words, companies that occupy the highest level of environmental management stages can reduce the impact of their operations on the environment while at the same time receiving economic and financial benefits from such action. In addition to the monetary and material aspect of the gain in being proactive in the environmental issue, the clients and the society confer legitimacy and recognition to this strategic position.

The outcome of this research point out some differences between the way environmental management was developed in the companies surveyed and the characteristics of the evolutionary stages of environmental management described in the literature. First, it can be said that it is common to find references to the fact that the environmental department must have a relevant role in choosing strategic directions when the company is at an advanced stage of its environmental practices. However, as seen, this did not occur in company C, even with the reach of this higher level. Among the most likely reasons for this is the centralization, by the leader, of the strategic issues of environmental management.

The literature reports that small and medium-sized companies are still at a preliminary stage in relation to their environmental practices. Company size is a relevant issue when it comes to the specifics of small enterprise. Portions (micro, small, medium) defined by quantitative criteria, for example the number of employees, are not capable of expressing the qualitative dissimilarity in administration of the companies nor indicate with precision the point of change of these differences. However, the results of the research show a relation between the increasing size of the companies in the number of employees (A = 50, B = 79, C = 100, D = 300) and the stages of environmental management (A in the 1st stage of control, B in the second stage of prevention, C and D in the third strategic stage).

The question of the formality of business planning can be divided into two dimensions, the record of decisions and the horizon of the plan. The formalization as a full-scaled and exhaustive record of resolutions, allowing a more agile, precise and impersonal communication, was used by company's B and C. Therefore, from the point of view of this dimension, companies A and D would have an informal strategic process; despite this fact, company D showed a great commitment to environmental practices. Again, the research results refute the literature, since it listing the formalization by the top management of the corporate policy statement that integrates environmental matters into the company's business with the purpose of encouraging a company-wide commitment.

The other dimension of the formalization, the horizon of the strategic plan, presented, through the outcome of the research, a coherent relationship with the integration of the business and environmental plans: companies A and B, with a horizon of up to one year, showed no signs of integration of plans; already companies C and D, with a horizon of more than five years, presented integration. This formalization dimension also demonstrates consistency with the increasing size of firms and the sophistication of the stages of environmental management.

The results of the research present another aspect of environmental management stages: companies C and D, positioned at stage three of the strategic approach to environmental practices, revealed permanent actions related to new by-products and transformations, and their managers expressed concerns about awareness of environmental issues. In turn, companies A and B, ranked respectively in stages one and two, indicate concerns about lowering the costs with environmental actions and lamented the lack of financial resources.

Finally, there is the suggestion for future studies that seek to explore, the relationship between environmental exercise and the incorporation of management around SME managers and, on the other hand, to assess to what degree the informality of SMEs can be considered as a facilitator or as an obstacle to proactive environmental management.

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Women Empowerment through Entrepreneurship: A Case Study of Successful Women Entrepreneurs in India

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ABSTRACT

Women empowerment is an important economic issue as the autonomy of women and the improvement of their social, political and economic status is of extreme significance. To achieve sustainable development, complete partnership and participation of both men and women are required in productive and non-productive activities (UNFPA, 1994). Women Empowerment. Indian women are said to have immense potential as successful entrepreneurs. They are predominantly constrained because of their double shifts as wives, mothers & business women. They work twice as hard as men to prove that they are competent enough in doing a good job (Lincoln, 2012). The Present case relates to two vibrant, young and dynamic women entrepreneurs Ms. Monika Seth of Seth Industries, Amritsar and Ms. Riya Bajaj of KS Overseas, Noida. The data was collected using both primary and secondary sources of information. For primary information, a structured interview was conducted with Ms. Monika Seth and Ms. Riya Bajaj. As a source of secondary information, extensive review of literature relating women entrepreneurship has been undertaken. Both women entrepreneurs discussed in the case are operational in the similar kind of business. The only difference lies in their place of operation. Their enormous success and remarkable growth are indicators of their endless efforts. The study gives a comprehensive picture of the pivotal issues relating procurement of finance for the business, acquisition of raw material, dealing with competition, handling labour issues and ideology of discussed women entrepreneurs with respect to role of government in promoting businesses in India. The purpose of this research is to understand the ideology and the work-life balance of women entrepreneurs in textile industry. The identification of societal, economic, financial and regulatory (GST) issues faced by women entrepreneurs can be further used by government for development of women entrepreneurs in the country.

Keywords: women entrepreneurship, creativity, work-life balance, competition, Impact of GST.

I INTRODUCTION

Entrepreneurship is the act of setting up new business or stimulating an existing business. An Entrepreneur helps in wealth formation and job creation by inventing new products and services (Sinha, 2013).

An entrepreneur is perceived as an individual with certain characteristics helpful in conceiving, initiating, establishing, running and finally managing an enterprise (Sinha, 2003). The economic backwardness of a region can be attributed to the lack of development of entrepreneurship in that region. Hence, it is important to encourage both men and women to take up entrepreneurship as a career to boost growth of the region as well as the country. Women empowerment is an important economic issue as the autonomy of women and the improvement of their social, political and economic status is of extreme significance. To achieve sustainable development, complete partnership and participation of both men and women are required in productive and non-productive activities (UNFPA(1994). Women Empowerment. (Retrieved from <https://www.unfpa.org/resources/issue-7-women-empowerment>). Women entrepreneurs contribute towards economic development and also help in addressing societal challenges. In India,

family responsibilities, traditional norms, lack of skill, confidence and access to entrepreneurial knowledge pose major challenge to women entrepreneurs (ALC India, 2017).

Various studies have shown that women entrepreneurs have faced innumerable challenges in operating businesses (Vinze, 1987; Rani and Sinha, 2016; Selvakumar and Ambika, 2014). The major challenges faced by a woman entrepreneur have been discussed as follows:

- (a) Post marriage, expectations of family and personal commitment act as a barrier as Indian women are more mindful about their family obligations than the business responsibilities (Lincoln, 2012; Bulsara et al., 2014).
- (b) Lack of Financial support, lack of information and advice, lack of education and training, non-cooperation of husband and family, lack of business contacts, lack of recognition and appreciation of the members of the family are some of the identified socio-economic challenges faced by women entrepreneurs (Selvakumar and Ambika, 2014; Rao, 2013).
- (c) Lack of economic empowerment and support for women in small businesses along with the lack of mentoring networks pose another major challenge (Bekh, 2014).

II MODERN LIBERALIZED WORLD

In the modern liberalized world, women have become highly professional and skilled. The problems, they used to face earlier in their entrepreneurial drive, are decreasing day by day. Even in India, various promotional measures, in the form of Self-Help Groups (SHGs), SIDBI, NABARD, Federation of Indian women entrepreneurs (FIWE), Indira Mahila Yojna(IMY) and Support to Training and Employment Programme (STEP) have been quite successful in providing much needed support to women entrepreneurs (Maruthiprasad and Venkatrama, 2016).

Besides, it has been observed that the family and friends are also acting as a strong support system to make women self-reliant. To showcase this, the present case study contains excerpts of an interview conducted with two young and dynamic women entrepreneurs who have handled their respective businesses so beautifully that they are growing by leaps and bounds. And both of them very confidently and happily acknowledge the contribution of their spouse and family in their thriving success. Indeed, they are living a life where there is a balance between a happy home life and a prospering career.

III OBJECTIVES AND METHODOLOGY

The primary purpose of this paper has been to study the journey of two young and dynamic women entrepreneurs who are operational in the northern region of the country. Both women entrepreneurs discussed in the case are operational in the similar kind of business. The only difference lies in their place of operation. A successful entrepreneur, Ms. Monika Seth of Seth Industries, Amritsar, Punjab has taken her venture to remarkable heights with her perseverance and self-determination. The second most successful woman is Ms. Riya Bajaj, the owner of KS Overseas operational in Noida, UP. With her remarkable fashion sense, she has made a significant place for her venture in the fashion world.

The data is collected using both primary and secondary sources of information. For primary information, a structured interview was conducted with Ms. Monika Seth and Ms. Riya Bajaj. As a source of secondary information, few research studies on women entrepreneurship have been reviewed through journals. Besides, newspaper articles were used as a reference wherever required.

IV SETH INDUSTRIES

- (a) **Introduction:** Seth Industries manufactures high quality and stylish scarves, shawls, stoles and throws. The company has a long tradition of creative fineness offering traditional classic raibleys to futuristic florals & abstract motifs(Profile, Seth Industries, Retrieved from <http://www.sethindustries.com/>)
- (b) **Product Catalogue:** The Product catalogue includes a variety of shawls, stoles, jamawar stoles, silk stoles, wool stoles, silk scarves which are a perfect mix of comfort and style (Product catalog, Seth Industries, Retrieved from <http://www.sethindustries.com/>) Seth Industries considers quality a major concern and hence follows rigorous quality control norms right from the acquisition of the raw material till the time the final product is dispatched. Every part of production is carried under the direction of experienced quality control professionals (Quality Assurance, Seth Industries, Retrieved from <http://www.sethindustries.com/>)
- (c) **Background:** Ms. Monika Seth was born and brought up in Amritsar in a Joint Hindu family. She completed her graduation in commerce from BBK DAV College, Amritsar in 1994. She had an outstanding sense and taste of fashion. After marriage, her lovable and understanding husband encouraged her to deploy her skills towards some productive purpose and she started her own entrepreneurial venture in the holy city of Amritsar, Punjab. This was more out of an urge to do something more dynamic and creative rather than being a home maker. (As told to the researcher)

V KS OVERSEAS

- (a) **Introduction:** The Company came into existence in 2013 with a mission to export the best quality fashion and clothing accessories.
- (b) **Product Catalogue:** The product catalogue includes different textures of scarves, shawls, stoles and jacquards. The fashion world constantly changes and updates itself. KS Overseas has also stayed abreast to the changing times.
- (c) **Infrastructure:** The entire designing is done in a building owned by the company. KS Overseas has a team of highly-skilled designers. The total workforce of the unit is 35-40 people.
- (d) **Background:** Ms. Riya Bajaj was born and brought up in Meerut. Her mother is a teacher and her father had ancestral business which he had to shut down because of health issues. She did her B.Sc. (Hons.) from Lady Irwin College, Delhi. Her dogged perseverance along with the guidance, support and vision of her husband has

helped her company to grow day by day (as told to the researcher)

VI REVIEW OF LITERATURE

Socio-cultural factors having impact on women entrepreneurs operational in India have primarily been identified by Vinze (1987); Mauchi et al. (2014); Chandwani (2015); Rani and Sinha (2016) in their respective studies, in addition to other influencing factors. While Selvakumar and Ambika (2014); Bulsara et al. (2014); Rao (2013) have laid emphasis on economic factors that have influence on the smooth functioning of enterprises owned by women entrepreneurs, Nandy and Kumar (2014); Chandwani et al. (2015) have identified the competitive factors having remarkable impact on

women entrepreneurs. Bekh (2014) and Rani and Sinha (2016) have considered the supporting and other factors respectively.

Considering the importance of key factors, the present case will take special inputs relating literally identified factors from the excerpts of a scheduled interview conducted with a renowned entrepreneur Ms. Monika Seth owning Seth Industries in Amritsar, Punjab and Ms. Riya Bajaj owning K.S. Enterprises Ltd, Noida

VII ANALYSIS OF THE CASE

The discussion with Ms. Monika Seth and Ms. Riya Bajaj has provided the following responses that have been given below:

Table I
Socio-cultural Factors

Entrepreneurs\Factors	Socio-cultural Factors (Vinze, 1987; Mauchi et al., 2014; Chandwani, 2015; Rani and Sinha, 2016)				
	Educational qualification	Religion	Friends & family support	Cultural issues	Language barriers
Ms. Monika	Bachelors of Arts	Hindu	Good support from Husband, In-laws and other family members	No	No
Ms. Riya	Bachelors of Science	Hindu before marriage, Sikh after marriage	Good support from husband and family	No	No

Table 2
Economic Factors

Entrepreneurs/ Factors	Economic Factors (Selvakumar and Ambika, 2014; Bulsara et al., 2014; Rao, 2013; Mauchi et al., 2014)						
	Sources of funds	Adjustment in industrial estate	Role of government	Procurement of manpower (Skilled and unskilled)	Procurement of raw material	Credit facility	Arrangement of finance for working capital requirements
Ms. Monika	Initially, the venture was self-financed, then at a later stage, for further expansion loan was taken from Bank	Very comfortable, because of husband's contacts	Supportive. The textile up gradation fund and the subsidy of 5% were of immense help	Faced the problem of procuring skilled labour	To ensure better quality standards, wool top is procured from Australia One European designer is on their pay roll for further assistance	Easily Available	All matters related to acquisition of finance and its disbursement viz. purchase of raw material, salary disbursements to workers and employees and taxation issues are handled by her husband.
Ms. Riya	No financial assistance from any financial institution was taken.	Comfortable	Supportive	In places like Noida, there is no such issue, since so many people from Bihar and UP come to Noida for work. So, it is easy to procure skilled labour.	The raw material comes from different places. from South India, from Punjab and small villages of UP.	Easily Available	Ms. Riya started the business with her savings KS overseas first order gave a remarkable boost to the business as it was fulfilled by the company using its resources optimally which further lead to cost minimization and, in return, could give the business major chunk of revenue KS overseas follows the same strategy of optimal utilisation of resources till date which leads to multiplication of their revenue which is further invested in the growth of the business.

Table 3
Competitive Factors

Entrepreneurs\ Factors	Competitive Factors (Nandy and Kumar, 2014; Cbandwani et al., 2015)			
	Threat of new entrants	Availability of suppliers	Availability of consumers	Competition
Ms. Monika	Yes	No problem, as along with the domestic market even the international market has also been explored to ensure better quality standards.	To ensure better market penetration, the Seth industries export house exports their products to other countries.	Not disclosed by the entrepreneur
Ms. Riya	Yes	Raw material is procured from domestic suppliers primarily from South India and from Punjab as well	KS Enterprises serves overseas market	Major players in the sector are NR Silk International LLP located in Noida and Shangora Industries located in Ludhiana, Punjab

Table 4
Supporting and Other Factors

Entrepreneurs\ Factors	Supporting Factors (Bekh, 2014; Mauchi et al., 2014)		Other Factors (Rani and Sinha, 2016)	
	Prior experience and training	Work-life balance	Industry dominance (on the basis of Gender)	Government regulations
Ms. Monika	Her Husband has a work experience with Raymond Limited, Mumbai	No Problem at all	International market is more female dominated while domestic market is Male dominated	Labour laws are obsolete and outdated. The governmental regulations to some extent are anti-industry
Ms. Riya	As per Ms. Bajaj, 'I have a husband with ocean full of experience which is helping us both to grow in this field'	No Problem at all	The entrepreneur considers that her field is the best in this case as there is no such dominating factor as men and women both can do this creative work and can show their skills in terms of stitching and designing.	Being the owner, she is the one who set rules and do the planning which everyone else at work has to follow for smooth functioning and to meet the deadlines of the customers

Table 5
Impact of GST on the Industry

Entrepreneurs\ Factors	Impact of GST on the Industry
Ms. Monika	Ms Monika Seth believes that eventually GST will have a good impact on the industry. The initial few years are always terrible when you intend to regularise something. No doubt, Seth Industries faces huge problem in submitting returns yet the entrepreneur is quite optimistic about the long term impact of GST regulation on the industry as a whole.
Ms. Riya	Ms Riya Bajaj considers that GST is causing great loss to her company. She further adds that earlier government used to give a refund of 8 per cent to scarves and garment industry, which has now been taken back. The regulatory framework in the form of GST has a bad impact on the industry, as per Ms. Bajaj.

VIII FINDINGS & CONCLUSION

Women are excelling and in many cases, outperforming men. Ms. Monika Seth, staying in conformity with a perfect work-life balance, had the passion and an excellent fashion sense and fortunately, her beloved husband could identify her special talent and skill and encouraged her to start a venture in textile industry by the name Seth Industries. With her outstanding fashion sense, the company keeps on updating with latest trends in the ever-changing world of fashion. The use of best quality woollen fabrics ensures complete warmth and luxurious feel. The rigorous quality control at every stage of production guarantees international standards of products.

The Seth Industries have the most experienced and talented team of designers and skilled staff, who have constantly stimulated their growth. The teams of weavers have expertise over both traditional and designer weaving techniques.

With a supportive family along with a hardworking and skilled employee base the company delivers what it promises and believes in building a long-term relationship with its clients. (As told to the researcher)

Similarly, Ms. Riya Bajaj's dedication towards her work, her zeal and her vigorous attitude has helped her to achieve heights. She possesses courage and dare-to-take-risk attitude. She believes that, in fashion industry, only good experience counts and she has proved it with her outstanding performance. Her experience has brought grass root level knowledge of textile industry, which helps her to provide best of the product to our clients within the standard parameters specified. Ms. Riya has worked incessantly towards growth without ignoring the importance of showing compliance to government regulations.

KS Overseas follows all the norms set by government for export factories. The management of the company ensures that every product which makes its way out of the factory & into the hands of our customers will offer the satisfaction of world class merchandise. (As told to the researcher)

In short, both women entrepreneurs discussed in the case are operational in the similar kind of business. The major player in the sector, as told by the entrepreneurs under consideration, is Shingora Industries, Ludhiana, which is a premium brand that caters to the high fashion lifestyle of women, men and kids. No doubt, competition is always inspiring and productive. Seth Industries and KS Overseas' enormous success and remarkable growth are indicators of their endless efforts. Wishing them all the very best for their future endeavours!

(a) Theoretical contributions and Managerial Implications

- (i) Identification of potential business opportunities in Textile sector in Northern India.
- (ii) Understanding the supportive role of government in promoting entrepreneurs by providing various subsidies.
- (iii) Analyzing the competition present in textile industry operational in NCR region and Amritsar.
- (iv) To gauge into the serious issue relating labour procurement and retention present in textile industry.
- (v) To study the impact of GST on textile business.

(b) Questions

- (i) How creativity and innovation boosts success? Answer the question by giving examples of successful women entrepreneurs in the industry.
- (ii) What is the impact of motivation and social support on enterprise creation?
- (iii) 'Women entrepreneurs are not as aggressive in raising cash as their male counterparts'. Comment upon the statement giving suitable examples.
- (iv) How can women overcome the challenges faced by them in their journey of entrepreneurship? Also, tell the way of getting women empowerment in India.
- (v) Identify the personality traits of successful women entrepreneurs? Give suitable examples.

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A Study on the Distribution of Male and Female Employees in the Scheduled Commercial Banks of India

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ABSTRACT

This paper seeks to understand the employment picture of male and female employee in the scheduled commercial banks of India. It is tried to see to what extent banks in India are maintaining the ratio of male and female employees in the banking business. In the study years from period 2000 to 2012 it is found that participation of women as an employee in the banking business in India is very low as compared to the male counterpart. In the entire period of study female employee percentage in the total employee is 13.69 per cent to 18.69 per cent. The given study also shows that male employee officer's figure represents a very high average figure of around 90 per cent and the female employee officer's figure represents an average of around 10 per cent. It is also observed foreign banks and the private group of banks have better scenario in the composition of female and male officers than the other nationalized groups banks in the country. At the current scenario there is a huge gap of employment inequality between male and female population in the scheduled commercial banks of India..

Key Words: Scheduled commercial Bank, Male Employee, Female Employee, Banks Group, Officers & Subordinates.

I INTRODUCTION

In providing the financial services to its customers banking industry uses its human resource which consists of male employees and female employees. At the same time smooth socio-economic development highly depends on equal participation of both the gender in the economic activities of the country. A high rate of female participation in the economic activities provides economic security and thereby provides women empowerment and a model of steady growth in the society. Banking industry is one of the most important industry in the building of a nation. Although it works for economic profit simultaneously its social responsibility is enormous. It is important to understand what is the proportions of male and female employees in the banking industry in India? To have smooth growth in all the areas, in the financial institutions also participation of both the gender is highly significant. The introduction of women bank by the govt. could be one way to make women empowerment in providing the power of financial decision making in banking business. A higher participation of women in banks as employee could also help to grow women entrepreneurship in the country.

II REVIEW OF LITERATURE

Seguino, Berik and Rodgers (2011) have pointed out how resource constraints could be relaxed in the effort to promote broadly shared development and growth. This paper identifies the linkages between gender equality and financing for development, with an eye to connecting the results to concrete policy implications that can be adopted by developing countries to ensure a win-win outcome: greater gender equality, resource mobilization, and improvements in societal wellbeing. Krogh et al (2009) pointed out that Employment is often

described as the most important link between economic growth and poverty reduction. Providing income earning opportunities through wage employment or self-employment for poor women is crucial in raising incomes and overcome poverty. However, currently women across the developing world enjoy limited access to fair and decent work compared to men. Similarly Vong, et al (2013) pointed out that the empowerment of women micro entrepreneurs is necessary for the holistic social-economic development of a nation. This paper addresses the gap in the study of formal financial access to rural women micro-entrepreneurs in Indonesia. More and more women are joining banking sector and making their mark. Banking has provided new areas of opportunity for women, and nationalization has been a key factor in countering some aspects of gender discrimination. Despite this increase, many women still are concentrated at the clerical level; very few women employees are at managerial level. Pitt and Khandker (1998) found that credit given to female participants in Grameen programs with women groups had strong beneficial effects on both male and female labor supply. Nussbaum (1995) argues that through training, credit, and other extension services, Bangladesh Rural Advancement Committee in particular has stimulated women's productivity in and out of the home. As pointed out this possibility is due to strong women involvement in financial decision making in Grameen Bank working procedure.

Although there are studies on male and female participation in the financial business and gender discrimination in jobs but no study is found in regard to the recruitment of male and female employee in the scheduled commercial banks in India. Thus, given paper is an attempt to understand the relative scenario of male and female recruitment in the scheduled commercial banks in India.

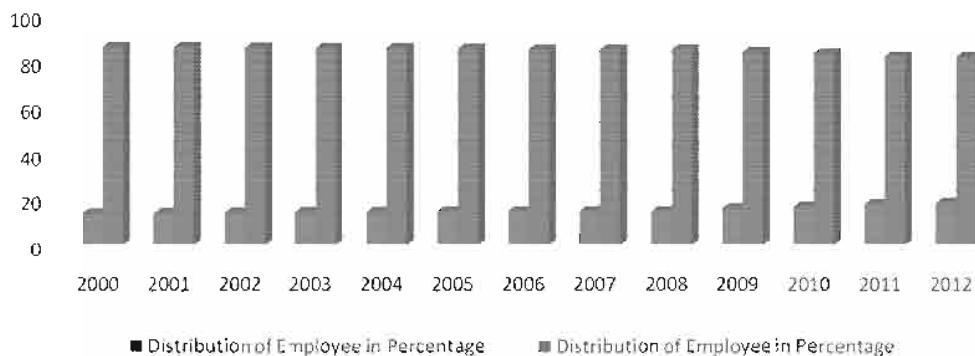
In connection to the above context it is tried to see how the banking industry in India is maintaining its male and female ratio in its recruitment process. To diagnose the above problem on the basis of availability secondary sources of data has been collected from the period 2000 to 2012. On the basis of various publications by RBI and information

available in various books, research journals & periodicals it is tried to explore the current study affairs of the scheduled Commercial Banks in India.

Table-1 reveals the distribution of Male and Female Employee in the Scheduled Commercial Banks of India from the period 2000 to 2012

Table-1
Distribution of Male and Female Employee in the Scheduled Commercial Banks of India
Source- Basic Statistical Returns of Scheduled Commercial Banks in India, RBI-2000 to 2012

Percentage of Male & Female Employees in the Scheduled Commercial Banks of India



Source: From Table-1

From table-1 it is observed that in the year 2000 the total number of employee in the Scheduled Commercial Banks of India were 10, 06,631 employees out of which total male employee were 8,68,819 employees and female were 1,37,812 employees. In percentage figure it was 86.31 for male employee and 13.69 for female employee which means a huge gap. The numbers of male employees were more than six times of the female employees during the year. Over the years in 2012 it is found that all the Scheduled Commercial Banks in India had the total of 11, 75,149 employees out of which

male employee were 9,59,835 employees and female employee were 2,15,314 employees. In percentage figure female employees were 18.32 per cent and male counterparts were 81.68 per cent. Although the ratio of female employee against male employee throughout the years is continuously increasing but the rate of growth is very low. In the year 2000 it was 13.69 per cent which increased to 18.32 per cent in 2012. From the above facts it can be said that male employees play a significant role in the banking business in comparison to the female employees in the scheduled commercial banks of India.

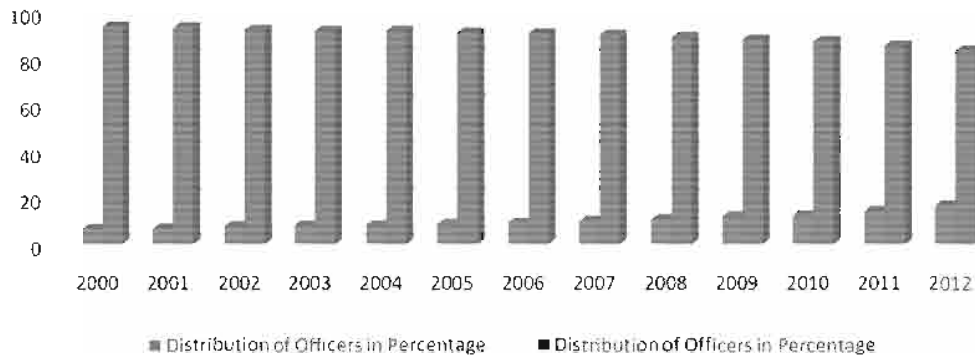
Table-2
Distribution of Male and Female Officers in the Scheduled Commercial Banks of India

Year	Total Female Employee	Total Male employee	Total Employee	Distribution of Employee in Percentage	
				Female	Male
2000	137812	868819	1006631	13.69	86.31
2001	127821	798697	926518	13.80	86.20
2002	126505	774783	901288	14.03	85.96
2003	128109	773040	901149	14.22	85.78
2004	124898	756824	881722	14.17	85.83
2005	130489	769944	900433	14.49	85.51
2006	132748	767376	900124	14.75	85.25
2007	132724	766683	899407	14.76	85.24
2008	123401	715368	838769	14.71	85.29
2009	138094	731318	869412	15.88	84.12
2010	153383	772645	926028	16.56	83.44
2011	186784	864101	1050885	17.77	82.23
2012	215314	959835	1175149	18.32	81.68

Year	Number of Female officers	Number of Male officers	Total number of Officers	Distribution of Officers in Percentage	
				Female	Male
2000	18933	272456	291389	6.50	93.50
2001	17948	250291	268239	6.69	93.31
2002	21248	255120	276368	7.69	92.31
2003	23411	263469	286880	8.16	91.84
2004	23515	265841	289356	8.13	91.87
2005	27282	286581	313863	8.69	91.31
2006	30566	299527	330093	9.26	90.74
2007	34441	313221	347662	9.91	90.09
2008	36091	298793	334884	10.78	89.22
2009	41538	310303	351841	11.81	88.19
2010	50507	350553	401060	12.59	87.41
2011	67958	402186	470144	14.45	85.55
2012	84375	418563	502938	16.78	83.22

Source- Basic Statistical Returns of Scheduled Commercial Banks in India, RBI-2000 to 2012

Percentage of Male & Female Officers in the Scheduled Commercial Banks



Source: From table-2

From table-2 it is observed that in 2000 out of 2,91,389 officers 18, 933 were female officers which is 6.50 per cent of the total officers employed in the scheduled commercial banks in India. It is also revealed that the number of female officers increased in the year 2012 is 84, 375 officers which is 16.78 per cent of the total number of officers employed. Over the years there has been 4.46 times increase in the female officers in the scheduled commercial banks of India. On the other hand the proportionate increase in the male officers in the scheduled commercial banks of India is 1.54 times during the same period. It indicates that the proportionate increase in the female

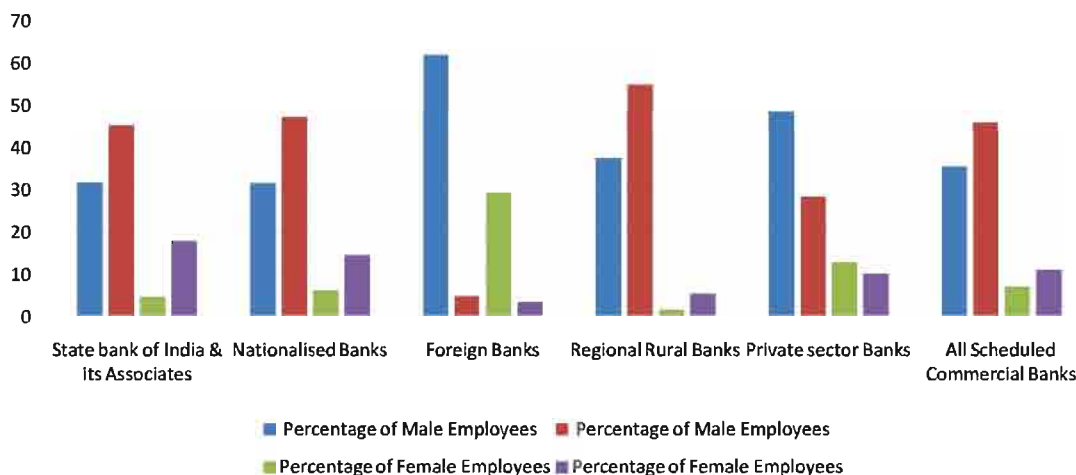
officers over the years is higher than the male officers. At the same time the total number of officers in the year 2000 were 2,91,389 numbers which augmented to figure 5,02,938 number of officers in 2012 which increased by 1.73 times over the years. As far as the distribution of male officers in percentage basis is concern, male officer's percentage figure in the year 2000 was 93.50 per cent which decreased to 83.22 per cent in 2012. From the given figures of male and female officers as shown in table-2, it can be understood that still there is a huge gap between the female and male group of officers in the scheduled commercial banks in India.

Table-3
Distribution of Categories of Male and Female Employee according to the Bank Group (As on March, 2012)

Bank Group	Male Employees		Female Employees		Total Employees
	Officers	Clerks & Subordinates	Officers	Clerks & Subordinates	
State Bank of India & its Associates	90961 (31.87)	129515 (45.38)	13505 (4.73)	51389 (18.01)	285370
Nationalised Banks	184627 (31.72)	275603 (47.35)	36934 (6.35)	84865 (14.58)	582029
Foreign Banks	13394 (61.95)	1082 (5.00)	6367 (29.45)	779 (3.60)	21622
Regional Rural Banks	31342 (37.59)	45918 (55.07)	1462 (1.75)	4660 (5.59)	83382
Private Sector Banks	98239 (48.54)	57700 (28.46)	26107 (12.88)	20700 (10.21)	202746
All Scheduled Commercial Banks	418563 (35.62)	541272 (46.06)	84375 (7.18)	130939 (11.14)	1175149

Source- Basic Statistical Returns of Scheduled Commercial Banks in India, RBI-2012

Percentage of Various Categories of Employees as on March-2012



Source: Table-3

It is also tried to see the distribution of male employee and female employee in the different scheduled banks at the current period for which required data of 2012 is collected and consider for the analysis. The data collected for the study purpose on various banks is shown in table-3. From table-3 it is observed that out of its total employee state Bank of India & its Associates have 90, 961 number of male officers which is 31.87 per cent while the same has 1,29,515 number of male clerks and subordinates which is 45.38 per cent. At the same time it has 13,505 numbers of female officers which is 4.73 per cent and 51,389 clerks and subordinates which is 18.01 per cent. Similarly the nationalized banks in India have 1,84,627 number of male officers and

36,934 numbers of female officers. As far as male clerks & subordinate employees are concern nationalized banks have 2,75,603 male 84,856 female clerks & subordinates employees in the country. In terms of percentage male officer percentage is 61.95 per cent and the female officer percentage figure is 6.35 per cent. About male subordinates and clerk employees are concern it is 47.35 per cent and female percentage figure is 14.58 per cent. In foreign banks male and female officer percentage figures are 61.95% and 29.45%. Regarding male and female subordinates staff it is 5% and 3.60%. As far as Regional Rural Banks are concern male officer percentage figure is 37.59 per cent and the female officer percentage figure is 1.75 per cent. The

percentage figures for male and female subordinates employee in RRBs is 55.07% and 5.59%. In the private sector banks male & female officers percentage figures are 48.54% & 12.88%. Regarding subordinate staffs it is 28.46% and 10.21%. As far as 2012 data is concern the total number of employees in the scheduled commercial banks of India were 11,75,149 employees out of which male and female officers percentage figures are 35.62% and 7.18% and male and female subordinates staffs percentage figures are 46.06% and 11.14%. In all the banks male categories employees percentage figures are higher than female categories employee's percentage figures.

III FINDINGS

Some of the important findings of the study are the following-

- (a) It is found that female employees in the total employees of the banks are very low. In all the years female employee percentage in the total employee is between 13.69 per cent to 18.69 per cent. At the same time male employee participation figure in the total employee is always more than 80 per cent. It indicates a huge gap of employment inequality and the low empowerment of female employees in the banking institutions.
- (b) It is observed that from period 2000 to 2012 the increase of female employees in the scheduled commercial banks of India is 1.56 times, on the other hand increase of male employees during the same period is 1.04 times. It can be concluded that the rate of increase of female employee is better than the male employees, but still there is a long way to go to bring equality in employment of female and male employees in the scheduled commercial banks in India.
- (c) In identifying the male and female officers ratio of the scheduled commercial banks over the study period it is found that male employee officers figure represents a very high average of around 90 per cent and the female employee officers figure represents an average of around 10 per cent. Here also male employee's officer's role is higher in comparison to female officers.
- (d) Over the years the increase of female officers in the scheduled commercial banks of India is 4.46 times, while in case of male officer's employees it is 1.54 times. It shows that increase of female officers is better than male officer which is a positive sign for women empowerment in the financial institutions.
- (e) As on March 2012, it is found that the foreign banks and the private banks have better scenario in the composition female and male officers than any other groups of scheduled banks in the country. Regional Rural Bank has the lowest composition of female officers amongst all other groups of banks which is 1.75 per cent of the total employees of the Bank.
- (f) It is observed that in March 2012, there were around 57 per cent of clerks and subordinates employees in the scheduled commercial banks of India and the remaining 43 per cent were officers employees out of which male employee officer's percentage figure was 35.62 per cent and the female officers percentage figure was 7.18 per cent.

IV CONCLUSION

Low rate of female employment in the banking and financial institution of a country like India is not a healthy sign and it largely hampers in the economic development and the inclusive growth of a country. More Participation of women in the financial institutions could bring a quicker rate of women empowerment in the society. Even to have a deep root success of Self-help group activities more participation of women in the financial institution like commercial banks is highly necessary. At the current situation Govt. must find out certain new ways to increase women employees in the banking institutions so that women financial empowerment and as well as economic productivity could be enhanced. The study established that in the banking institutions of the country there is a huge gap between male and female group of employment and needs good attention if the intentions of women empowerment, inclusive growth, balanced social development etc. have true sense to the policy makers.

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Penetration of Micro Insurance in India: A Tool for Financial Inclusion

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ABSTRACT

Poor people live in risky environment than the rest of the population, and they are more vulnerable to cope when a crisis does occur. One possible solution to overcome risks is "Micro Insurance". Micro insurance is a special mechanism to protect poor people against different risks. Currently, majority of the poor people in India are employed in the unorganized sector. The availability of micro insurance would in some ways provide them with some protection and peace of mind. In doing so, micro insurance gives them an opportunity to improve their lives. The problem is that, the benefit of micro insurance is not reached to the target population. The study also suggests the possible ways for effective implementation of micro insurance to the targeted population.

Keywords: Inclusive growth; financial services; Insurance sector; Insurance inclusion; Micro insurance; financial inclusion

I INTRODUCTION

Micro-insurance, the term used to refer to insurance to the low-income people, is different from insurance in general as it is a low value product (involving modest premium and benefit package) which requires different design and distribution strategies such as premium based on community risk rating (as opposed to individual risk rating), active involvement of an intermediate agency representing the target community and so forth. Insurance is fast emerging as an important strategy even for the low-income people engaged in wide variety of income generation activities, and who remain exposed to variety of risks mainly because of absence of cost-effective risk hedging instruments. In order to facilitate penetration of micro insurance to the lower segment of population, IRDA (Insurance Regulatory and Development Authority) has formulated the micro insurance regulations. Micro Insurance Regulatory, 2005 provide a plate form to distribute insurance product, which are affordable to the rural and urban poor people and to enable micro insurance to be an integral part of the country's wider insurance system. Again on 13th May 2015, the insurance Regulatory and Development Authority (IRDA) India introduced the revised Micro insurance Regulation (2015) which supersedes the existing regulations introduced in 2005. The new regulation makes a number of important amendments including to guidance on product development, adjusting the risk coverage level, permitting more entities to distribute micro insurance products and the training of micro insurance agents and there specified personal. The main thrust of micro insurance regulation is protection of low income people with affordable insurance products to help them cope with and recover from common risk with standardized popular insurance products adhering to certain levels of

cover, premium and benefit standard's. The regulatory has allowed Non Government Organizations (NGOs) and self Help Groups (SHGs) to act as agents to insurance companies in marketing the micro insurance.

II MICRO INSURANCE PENETRATION INDIA

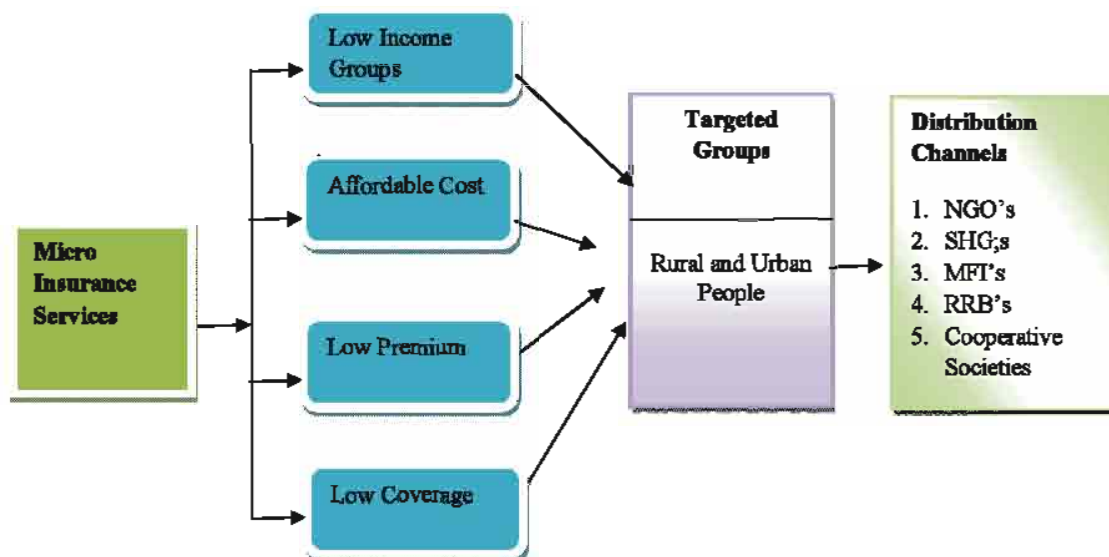
In order to facilitate penetration of micro insurance to the lower income segments of population, Insurance Regulatory and Development Authority (IRDA) has created special category of insurance policies called micro-insurance policies to promote insurance coverage among economically weak sections in society. The IRDA Micro-insurance Regulations, 2005 provide a platform to distribute insurance products and services, which are affordable cost to the rural and urban poor and to make possible micro insurance to be an integral part of the country's wider insurance system. The main thrust of micro insurance regulations is perform of low income people with affordable insurance products to help them cope with and recover from common risks with standardized popular insurance products adhering to certain levels of risk cover, premium and benefit standards.

(a) Characteristics of Micro Insurance

- (i) Micro insurance is insurance and applies principles of risk pooling
- (ii) Micro insurance products are designed for rural and urban low income people
- (iii) Micro insurance targets people in the informal sector
- (iv) Micro insurance products are designed general as well as life insurance (health, live stock, personal accidents, etc.)

Chart1

Micro Insurance Products Delivery Mechanism



(b) Micro-insurance policy is:

A general or life insurance policy with a sum assured of Rs.50, 000 or less

(i) A general micro-insurance product is any:

- Health insurance contract
- Any contract covering belongings such as
- Hunt
- Live stock
- Tools or instruments or
- Any personal accident contract
- They can be on an individual or group basis

(ii) Intermediaries:

- Non-Government Organizations (NGO's)
- Self-Help Groups (SHG's)
- Micro-Finance Institutions (MFI's)
- Regional Rural Banks (RRB's)
- Co-operative societies

III REVIEW OF LITERATURE

Prabhakara (2007) examined that creating awareness of the need for services like life insurance, basic banking services their accessibility and affordability increase the business opportunities of bankers and life insurers in rural as well as urban. Creating awareness to banking services and insurance services among rural and urban poor could also be regard as one of the ingredients infrastructures to the financial market supports the financial inclusion programmes of governments where life insurance deserves to be an integral part. The study also focused that a 5 part of these financial inclusion programmes, micro

insurance competently fits to be propagated in the targeted market segments.

Gunaranjan (2007) studied that bringing in financial inclusion for the poor, rural and socially disadvantaged sections of the society is now a major thrust area for policy maker's interventions. The rural and social sector obligations and the micro insurance regulations are important steps in the directions of ensuring financial inclusion and social protection for the poor.

Choudhari (2013) stated that access to safe, easy and affordable financial services to the poor and vulnerable groups, disadvantaged people in the society is so far largely remained concentrated around banking inclusion but the focus is fast shifting towards inclusion of poor people insurance also. The study also found that the goal of financial inclusion will remain unmet until the insurance needs of people particularly of those living in rural and semi-urban areas are met.

IV OBJECTIVES OF THE STUDY

- (a) To know the opportunities of Micro Insurance in rural area of India.
- (b) To study the financial inclusion through Micro Insurance.
- (c) To reach the suggestions and conclusion.

V RESEARCH METHODOLOGY

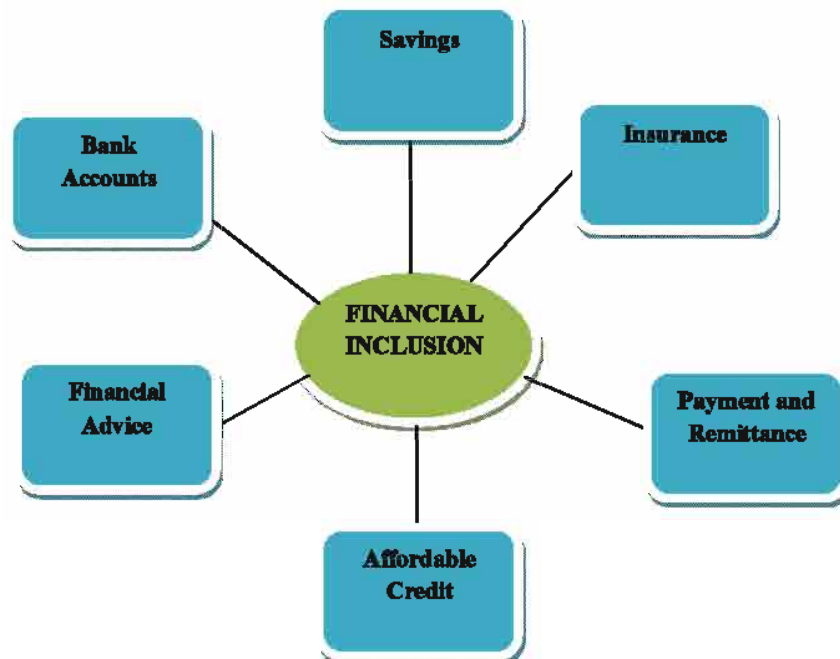
The study is based on secondary data. Data has been collected from journals, articles, websites and IRDA reports etc.

VI MICRO INSURANCE INTERVENTIONS AND ENSURING FINANCIAL INCLUSION

The rural and social sector obligations and the micro insurance regulations form IRDA are important steps in the direction of ensuring financial inclusion and social protection for the poor. As part of these financial inclusion programmes, micro insurance competently spread in the targeted market segment. To improve the market share of micro insurance

segment the IRDA is reviewing the micro insurance regulations, 2005. In this connection, the authority has already released draft modifications of the regulations on 31st Jan, 2014. Also, the Authority has issued a circular on 3rd April, 2013 permitting several more entities like district co-operative banks, regional rural banks, rural banks, etc. Who are banking correspondents to be appointed as micro insurance agents facilitating better penetration of micro insurance business in rural and urban people which leads to financial inclusion.

Chart 2
Dimensions of Financial Inclusion



VII PROSPECTIVE OPPORTUNITIES FOR MICRO INSURANCE PLAYERS IN RURAL INDIA

Rural India per capita income level has risen due to shifting of its occupation from agricultural based activities to non-farm agricultural income and it has become an important aspect of rural India. The rural people income mostly comes from cottage industries, dairy, food processing and packaging, commodity trading and handicraft etc. The non agricultural base of rural occupation and income has been growing in rural GDP figures that are estimated at 45 %. Insurance companies can add about Rs. 1000 crore to their net worth from nearly 200 million rural folk that are looking for alternate savings channels for their surpluses provided these come out with innovative schemes at affordable premium. Currently, only 8-10% rural households are covered under life insurance

schemes and remaining 90% can be targeted for new innovative insurance schemes.

There are several opportunities for doing marketing of micro insurance products in rural and urban areas which significantly impact on marketing of micro insurance services in India.

- (a) Growth in rural consumption level
- (b) Increase in literacy rate
- (c) The government has increased spending in rural areas for development in infrastructure and rural connectivity
- (d) Improved access to finance and institutional credit has brought greater cash inflows to households.
- (e) Increased in level of income

VIII SUGGESTIONS

Following policy measures can be suggested to improve the penetration of Micro insurance Schemes in India

- (a) There is a need for a vast improvement in the awareness levels of the insuring public is necessary for enhanced insurance inclusion of the masses.
- (b) Government has to play an important role in developing public-private partnerships for delivering ambitious state funded insurance programs, and MFIs can be partners for these government-funded insurance schemes. Insurance regulators (and other government entities) can help create an enabling environment that facilitates the commercial viability of micro insurance.
- (c) There is a misconception about the parity between the Government sponsored micro health insurance schemes and those introduced by the private sector companies. Hence there is a need for making micro insurance more affordable to the poorer sections of the society.
- (d) Insurance companies should go beyond devising new products to improving their processes for building awareness, marketing enrolment, premium collection, claim settlement and renewal. Further, the use of technology such as mobile phones and ATMs for premium collection should be encouraged to keep transaction costs low.
- (e) High transaction cost of banks in servicing large number of small rural accounts is an issue that needs to be addressed. Use of 'Group Mode' i.e. SHGs, JLGs etc. for financing is a proven mode for reducing the transaction cost. Banks are already financing vulnerable sections of rural borrowers through SHGs. The same needs to be further accelerated.
- (f) There is a need to establish a council of micro insurance representatives, regulator and government. This body should meet on a regular basis to discuss the issues and strategies to develop the sector. This body can also help to develop regulations. It could help facilitate the sharing of information between insurers.
- (g) Creating awareness through use of pictorial posters, local folk arts and street theatres might be useful to explain the mechanisms of insurance. Local community-based organizations could organize premium collections, as they have better access to the local people.
- (h) The regulator should take the responsibility of creating awareness among low -income people of micro insurance, as it is for the public good. The regulator should take the responsibility of developing the sector more actively.

IX CONCLUSION

In summary, micro-insurance is a tool for the country's poor people to protect themselves from adversities. It will reduce financial risks and provide optimism to policy holders, helping them cope with financial emergencies. Micro-insurance is considered as an integral output of micro finance and will assist the poor from being further impoverished as a result of adverse events. As micro insurance evolves, there will be increasingly higher standards for quality products tailored to meet client needs. The foundation of the sector is expanding quickly with key stakeholders joining forces and unparalleled resources, making this a pivotal time in the development of Micro insurance. Micro insurance providers must improve their communication with customers and expressly strive to serve the needs of poor people. Government must take necessary steps in initiating micro insurance only then can micro insurance become the success story hoped for by so many.

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Domination Polynomial: The Study of Various Graph Operations

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ABSTRACT

Let

$G = (V, E)$ be a graph of order n . The independent domination polynomial of G is the polynomial

$$D_i(G, X) = \sum_{j=\gamma_i(G)}^n d_i(G, j) X^j,$$

where $d_i(G, j)$ is the quantity of free overwhelming arrangements of size j . In this paper, we present the free mastery polynomial of a chart. The autonomous mastery polynomials of some standard diagrams are acquired and a few properties of the free control polynomial of charts are set up

Let G be a simple graph of order n . The domination polynomial of G is the polynomial $D(G, \lambda) = \sum_{i=0}^n d(G, i)\lambda^i$, where $d(G, i)$ is the number of dominating sets of G of size i . Every root of $D(G, \lambda)$ is called the domination root of G . In this paper, we study the domination polynomial of some graph operations.

Keywords: Dominating polynomial, independent dominating polynomial, independent dominating polynomial roots.

1 INTRODUCTION

An associated ruling arrangement of a diagram G is a set D of vertices with two properties:

- (a) Any hub in D can achieve some other hub in D by a way that stays entirely inside D . That is, D prompts an associated subgraph of G
- (b) Every vertex in G either has a place with D or is contiguous a vertex in D .

That is, D is an overwhelming arrangement of G . A base associated commanding arrangement of a diagram G is an associated ruling set with the smallest conceivable cardinality among all associated vast arrangements of G . The associated control number of G is the number of vertices in the base associated ruling set. By the meaning of associated mastery number, $\gamma_d(G)$ is the base cardinality of an associated

ruling set in G . For more insights about control number and its related parameters, we allude to [1] – [4]. For a point by point treatment of the mastery polynomial of a diagram, the reader is alluded to [5], [6]. We present the associated mastery polynomial of G , we get associated control polynomial and register its underlying foundations for some standard diagrams.

In a graph $G(V, E)$, the open neighborhood of a vertex $v \in V(G)$ is $N_v \subseteq V$; $v \in E$ the arrangement of vertices nearby v . The shut proximity is $N_v \cup \{v\}$. The subgraph actuated by the set S . A set $S \subseteq V$ is an overwhelming set if each vertex in $V - S$ is nearby a vertex of S and the base cardinality of a vast set is known as the mastery number of G and is indicated by $\gamma_d(G)$. A base overwhelming of a chart G is known as a γ_d -set of G .

2.1 Definition

Let G be a simple connected graph. The connected domination polynomial of G is defined by $C_d(G, x) = \sum_{i=\gamma_d(G)}^n c_d(G, i) x^i$, where $\gamma_d(G) \leq i$ is the connected domination number of G

2.2 Theorem

Let G be a graph with $|V(G)| = n$. Then

- (i) If G is connected then $C_d(G, n) = 1$ and $C_d(G, n-1) = n$
- (ii) $C_d(G, i) = 0$ if and only if $i < \gamma_d(G)$ and $i > n$.
- (iii) $C_d(G, x)$ has no constant and first degree terms
- (iv) $C_d(G, x)$ is a strictly increasing function in $[0, \infty)$.
- (v) Let G be a graph and H be any induced subgraph of G . Then $\deg(C_d(G, x)) \geq \deg(C_d(H, x))$.
- (vi) Zero is a root of $C_d(G, x)$ with multiplicity $\gamma_d(G)$.

Proof:

- (i) Since G has n vertices, there is only one way to choose all these vertices and it connected and dominates all the vertices. Therefore, $c_d(G, n) = 1$. If we delete one vertex v , the remaining $n-1$ vertices are connected dominate all the vertices of G . (This is done in n ways). Therefore, $c_d(G, n-1) = n$.
- (ii) Since $C_d(G, i) = 0$ if $i < \gamma_d(G)$ or $C_d(G, n+k) = 0$, $k = 1, 2, \dots$. Therefore, we have $c_d(G, i) = 0$ if $i < \gamma_d(G)$ or $i > n$. Conversely, if $i < \gamma_d(G)$ or $i > n$, $c_d(G, i) = 0$. Hence the result

Theorem 2.1. For every $n \in \mathbb{N}$,

$$D(F_n, x) = (2x + x^2)^n + x(1 + x)^{2n}.$$

Proof. The join $G = G_1 + G_2$ of two graph G_1 and G_2 with disjoint vertex sets V_1 and V_2 and edge sets E_1 and E_2 is the graph union $G_1 \cup G_2$ together with all the edges joining V_1 and V_2 . An elementary observation is that if G_1 and G_2 are graphs of orders n_1 and n_2 , respectively, then

$$D(G_1 \cup G_2, x) = D(G_1, x)D(G_2, x)$$

and

$$D(G_1 + G_2, x) = ((1 + x)^{n_1} - 1)((1 + x)^{n_2} - 1) + D(G_1, x) + D(G_2, x).$$

Clearly $D(K_1, x) = x$ and $D(K_2, x) = 2x + x^2$, so by the previous observations,

$$\begin{aligned} D(F_n, x) &= D(K_1 + nK_2, x) \\ &= (1 + x - 1)^1((1 + x)^{2n} - 1) + x + (2x + x^2)^n \\ &= (2x + x^2)^n + x(1 + x)^{2n}. \quad \square \end{aligned}$$

3.1 Theorem

If F_m is a friendship graph with $2m+1$ vertices, then the connected domination polynomial of F_m is

$$C_d(F_m, x) = x [(1+x)^{2m} - 1] \text{ and the connected dominating roots are } 0 \text{ with multiplicity } 2 \text{ and } e^{\frac{i\pi}{m}} - 1, e^{\frac{i2\pi}{m}} - 1, \dots, e^{\frac{i(m-1)\pi}{m}} - 1 \text{ with multiplicity } 1.$$

Proof:

Let G be a friendship graph of size $2m + 1$ and $m \geq 2$. By labeling the vertices of G as $v_1, v_2, \dots, v_{2m+1}$ where v_1 is joined with all the vertices and $(v_2, v_3), (v_4, v_5), \dots, (v_{2m}, v_{2m+1})$ are joined itself. Clearly there are $2m$ connected dominating set of size two namely $\{v_1, v_2\}, \{v_1, v_3\}, \dots, \{v_1, v_{2m+1}\}$. Similarly for the connected dominating set of size three, we need to select the vertex v_1 and two vertices from the set of vertices $\{v_2, v_3, \dots,$

$v_{2m+1}\}$. That means there are $\binom{2m}{2}$ connected dominating sets. In general, $c_d(G, i) = \binom{2m}{i-1}, 2 \leq i \leq 2n+1$.

$$\begin{aligned} \text{Hence } C_d(F_m, x) &= 2m x^2 + \binom{2m}{2} x^3 + \dots + \binom{2m}{2m} x^{2m+1} \\ &= x [(1+x)^{2m} - 1]. \end{aligned}$$

Consider, $x [(1+x)^{2m} - 1] = 0$. The roots of this polynomial are 0 with multiplicity 2 and $e^{\frac{i\pi}{m}} - 1, e^{\frac{i2\pi}{m}} - 1, \dots, e^{\frac{i(m-1)\pi}{m}} - 1$ with multiplicity 1 .

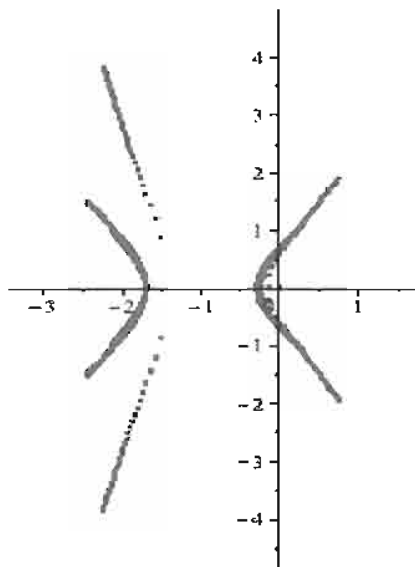


Figure 2: Domination roots of graphs F_n , for $1 \leq n \leq 30$.

II MAIN RESULTS

Just like the case with other diagram polynomials, for example, chromatic polynomials and autonomy polynomials, it is normal to consider the mastery polynomial of a piece of two diagrams. It isn't difficult to see that the equation for control polynomial of the join of two diagrams is acquired as takes after. This task of charts is commutative.

Utilizing this item, one can develop an associated diagram G with the quantity of commanding sets n , where n is a subjective odd normal number; see [5]. Let to consider the crown of two charts. The accompanying hypothesis gives us the control polynomial of charts of the shape $H \circ K$ 1 which is the primary outcome for mastery polynomial of particular crown of two charts.

Theorem 1 (see [1]). *Let G_1 and G_2 be graphs of orders n_1 and n_2 , respectively. Then*

$$D(G_1 + G_2, x) = ((1 + x)^{n_1} - 1)((1 + x)^{n_2} - 1) + D(G_1, x) + D(G_2, x). \tag{1}$$

Theorem II. (i) Suppose that $G_{n,t} = P_n \diamond K_t$. Then

$$D(G_{n,t}, x) = ((x + 1)^t - 1) \times [D(G_{n-1,t}, x) + D(G_{n-2,t}, x) + D(G_{n-3,t}, x)]. \tag{8}$$

(ii) Suppose that $H_{n,t} = C_n \diamond K_t$. Then

$$D(H_{n,t}, x) = ((x + 1)^t - 1) \times [D(H_{n-1,t}, x) + D(H_{n-2,t}, x) + D(H_{n-3,t}, x)]. \tag{9}$$

(iii)

$$D(G_3^n \diamond K_t, x) = ((1 + x)^{2t} - 1)^n + ((1 + x)^t - 1)(1 + x)^{2nt}. \tag{10}$$

Proof. (i) From Theorem 8, we have $D(G_{n,t}, x) = D(P_n, (1 + x)^t - 1)$. Now by Part (i) of Theorem 9, we have the result.

(ii) From Theorem 8, we have $D(H_{n,t}, x) = D(C_n, (1 + x)^t - 1)$. Now by Part (ii) of Theorem 9, we have the result.

(iii) From Theorem 8, we have $D(G_3^n \diamond K_t, x) = D(G_3^n, (1 + x)^t - 1)$. Now by Theorem 10, we have the result. \square

Definition 2.1. Let $G = (V, E)$ be a graph of order n with independent domination number the

$\gamma_i(G)$ the independent domination polynomial of G is $D_i(G, X) = \sum_{j=\gamma_i(G)}^n d_i(G, j) X^j$, where

$d_i(G, j)$ is the number of independent dominating sets of size j . The roots of the polynomial

$D_i(G, X)$ are called the independent dominating roots of G .

Example. Let $G = (V, E)$ be a graph as in Figure 1.

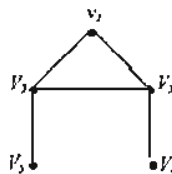


Figure 1

$$D_i(G, x) = \prod_{j=1}^k D_i(G_j, x)$$

Now we have to prove that the result is true for $n = k + 1$,

$$\text{So let } G \cong \bigcup_{j=1}^{k+1} G_j \cong \bigcup_{j=1}^k G_j \cup G_{k+1}.$$

$$D_i(G, x) = D_i\left(\bigcup_{j=1}^k G_j \cup G_{k+1}\right)$$

$$= D_i\left(\bigcup_{j=1}^k G_j, x\right) D_i(G_{k+1}, x) \text{ by Theorem 2.3}$$

$$= \prod_{j=1}^k D_i(G_j, x) \cdot D_i(G_{k+1}, x)$$

$$= \prod_{j=1}^{k+1} D_i(G_j, x).$$

$$\text{Hence } D_i(G, x) = \prod_{j=1}^n D_i(G_j, x).$$

Clearly $\gamma_i(G) = 2$ and there are only two minimum independent dominating sets $\{v_3, v_5\}$, $\{v_2, v_4\}$ and one independent dominating set $\{v_1, v_4, v_5\}$ of size 3. Hence, $D_i(G, x) = x^2(2 + x)$

Obviously there are two independent dominating roots of G which are 0 and -2.

Observation 2.2. For any graph $G = (V, E)$ The independent Dominating polynomial of G is $D_i(G, x) = \sum_{j=\gamma_i(G)}^{\beta(G)} d_i(G, j) x^j$ where $\beta(G)$ is the maximum independent number and $\gamma_i(G, j)$, is the number of independent dominating set of size j .

Theorem 2.3. Let $G = G_1 \cup G_2$. Then $D_i(G, x) = D_i(G_1, x) D_i(G_2, x)$.

Proof. Any independent dominating set of k vertices in G is constructed by choosing an independent dominating set of j vertices in G_1 (for some $j \in \{\gamma_i(G_1), \gamma_i(G_2), \dots, |V(G_1)|\}$) and the independent dominating set of $k - j$ vertices in G_2 . The number of ways of doing this overall $j \in \{\gamma_i(G_1), \dots, |V(G_1)|\}$ is exactly the coefficient of x^k in $D_i(G_1, x) D_i(G_2, x)$.

Theorem 2.4. Let $G \cong \bigcup_{j=1}^n G_j$. Then $D_i(G, x) = \prod_{j=1}^n D_i(G_j, x)$.

Proof. We prove this by mathematical induction, the result is true for $j=1$ is trivial and by Theorem (2.2) for $j = 2$.

Suppose that $D_i(G, x) = \prod_{j=1}^n D_i(G_j, x)$ is satisfy for $n=k$

i.e., For $G = \bigcup_{j=1}^k G_j$

Theorem 2.11. Let $K_{1,m}$ be a star and $G = (V, E)$ be the spider graph which constructed by subdivision $K_{1,m}$ where $m \geq 3$. Then

$$D_i(G, x) = (2^m - 1)x^m + x^{m+1}$$

Proof. Let $G = (V, E)$ be the spider graph, which we get from $K_{1,m}$ by subdivision as in figure 2.

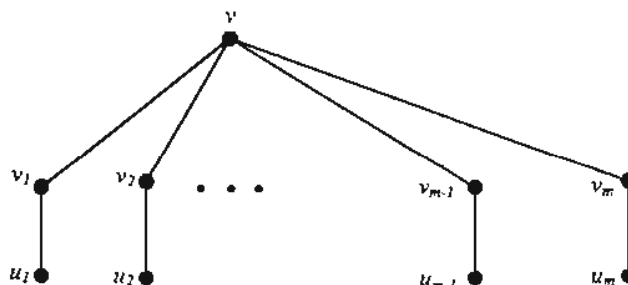


Figure 2. Healthy spider of $2n + 1$ vertices

Observing $\gamma_i(G) = \gamma(G) = m$. Let $A = \{v_1, v_2, v_3, \dots, v_{m-1}, v_m\}$ and $B = \{u_1, u_2, u_3, \dots, u_{m-1}, u_m\}$. To find the number of minimum independent dominating sets which of the size m . We can take one vertex from A and $m-1$ vertices from B , two vertex from A and $m-2$ vertices from B and so on.

$$\text{i.e., } d_i(G, m) = \binom{m}{1} + \binom{m}{2} + \dots + \binom{m}{m-1} + \binom{m}{m} = \sum_{i=0}^m \binom{m}{i} - 1 = 2^m - 1$$

Also, there is only one independent dominating set of size $m+1$, which is $\{v, u_1, u_2, \dots, u_m\}$, $d_i(G, m + 1) = 1$. Hence $D_i(G, x) = x^m (2^m - 1 + x)$.

Theorem 2.8. [33] Let G be a graph and $u \in V$. Then

$$D(G, x) = D(G - u, x) + D(G \odot u, x) - D(G \odot u - u, x).$$

We are now ready to give a formula for the domination polynomial of B_n .

Theorem 2.9. For every $n \in \mathbb{N}$,

$$D(B_n, x) = (x^2 + 2x)^n(2x + 1) + x^2(x + 1)^{2n} - 2x^n.$$

Proof. Consider graph B_n and vertex v in the common edge (see Figure 4). By Theorem 2.7 we have:

$$\begin{aligned} D(B_n, x) &= xD(B_n/v, x) + D(B_n - v, x) + xD(B_n - N[v], x) - (1 + x)p_v(B_n, x) \\ &= xD(B_n/v, x) + D(B_n - v, x) + x(D(nK_1, x)) - (1 + x)x^n \\ &= xD(B_n/v, x) + D(B_n - v, x) - x^n. \end{aligned}$$

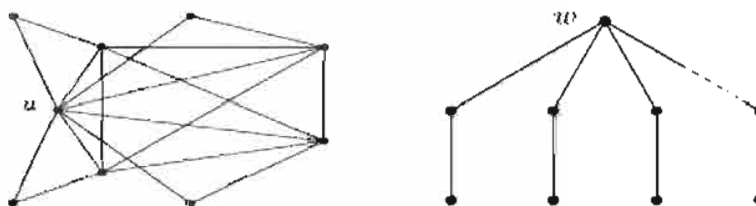


Figure 5: Graphs B_4/v and $B_4 - v$, respectively.

Now we use Theorem 2.8 to obtain the domination polynomial of the graph $B_n - v$ (see Figure 5). We have

$$D(B_n/v, x) = D((B_n/v) - u, x) + D((B_n/v) \odot u, x) - D(2nK_1, x),$$

where $(B_n/v) - u = K_n \circ K_1$ and $(B_n/v) \odot u = K_{1,2n}$ (see Figure 6).



Figure 6: Graphs $B_4/v - u$ and $B_4/v \odot u$, respectively.

Using Theorem 2.8, we deduce that $D(B_n/v, x) = (2x + x^2)^n + x(x + 1)^{2n}$. Also we use Theorems 2.6 and 2.7 to obtain the domination polynomial of the graph $B_n - v$ (see Figure 5). Hence $D(B_n - v, x) = xD((B_n - v)/w, x) + D(K_2, x) - x^n$, where $(B_n - v)/w = K_n \circ K_1$. So $D(B_n - v, x) = (2x + x^2)^n(x + 1) - x^n$. Note that in this case $p_v(B_n, x) = p_v(B_n - v, x) = x^n$. Consequently,

$$\begin{aligned} D(B_n, x) &= x((2x + x^2)^n + x(x + 1)^{2n}) + (2x + x^2)^n(x + 1) - x^n - x^n \\ &= (x^2 + 2x)^n(2x + 1) + x^2(x + 1)^{2n} - 2x^n. \quad \square \end{aligned}$$

III CONCLUSION

The free ruling polynomial of a chart is one of the logarithmic portrayals of the diagram and nature of any diagram portrayal depend about what data would we be able to get from that introduction about the diagram. As this paper is presented the idea of autonomous ruling polynomial a still there are a considerable measure of issues can be unraveled later on about this idea case isn't for constrained, the examination of the underlying foundations of the free commanding polynomial and order of the diagrams we can set the accompanying open issues: (1)

Arrangement of charts which has genuine free ruling roots. (2) Characterization of pictures which has just three unmistakable roots. (3) The summation of the underlying foundations of free control polynomial of a graph gives us another parameter of a chart As of late we chip away at all these open issues, and it will show up as of late.

- (i) What is the fundamental recipe for the control polynomial of the Cartesian result of two charts? For two graphs G and H , let $[H]$ be the chart with vertex set $V(G) \times V(H)$ and to such an extent that vertex (a, x) is nearby

vertex (b, y) if and just if a is nearby b (in G) or $a = b$ and x is nearby y (in H). The chart $[H]$ is the lexicographic item (or arrangement) of G and H and can be thought of as the chart emerging from G and H by substituting a duplicate of H for each vertex of G . There is a primary issue.

- (ii) By what method can register the control polynomial of Lexicographic result of two diagrams?

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A Study on Investment Pattern of Indian Army Personnel in Panchkula District

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ABSTRACT

In today's modern era, a large variety of investment avenues are available to the investors. In this paper an attempt has been made to study the basic financial literacy and awareness about available investment avenues of Indian army personnel residency in Panchkula district. This research paper is focused on awareness and investment pattern of army personnel. In spite of low income, the respondents have been saving for the future needs. The main purpose of investment is for children education, marriage and safety after retirement. Among all investment bank fixed deposits, insurance policies and PPF are safest and most preferred by the respondents. To conduct the present study primary data has been collected via personal interaction with the respondents for the fulfillment of present study objectives.

Keywords: Investment, Awareness of Investment avenues, army personnel, investment preference.

I INTRODUCTION

Investment refers to commitment of funds for future periods against a return which is adequate to induce part with money. This word has wide variety of contexts such as investment in a house or investment in a mutual funds or investment in securities. Investment is considered as sacrifice of current present values of money for the future rewards. Funds are required for a fairly long term for the purpose of acquiring fixed assets and some for day to day working. Investment is the allocation of monetary resources into some profitable assets to yield some profit in future over a given period of time. Investing may be defined as the deployment of funds in available investment opportunities/economic activity for future returns.

Investment may be safe investment to risky investment. Every investor has different objectives and needs depending upon on their age, income, attitude, preference, qualification, awareness etc. Even a small amount of investing in investment options can gives more profitable rewards and returns over a long term. But to achieve a good profit the investors has full knowledge of investment decision i.e. where to invest, when to invest and how much to invest.

Investments are beneficial for the both the development of society as well as for the economy. Varieties of investment options are available in present scenario but still most of the people depend on the traditional bank deposits schemes as the best investment option. There is continuously decrease in the interest rate given by banks on their deposits. Hence a study is under take to study the other available investment options in the market.

An attempt is made to find out the investment pattern preferences and financial planning among the Indian

army personnel while investing in available investment avenues.

The following are the wide varieties of investment avenues which are available in India:-

- (i) Post office Saving Schemes
- (ii) Insurance Policies
- (iii) Public Provident Fund
- (iv) Banking Products
- (v) Company Fixed Deposits
- (vi) Share Capital
- (vii) Bonds and Debentures
- (viii) Real Estate
- (ix) Mutual Funds
- (x) National Saving Certificates
- (xi) National Pension Fund
- (xii) Gold/ Silver and precious Articles

Investment culture is essential for the development of the individual, society as well as for the faster growth of the economy. In Finance, investment means the purchase of a financial product or other items with an expectation of favorable future needs.

There are wide schemes which were introduced for the purpose of tax saving. These schemes are available for the assess who invest in these schemes and eligible to get the tax benefits under section 80C of Income Tax Act, 1961. Listed below are some of these taxes saving schemes:-

- (i) Post office Saving deposits schemes
- (ii) Life Insurance Premium
- (iii) Public Provident Fund
- (iv) National Saving Certificates
- (v) Repayment of Housing Loan
- (vi) Fixed Deposits
- (vii) Mutual Funds

II REVIEW OF LITERATURE

Manikandan. A &MuthumeenakshiM (2017) analyzed the various investment avenues available in

the market for various investors to invest. They studied investor's preferences and level of satisfaction towards investment avenues and concluded that most of the investors invested their saving in the low risk and highest returns options. Most of the respondents prefer to invest in long term safe and secure options like purchasing gold, silver and in real estates. Education qualification, age, occupation, annual income and saving etc affect the investment decisions of the respondents/investors.

PratibhaChaurasia (2017) concluded the investment preferences of investors with sample size 229 in the area of Indara in Madhya Pradesh state. She concluded that financial planning is very important for personal as well as for the development of the Economy. Demographic factors have a significant effect on the investment preferences of the investors. The study gives detail knowledge of the investment avenues available in the market. The main finding of the study are that fixed deposits is the most preferable investment options of the investors and debt instruments is the least preference as investors of the Indara city have less confidence in capital markets investments.

GeethaSineni& S Siva Reddy (2017) examined the relationship of investor's perceptions & satisfaction level towards mutual fund in rayalaseema area of Andhra Pradesh. They studied that mutual fund as the one of the best avenues of investment. The sample size was 600 of four district of Andhra Pradesh. Primary data was collected and analyses by using the statistics tools like chi-square and factor analysis. The objective of the study is to find out the socio-economic conditions, proportions of the investors towards investment in mutual fund. Major finding of the study is that 30% of the respondents were aware about the mutual funds concepts and its schemes. Study also concluded that mutual fund industry shows growth only if investors have more preferences towards it.

K. Parimalakanthi& M. Ashok Kumar (2015) examined and studied that a large varieties of investment avenues are available in the market for making a good investment and earn a regular return on them for all the classes of the people in the society. The study focused to identify the investor preferences and behavior towards the investment in Coimbatore city. Further this study main objective is to find out how the investors behavior varies according to their age, gender, education level, occupation, income level etc. the sample size was 107 respondents selected. The collected data was analyzed by making use of fried men test, garratt ranking and factor analysis. The study concludes that majority of the investors are male residing in urban area and ages range between 26 to 30 years and most of the investors were unmarried, professional qualified, and belong to middle class and live in nuclear family.

M. Yasodha& G. Ravindran (2015) analyzed to determine the investment pattern among the colleges teachers in Coimbatore district. The researchers studied that the investment scenario is changing in India due to FDI and globalization in the developing countries. Data was collected from the 748 college's teachers to study their saving and investment pattern. The study concluded that majority of the respondents save their money in secure & safety mode of investment like bank deposits, insurances policies gold etc. which were called low risk instruments. The data was analyzed by using f-test and chi-square statistical tools and concluded the results. Main study found that investors are more sensitive about their investments & they invest regularly in low risk and safe investment.

Megha Goyal &Anukrati Sharma (2014) concluded that middle class income group behavior towards the different kinds of investment avenues. Middle class group plays an important role in the development of the economy especially in the case of India. Middle class peoples saving and investment pattern was greatly influence by their future needs and conditions of the markets. The study revealed that experience and future needs of the middle class group are significantly influencing the saving and investment behavior of the group. The major finding of the study that about 40% of investor prefer bank fixed deposits of their first choice of investment followed by insurance of about 31%. Middle class people prefer to invest annually rather than invested regularly.

III NEED OF THE STUDY

None of the studies have been made and no significant studies that have focused regarding the investment pattern and financial planning of Indian army personnel, so the present study has been undertaken. The study is unique in all respects.

IV RESEARCH GAP

Review available from literature reveals that the number of research studies has been done on investment pattern and financial planning. But, no study has concentrated on investment pattern and financial planning of Indian Army Personnel. Thus, there is a need to study the investment pattern, perceptions, preferences and financial planning of the Indian army personnel towards the various investment avenues. No study is conducted to address this issue. Through this research, the gap will be filled and we will get new insights about the Indian army personnel investment and financial planning

V OBJECTIVES OF THE STUDY

- (a) To study the investment pattern of Indian army personnel in Panchkula district.

- (b) To understand the awareness level of Indian army personnel about various investment avenues.
- (c) To measure the level of financial literacy among respondents.

websites etc. The collected data were analyzed with the help of statistical tools and technique like percentage analysis, chi-square, tables and graphs.

VII HYPOTHESIS

- (a) H0: There is no significant difference between educational qualification and awareness level.
H1: There is a significant difference between educational qualification and awareness level.
- (b) H0: There is no significant relation between investment pattern and age group of the respondents.
H1: There is significant relation between investment pattern and age group of the respondents

VI RESEARCH METHODOLOGY

The present study is based on primary and secondary data. Considering the practical difficulties of the study the sample size was decided as 40 respondents only. Convenience sampling method has been adopted. Primary data was collected from 40 army personnel residing in Panchkula district of Haryana through personal interaction with them. In addition to this the secondary data was also collected from various newspapers, journals, magazines, books, and

VIII DATA ANALYSIS AND INTERPRETATION

Table-1

Awareness level of Respondents towards the various available investment avenues

Investment Avenues	No of respondents those are not aware about investment avenues	No of respondents those are aware about investment avenues	Total
Bank Deposits& Fixed Deposit	7	33	40
Mutual Funds	29	11	40
Life Insurance	0	40	40
Gold/Silver	0	40	40
PF & PPF	4	36	40
Pension Funds	25	15	40
Shares and securities	25	15	40
Debentures& Bonds	27	13	40
Real Estates	15	25	40
Post Office Saving Schemes	12	28	40

Source: Primary data collected via personal interaction

Table 1 from the above table, it can be summarized the awareness level about the traditional and modern investment avenues among the investors. It is concluded that still most of the respondents have

awareness about traditional alternatives like, insurance policies, fixed deposits, PPF, post office schemes than the modern investment alternatives.

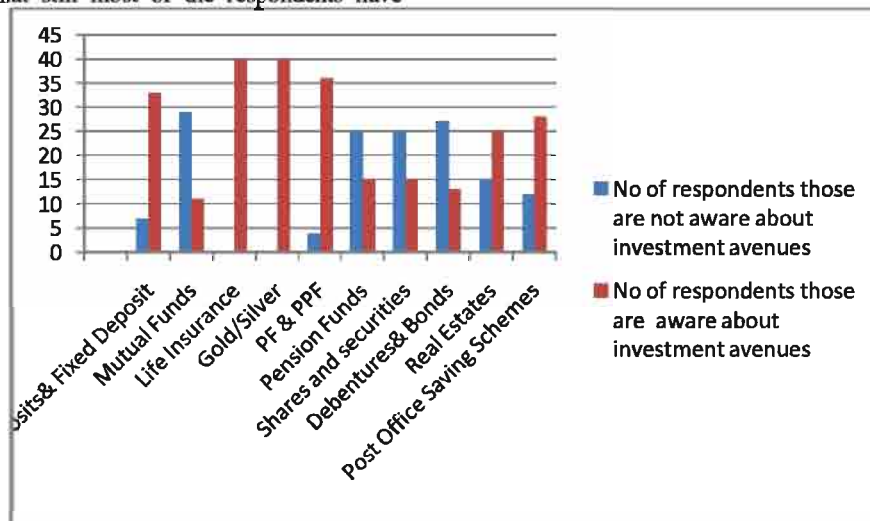


Table-2
Main purpose of Investment

Sr.no	Particular	No of Respondents
1	High Returns	12
2	Tax Benefits	25
3	Retirement benefits	33
4	Liquidity	35
5	Safety and Security	35
6	Uncertain needs and emergency	15
7	Children Marriage	27
8	Children Education	27

Source: Primary data collected via personal interaction

Table 2 shows the main purpose of investment among Indian Army Personnel. The respondents save

and invest mainly for the future needs, like children education, marriage and safety after retirement.

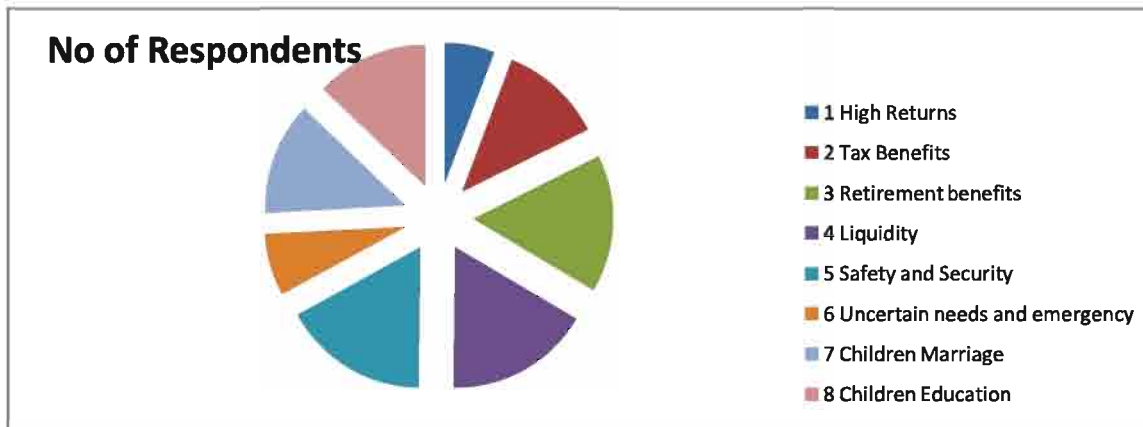


Table-3
Financial Literacy of respondents

Sr.no	Financial Literacy	%
1	Very Good	30
2	Good	35
3	Moderate	20
4	Poor	15
	Total	100

Source: Primary data collected via personal interaction

Table 3 shows the level of financial literacy among respondents. 30% respondents had very good

knowledge about investment whereas 10% had poor financially literate.

IX HYPOTHESIS TESTING

(a) H₀: There is no significant difference between Educational Qualification and awareness of the bank employees.

Table 4
Relationship between Educational Qualification and awareness of the respondents:

Educational Qualification	No of Investors Aware	No of Investors Not Aware	Total
Post Graduate	9	2	11
Under Graduate	11	5	16
Others	2	11	13
Total	22	18	40

Chi-Square test has been applied and result of test is below

Degree of Freedom

$$V=(r-1)(c-1)$$

$$V=(3-1)(2-1)$$

$$V=2$$

Degree of Freedom	2
Table valve at 5% level	5.99
Calculated valve	12.662

Since the calculated valve of chi-square test 12.662 is more than the table valve at 5% level of significance. So the null hypothesis is rejected. Hence there is significant relation between educational qualification and awareness of the respondents.

(a) **H0**: There is no significant relation between investment pattern and age group of the respondents.

Table 5
Relationship between investment pattern and age group of the respondents:

Age	Bank	Insurance	Post Office schemes	Mutual Funds	Real Estates	Precious Article/Gold	Other Securities	Total
20-25	7	2	3	0	0	0	0	12
26-45	4	2	2	1	0	0	0	9
46-60	5	5	5	0	2	1	1	19
Total	16	9	10	1	2	1	1	40

Chi-Square test has been applied and result of test is below

Degree of Freedom

$$V=(r-1)(c-1)$$

$$V=(3-1)(7-1)$$

$$V=12$$

Degree of Freedom	12
Table valve at 5% level	21.0
Calculated valve	10.153

Since the calculated valve of chi-square test 10.153 is less than the table valve at 5% level of significance. So the null hypothesis is accepted. Hence there is no significant relation between investment pattern and age group of the respondents

X FINDINGS OF THE STUDY

- (a) Majority of the respondent's age is between 25-35 years.
- (b) 53% respondents are married and save money for the children education and marriage.
- (c) It can be seen that 68% save their income in banks and insurance policies.
- (d) Knowledge must be provided about NSC, Mutual Funds, and Senior Citizen Saving Scheme etc.
- (e) 35% respondents have good level of financial literacy.
- (f) Most of the investment decision in the family taken by the male members.

XI CONCLUSION

No doubts, a large variety of investment avenues are available, but still most of the investment is made in traditional alternatives which are more secure, safe and provide more liquidity than the modern investment avenues. In this study the researchers are trying to identify the relationship between financial awareness and investment among the respondents. The results of the study concluded that financial literacy level of the investors is good, but they are not much aware about share market securities and mutual funds. Respondents mainly prefer to invest in traditional and safe financial products and not much interested in making investment which are complex and risky.

Hence the study concluded that the most of the army personnel of Panchkula district saving their money for children education, marriage and future needs after retirement by investing in bank fixed deposits, insurance policies followed by PPF and gold.

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Green Accounting In India: A Balancing Tool

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ABSTRACT

In today's worldwide economy, organizations are increasingly asked to demonstrate sound business management that includes concern for social, environmental and economical issues. The explicit cost of business has more share of the social cost with specific reference to the environment, the margin where they are operating. As a result of observing the trends and patterns of the production process well equipped with the enhanced technology, it is expected to adapt the measures which can bring harmony with the ecosystem and economy. The argument created by worldwide competition makes it essential for enterprises to continuously rationalize and advance all resources and processes. In the view of all the facts and figures it seems desirable to introduce the concept through which the cost of utilization of natural resources can be evaluated and can be put across with the quantum of the production. Green Accounting mainly focuses to bring harmony between corporate environment and natural environment. The present research article is a small attempt to discuss the rationale for introducing the green accounting concept at this hour and the policies to be followed for the application of the same in the Indian business world. Secondary data was gathered around for the purpose. A well known proverb says stitch in time save nine, as its an alarming time for the country to adapt the measures rigorously to preserve the environment along with the growth of the nation.

Keywords— Social Cost, Green accounting, Environment, Global Economy

I INTRODUCTION

Nature's play an important role in the lives of an Individual on this planet. It has endowed with resources to be utilized, not only by the existing generation but also by the generations to come in the future. The ignorance to the environment and natural resources distorts the picture of production primarily in two ways, firstly it fabricates undesirable output for example pollution and secondly it leaves out a number of impurities in the process of production. The need for full accountability of all types of inputs and outputs complicates the nation's economic and environmental policies. The loss in environmental capital, if not taken into account, will eventually reflect itself in production measurement and income. It has been understood over a period of time that a nation with marketable natural resource is better off than those without such resources. In general a balance between economic growth and care of environment and natural resources is needed in every nation, particularly, in under developed and developing countries.

The factors like GDP and GNP are there to evaluate the production in the national as well as domestic level. More likely the maintenance of proper accounts on environment and natural resources will check their depletion and degradation and ultimately protect the deficit of economic and public health. For this purpose the theory of Environmental Accounting has been introduced a way back in India. The interpretation of this accounting used in general is the term Green Accounting. The phrase green accounting has been used since the 1980s and known as a management tools. The conservative system of national accounting was first started in 1942 in the USA. Green accounting is vital tool for

understanding the role played by the natural environment in the economic accounts. The cost enforced by resources degradation and pollution, describes an efforts to integrate environmental benefit along with costs into economic decision making. Specifically, Green accounting includes the integrated environmental cost with economic accounting.

To explore the concept several researchers have given their views and comments on the existence of the term and have tried to analyse the application of it critically.

Grojer & Stark (1977) contended that accounting ought to be a reflection of prevailing social values and culture, and that the purpose of accounting is to provide a description in both monetary as well as non-monetary terms of the positive and negative effects which human beings or groups of human beings perceive as stemming from a company's operations.'

They then explained conventional accounting as a division of their larger conception of social accounting.

Anderson et al. (1978) extended the concept to 'social responsibility accounting' and defined it as a systematic assessment and reporting on those parts of a company's action that have a social impact.' According to Anderson et al.(1978, p.6) social responsibility accounting describes the effect of corporate decisions on environment, on the rights of individuals and groups, the utilization of non-renewable resources and other ecological factors and maintaining public service, public safety, health and education and on several other such social concerns.' During th

In the 1980s, the public stature of environmentalism had increased significantly also this was reflected in some authors broadening of the term 'social accounting' to 'environmental and social accounting'. Gray (1987) defined 'social and environmental accounting' as the process of communicating the environmental and social effects of organizations' economic actions to particular interest groups in society and to society at large. As such it includes extending the accountability of business (particularly companies), beyond the conventional role of providing a financial account to the owners of capital, precisely, shareholders.

Such an extension is predicated upon the assumption that companies do have wider responsibilities than simply to make money for their shareholders. In more recent times the political aspect of social accounting has also been noticeable in proposed definitions of social accounting. For instance, Mathews (1993, p.64) defined social responsibility accounting as 'voluntary disclosures of information, both qualitative and quantitative, made by organizations to inform or influence a range of audiences. The quantitative disclosures can be in financial or non-financial terms.' Mathews' inclusion of the terms 'inform or influence' is noteworthy as it highlights the communicative and constitutive potential of accounting (alluded to by Linowes 1968).

Manoj Goswami (2014) in his paper have analysed the problems and prospects of the application of Green accounting in Indian corporate sector. In his study with the support of certain government reports he tried to explore the various dimensions related to green accounting applications. Larry O'Connor has done a study related to research in social and environmental accounting. In his study he mentioned reviews of the researchers and have also given the future directions of the research related to environmental accounting. Dina Wahyuni has increased public green awareness to encourage business to consider environmental effect of their activities along with the environmental decision making. In this paper he discussed EMA (Environmental Management Accounting) as a tool to explain in systematic way corporate environmental aspects. He has focused on EMA method to narrate corporate environmental expenditure for the betterment of environmental districts.

Observing the reviews of the scholars and experts the present study is a small attempt to describe the basic meaning and purpose of Green accounting in Indian corporate world and its impact on overall harmonization of economics of the country and ecosystem.

II OBJECTIVE OF THE STUDY

- (a) To discuss the present status of the Green Accounting in India.
- (b) To understand the benefits and limitations of Green Accounting in Indian Accounting system.

III BACKGROUND OF GREEN ACCOUNTING

Over the last fifty years India has lost over half its forest. India's biodiversity is under the threat of double digit GDP fixation. GDP calculates the value of output produced within a country over a certain period of time. However, any depreciation measurements exercised, will report only for manmade capital and not the harmful impact of growth on valuable natural capital, such as biodiversity, forests, land, and water, which will result in negative effects on human health and welfare.

Climate volatility is getting higher day by day. The extensive and exhaustive use of the natural resources for the production purpose is producing propounding effect on the ecological system thus creating imbalances. The issues related to these things have been raised so long back in the international summits right from sixties. During 1968 and 1972, two international conferences were held to measure the challenges of global environment and to propose corrective action. The UN conference on human and environment (Stockholm Conference) which was held in June 1972 were considered as the pivotal event in the growth of the global environment movement. United Nations has also made an attempt by developing Integrated System of Environmental economic accounting (SEEA), a central multipurpose conceptual framework that describes accounting of interactions between the economy and environment, and the stocks and variation in the stocks of environmental assets.

The Green Indian States Trust (GIST) in 2003 released a series of environmentally adjusted accounts under the Green Accounting. As per their result, the loss of forest ecological services (i.e. ground water augmentation, soil erosion prevention, and flood control) over three years (2001-03) because of declining dense forests was evaluated at an astounding 1.1 per cent of GDP. As per GIST's latest results, the North-Eastern states continue to be most affected, particularly Mizoram and Arunachal Pradesh where the shortfall of forest ecological services is over 12 per cent of their NSDP.

Considering the status of the environmental degradation at such a fast pace civil society is increasingly demanding that business should play a proactive role in societal and environmental objectives in addition to increase in shareholder wealth. This urge has given a base to introduce the concept of green accounting system in Indian corporate accounting system. In the concept of green accounting national accounts are incorporating the value of nature's goods and services. The concept measures the amount of loss which has been done to the environment by the habitants in terms of money and its effect on national income or enterprise income to take remedial expense.

IV GREEN ACCOUNTING PROS AND ISSUES

Green life cycle begins with the consumption of the raw material, moves to manufacturing, distribution to customer used, when its being post-customer used is recycle process back to raw material again. The stress on environmental issues has generated awareness among the companies to bring out their environmental contribution as green reports. India expects to prepare a system of green national accounting in five years that would consider the environmental costs of development and the use of precious depleting natural resources in the process of producing national income.(statement by Union Minister of State for Environment and Forests Jairam Ramesh). The government is emphasizing to bring forward the system of green national accounting formally by year 2015. Observing the positive effects of the green accounting system in order to preserve the ecology, one cannot avoid the complications and issues arises by the adoption of this system. Several mathematical and systematic hitches are the real hurdles, require due recognition and consideration. To introduce this concept, firstly it requires standardization across all states in terms of publication of data related to resources. Further the calculation and evaluation of the natural assets and the losses occurred is a tedious task to do. Although countries have adopted the measures to evaluate it, still it requires the uniformity on a larger basis.

Add on to the above stated issues the major issue is to train the manpower to understand the concept of green accounting and have hands on experience to work with this. This exercise will itself consume a considerable amount of time and money. The natural resources consumption vary with the type of

industries, thus it needs the separate policies and frameworks varied from industry to industry. It's a twin problem for developing country like India, where it has to save environment and perform economic development which leads to necessity green accounting. As the country's economy is not so strong, hence it should be develop first. As per the study done by World Bank, about Rs. 34,000 crores were lost by India due to environmental damage. Company like AT&T are practically implementing green accounting.

V CONCLUSION

Environmental growth and balances is of prime importance in the present scenario. Green accounting system involves twin responsibility as firstly it supports the losses and damages occurs in the environment by evaluating it in terms of money, also it has to assist the progress of production for the accomplishment of sustainable development. Presently it is at a very nascent stage having more of theoretical background then the practical one. There is an urgent need of implementing this concept practically in sporadic ways to understand its effects and later on by observing the benefits and criticalities it should be carry forward on larger scales.

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Limnological Status and Aquatic Planktonic Biodiversity of River Tapti at District Burhanpur, Madhya Pradesh, India

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ABSTRACT

The diversity of various types of plankton like phytoplankton and zooplankton were studied for river tapti near Burhanpur in M.P. The plankton was collected by standard plankton net from three different sites of River Tapti. The phytoplankton were represented by Bacillariophyceae, Chlorophyceae, Cynophyceae and Euglenophyceae, out of which genetics diversity of Bacillariophyceae was more. The zooplankton were identified in various Phyla like Protozoa, Helminthes, Rotifera, Annelida, Arthropoda etc. Diversity of Arthropods was highest. The percentage composition of various groups was calculated for the samples taken from different sites. The composition of plankton as percentage representation was correlated for different sites with sites characteristics. On the basis of different physico-chemical and biological parameters, the status of River Tapti is eutrophic in nature and during period under study 12 fish species, 42 phytoplanktons (15 Bacillariophyceae, 18 Chlorophyceae, 09 Cynophyceae) and 32 Zooplanktons (10 Rotifera, 03 Crustacea, 11 Protozoa, 06 Copepoda, 02 Ostracoda) Genera have been recorded.

Keywords: Limnology, Phytoplanktons, Zooplanktons, Tapti River, Burhanpur M.P., India.

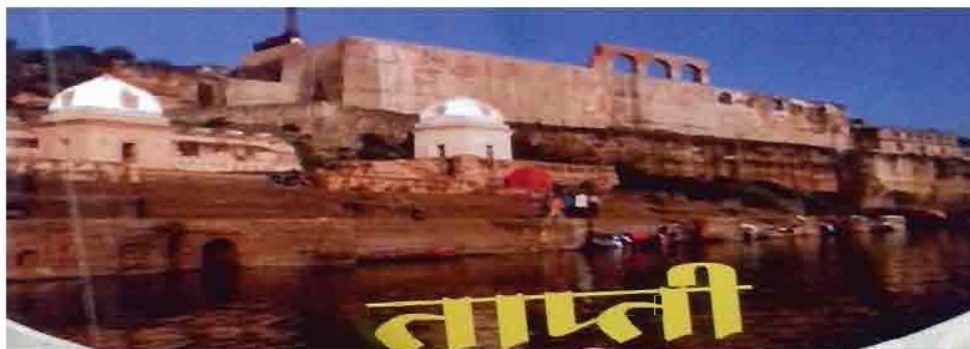
I INTRODUCTION

The Tapti is also one of the sacred rivers of India. Amongst its various names tapti, payoshmi, Tapti and Tapti are more commonly known. All these names can note one and the same meaning the Copley of the tap, meaning heat. The general direction of the river in Nimar (East) is from north-east to south-west. It enters east Nimar at a distance of 120 mile (193km) from its sources.

The diversity of various types of plankton like phytoplankton and Zooplankton were studied for river Tapti near Burhanpur in M.P, India. Planktons are poor swimming but most drifting small organism that inhabit called the water column of ocean and fresh water bodies the name comes from the Greek term, plankton-meaning "wanderer" and drifter plankton is composed of tiny plant called Phytoplankton and animal called Zooplankton, as well as organism that are not easily classified in to

those two groups (such as protozoa and bacteria), Planktonic organism are suspended in water and are also small that even slight current move them about, the occurrence and abundance of Zooplanktons depend on its productivity, which in turn is flow by abiotic factors and the level of nutrients in the water. In a fresh water system, the Zooplanktons from and important faunal group, are most of them life on primary producer and make themselves available to be eat in by higher organism IN FOOD chains including fish and contribute significantly to the biological productivity of this ecosystem (Michael 1973). The Phytoplankton are the primary producers as they trap solar energy and produces organic molecules by consuming CO₂, phytoplankton are not only primary producers but also brings out biogenic oxygenation of the water during the time Welch, Wetzel, 1975, 1983).

I. Map. No.01-04: Maps showing study area of River Tapti at District Burhanpur, M.P., India.





District Burhanpur is located between 21° - 21.05 - 21° 37' N Latitude and 75° 13 - 76° E Longitude in Madhya Pradesh. Tapi is one of the major perennial rivers flowing towards west coast of India is an important sources of fresh water to this region. The 720km. Long River originates near Multai in the Betul District of



Madhya Pradesh. The Selected study sites in Tapi River are Ehat kheda , Jainsbad, Daryapur kalen, looking to the importance of subject as research Topic "LIMNOLOGICAL STATUS AND AQUATIC PLANKTONIC BIODIVERSITY OF RIVER TAPTI AT DISTRICT BURHANPUR, M.P. , INDIA" has been undertaken.

Image No.01: Burhanpur: The cultural heritage city



Image No.2: Surva patri originates (source-visited, near betul) and Burhanpur Dist. Of M.P.

II MATERIALS AND RESEARCH METHODOLOGY

Experimental Work

- (a) Sampling sites, culture, observation- Planktonic study is carried out manually, for

which sampling were done 3-4 times in a month and in each day 3 times sample were taken. In each study site sample taken from 3 places (The selected study sites in Tapi river are Ehatkheda, Jainsbad, Daryapur Kalen.) sample taken from 2m. Depth below the surface water.



Sampling site 1st



Sampling site 2nd

(b) Biological Estimation

The plankton samples are collected following Lind (1979, Welch 1953), Welzel (1975) by filtering 40 liters of water through plankton net having pore size 64 μ. Concentration plankton samples are fixed in 4% formalin.

Zooplankton are identified with the help of keys provided by Pennak (1978), Sehgal (1983), Needham and (1962), Tonapi (1980), A.P.H.A. (1980).

The phytoplankton will be identified with the help of keys given by Prescott (1962), Smith (1950), Agarkar (1975), Edmondson (1959).



Sampling site 3rd

Counting of the individual plankton will be done by "lac keys" dropping method (1935) using the formula.

$$\text{Plankton units / liter} = \frac{N \times C \times 10}{Y}$$

N = Number of phytoplankton counted 0.1 ml concentrate.

E = Total volume of concentrate in ml.

Y = total volume of water filtered for sample in liters

The phytoplankton density was expressed on units / liter and Zooplankton density will express in individuals / liter.

During the period of study the range of variation in different physico-chemical parameters is as:

S.No	Parameter	Tapti River
1	PH	7.4-9.4
2	Water Temperature	12-22.6 c
3	Transparency	20-60.0 cm
4	Dissolved Oxygen	2.2-11.6 mg/Lit.
5	Free CO2	Nil-18.0 mg/Lit.
6	Alkalinity	120-270 mg/Lit.
7	Total Hardness	100-220 mg/Lit.
8	Chloride	28-90.4 mg/Lit.
9	B.O.D.	8.0-26.3 mg/Lit.
10	Nitrate	0.6-2.2 mg/Lit.

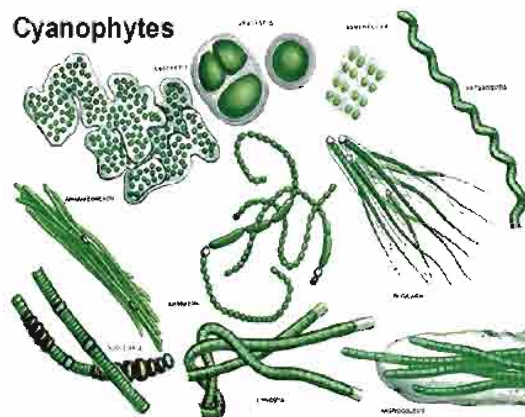
On the basis of the observations that Tapti River are entropic in nature.

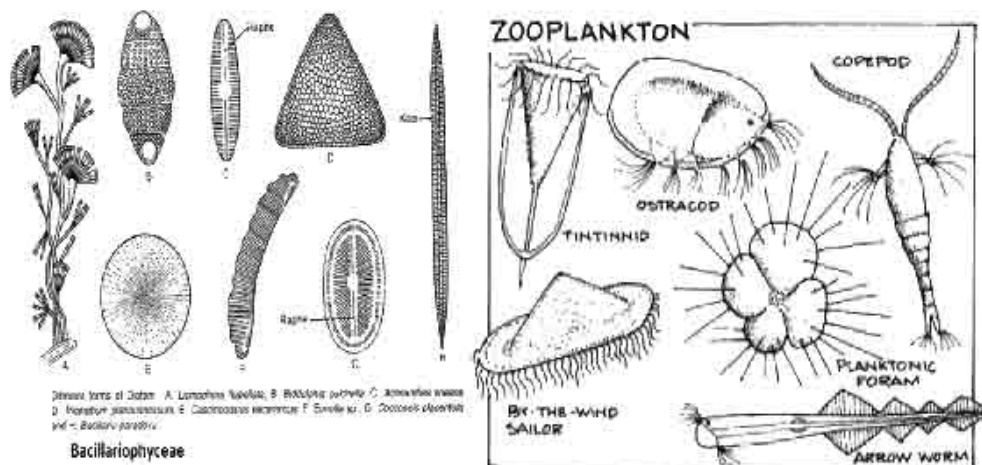
III RESULT & DISCUSSION

Among the phytoplankton chlorophyceae species, Cynophyceae species, bacillariophyceae species and Euglenophyceae species were recorded from the

Tapti River during sep. 2015 to feb.2016. Monthly variation was recorded among phytoplankton. Half yearly average percentage composition of various groups of phytoplankton at different sites was studied.

Figure No.4: Types of Phytoplankton and Zooplanktons in sampling sites





At site 1st bacillariophyceae and Euglenophyceae were dominant with 30% contribution of each group, at site 2nd chlorophyceae and Euglenophyceae with 35 % of each group were recorded and planktonic from representing chlorophyceae and Cynophyceae species were 30% each recorded from site 3rd. At site 3rd, second dominant group was bacillariophyceae about 25%. Seasonal variation in the amount of Euglenophyceae may be related to the influence of biotic factors (manoj, 1993). From unpolluted sites of several rivers of India, it has been observed that bacillariophyceae was dominating followed by the dominance of chlorophyceae. Similar observation has been recorded for four sampling sites also.

Protozoa and rotifer Zooplanktons were of nearly equal composition but arthropod more in percent composition at site 2nd whereas, other groups were

protozoa and rotifers in decline manner. At site 3rd protozoa and rotifers were more in number as this site has less impact as well as less turbidity.

The diversity and density of Zooplankton certainly get influenced by the physico chemical properties of water (onshore et,ak,1997) in that the density of Zooplankton remains more in the lower reaches of the rivers and very less density as well as diversity of Zooplankton community has been reported from head water and first and second order streams. Further it is a fact that the diversity of Zooplankton is always less in the flowing fresh water compared estuarine water or tidal influenced zone . The similar observation has been recorded for river like Narmada, Tapti, mahi and Sabarmati (Sharma, 1995. Nanda 2003).

Figure No.5 Aquatic Flora(Flowering Plants) in Tepti River At Burhanpur, M.P., India



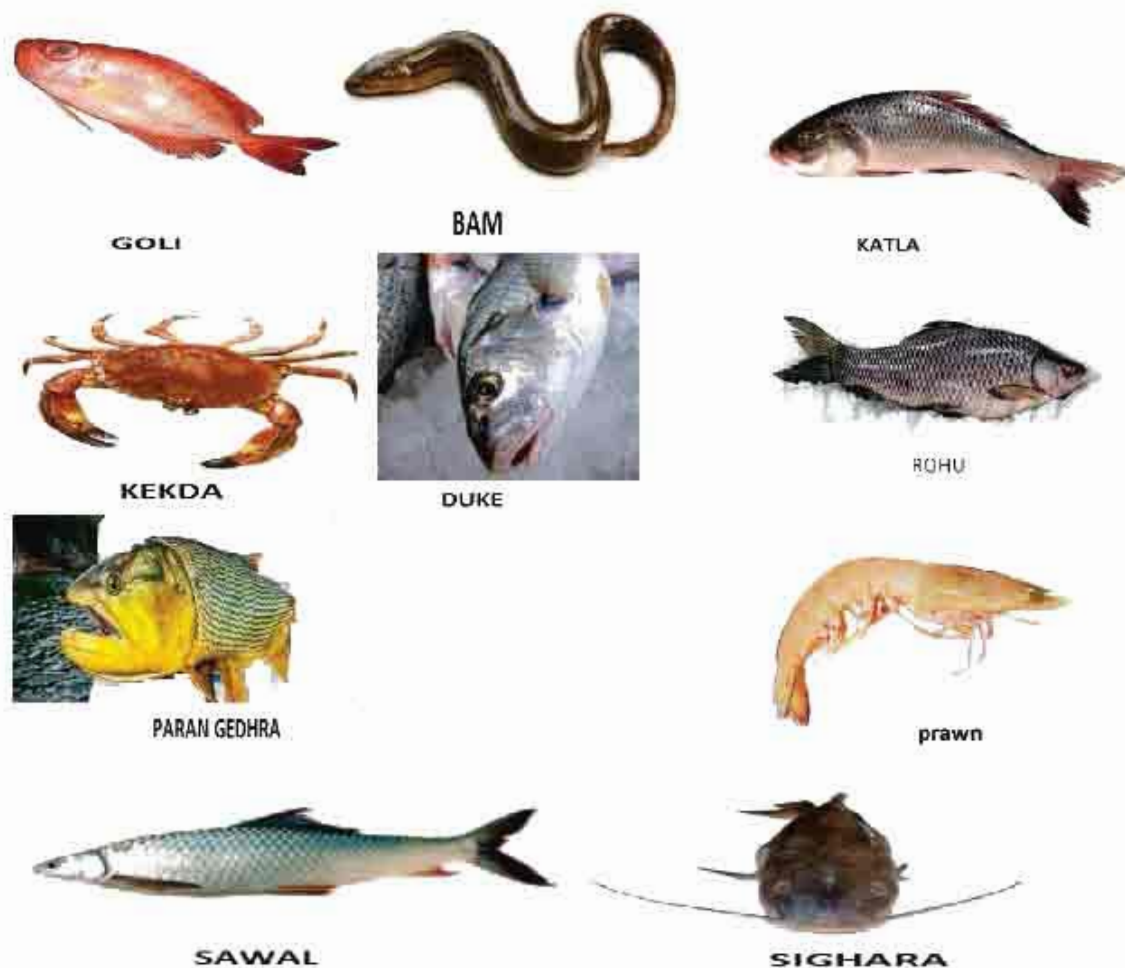


Table No.1
Biostatistical Estimation of species diversity:

S. No.	Type of Planktons	Group & Genera	Name of Genera	Total result
	Phytoplanktons	Chlorophyceae: 18	Chlorella, Coelastrum, Oedogonium, Plectonon, Scenedesmus, Chlamydomonas, Spargium, Ulothrix, Hydrocoleum, Cladophora, Chlorococcum, Microspora, Desmidiaceae, Chlamy, Nitella, Zygnema, Syndesmus and Volvox.	42
		Bacillariophyceae: 15	Navicula, Nitzschia, Fragilaria, Ceratoneis, Amphora, Caloneis, Synechra, Diatoma, Geomphosira, Pennularia, Melosira, Tabellaria, Denticula, Cymbella and Cyclotella.	
		Myxophyceae: 09	Anabaena, Anacyclus, Oscillatoria, Spirulina, Nostoc, Rivularia, Aphanizomenon, Clostridium and Phormidium.	
II	Zooplanktons	Rotifera: 10	Keratella, Rotatoria, Testudinaria, Asconochloa, Polyarthra, Plutocera, Asplanchna, Pseudocyclops, Brachionus and Trichocerca.	32
		Crustacea: 03	Eubranchionus, Moina, Nauplius.	
		Protozoa: 11	Actinophrys, Actinosphaerium, Euglena, Paramecium, Paridinium, Camperella, Epistylis, Vorticella, Arcocella, Difflugia, Ceratium.	
		Copepoda: 06	Cyclops, Daphnia, Daphnia, Bosmina, Heliodella and Nauplius stages.	

		Ostracoda 02	Cypris and Stenocypris	
III	Aquatic flowering plants	Dicots 48 Monocots 33	48 33	81
IV	Types of fishes	Fishes 12	Cherinus sp.(Crab), Catla catla (Catla), Labeo boggut (Gory-gor), Masacombha pandulipandus (Palaemon sp. (Smallprawn), Chorarumarubha(Mandua), Notopterus notopterus (Patola) patola), Wallago attu (Padm), Manacemba armaputi Mastacemba), Labeo chitala Roha (ro), Heteranopterus fossilis(Singhar), Sitona selencha Selarchi	12

Figure 6 Type of Fauna (Fishes) in Tapti River at Burhanpur,MP.,India.



IV CONCLUSION

On the basis of different physico-chemical and biological parameters, the status of River Tapti is eutrophic in nature and during period under study 12 fish species, 42 phytoplanktons (15 Bacillariophyceae, 18 Chlorophyceae, 09 Cynophyceae) and 32 Zooplanktons (10 Rotifera, 03 Crustacea, 11 Protozoa, 06 Copepoda, 02 Ostracoda) Genera have been recorded. In future with increasing human interference at the same rate, it is possible that the

River Tapti will further be polluted. Therefore further studies need to be undertaken to suggest restorative measures, which are of great - socio - economic importance to the region. The current prevailing condition of physico chemical parameters of River Tapti and Aquatic diversity besides acting as potential bio indicators of trophic status requires the management strategies for the conservation of River Tapti at District Burhanpur, Madhya Pradesh, India. (see Table No.1)

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Understanding the Psychometric Testing of a Measuring Instrument in Business Research

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ABSTRACT

The purpose of this paper was to understand the issues involved in the psychometric testing of a measuring instrument in business research. The two most important testing tools for measuring instrument are validity and reliability. Validity refers to whether a measuring instrument is measuring what it purports to. Three types of validity were discussed in this paper: (1) transaction validity, which assesses how well the measuring instrument samples the content domain being measured; (2) criterion validity, which assesses how well the measuring instrument correlates with other measures of the construct of interest; and (3) construct validity, which assesses how well the measuring instrument represents the construct of interest. How consistently does the measuring instrument measure whatever it does measure? This is the issue of reliability. Reliability is the degree to which the measuring instrument is dependable, consistent and replicable over time, over the instruments and other groups of respondents. Three types of reliability were discussed in this paper: (1) reliability as stability is a measure of consistency over time and over similar samples. (2) reliability as equivalence: If equivalent forms of a measuring instrument yield similar results, then the measuring instrument can be said to demonstrate this form of reliability and (3) reliability as internal consistency which examines the inter-item correlations within a measurement device and indicates how well the items fit together conceptually.

Key Words: Validity, Reliability, Criterion Validity, Construct Validity and Internal Consistency.

I INTRODUCTION

Quantitative research always depends on a measuring instrument. Two very important concepts that researcher must understand when they use measuring instrument are validity and reliability. Validity and reliability are jointly called the “psychometric properties” of a measuring instrument. Both are the yardsticks against which the adequacy and accuracy of our measurement procedures are evaluated in business research. A measure can be reliable but not valid, if it is measuring something very consistently but is consistently measuring the wrong construct. Likewise, a measure can be valid, but not reliable if it is measuring the right construct, but not doing so in a consistent manner. Hence, reliability and validity are both needed to assure adequate measurement of the constructs of interest. The purpose of this paper was to understand the issues involved in the psychometric testing of a measuring instrument in business research. The qualitative approach is used to describe and discuss the psychometric testing of a measuring instrument.

II VALIDITY

Validity is the most important consideration in developing and psychometric testing of a measuring instrument. Validity refers to whether a questionnaire is measuring what it purports to (Bryman & Cramer 1997). There are several different types of validity (Polgar & Thomas 1995, Bowling 1997). A validity can be tested using either theoretical or empirical approach. Both approaches are necessary for the validation of a measuring instrument. Theoretical testing of a validity focuses on how well the measuring construct is represented in an operational

manner. This type of validity is termed as translational validity. This is also called representational validity. There are two popular methods (face validity and content validity) to evaluate the translational validity.

Face validity refers to whether measuring instrument seems to be a reasonable measure of its underlying construct “on its face”. It is the easiest validation process to undertake, but it is the weakest form of validity. It evaluates the appearance of the questionnaire in terms of feasibility, readability, consistency of style and formatting, and the clarity of the language used (Haladyna 1999; Trochim 2001; Devon 2007). To determine the face validity of a measuring instrument, a face validity form is developed for respondents to assess each item in terms of the clarity of the wording; the likelihood the target audience would be able to answer the questions, the layout and style on a Likert scale of 1-4, strongly disagree= 1, disagree= 2, agree= 3, and strongly agree= 4. All respondents rate each item and items rated at three or four on a Likert scale of 1-4 are accepted as face validity. The feedback is taken on the items rated below three and modified as per need of the face validity.

Content validity refers to expert opinion concerning whether the scale items represent the proposed construct, the questionnaire is intended to measure. Content validity indicates the content reflects a complete range of the attributes under study and is usually undertaken by seven or more experts (Pilot & Hunger 1999). To estimate the content validity of a measuring instrument, the researchers clearly define the conceptual framework of the measuring construct by undertaking a thorough literature review and seeking expert opinion. Once the conceptual framework was established, a panel of seven or more

purposely chosen experts in the relevant areas is employed to review the draft of the measuring instrument to ensure it is consistent with the conceptual framework. Each expert independently rated the relevance of each item on the measuring instrument to the conceptual framework using a Likert scale of 1-4 (1=not relevant, 2=somewhat relevant, 3=relevant, 4=very relevant). The Content Validity Index (CVI) is used to estimate the validity of the items (Lynn 1996). According to the CVI index, a rating of three or four indicates the content is valid and consistent with the conceptual framework (Lynn 1996). For instance, if five of eight content experts rate an item at three or four, the CVI would be $5/8=0.62$, which does not meet the 0.87 (7/8) level required, and indicates the item should be dropped (Devon 2007). Theoretical approach of validity is an initial step in establishing validity, but is not sufficient by itself. Therefore, empirical approach of validity must also be demonstrated to develop a complete valid tool. The empirical approach of validity testing focuses on how a given measuring instrument is related to external criteria. This approach of validity testing is based on empirical data collected by a researcher. There are two types of validity (**riterion validity and construct validity**) under the empirical approach of validity. Criterion validity measures how well a measuring instrument predicts an outcome for another measuring instrument. It is useful for predicting performance in another situation. There are two popular methods to evaluate the criterion validity. These are concurrent validity and Predictive validity.

Concurrent validity is the relationship between scores on a newly developed test and previously developed test obtained at the same time. For instance, a researcher has developed an English language aptitude test and needs evidence that the test really measures English language aptitude. The researcher could select a well-known and previously validated English language aptitude test (criterion), administer it and the new English language aptitude test to a group of students, and determine the correlation between the two sets of scores. A substantial correlation between the new aptitude test and the widely accepted test is evidence that the new aptitude test is also measuring English language aptitude. The high correlation reflects high concurrent validity and low correlation reflects low concurrent validity.

Predictive validity is the relationship between scores on a newly developed test and scores on a criterion test available at a future time. For instance, a researcher has developed an English language aptitude test and needs evidence that the test really predict performance in English language courses. At the gathering predictive validity evidence of an English language aptitude test, one would look at the relationship between scores on the test and the scores students eventually earned in a future English language course (criterion). If a relationship is

demonstrated, the scores on an aptitude test could be used later to predict performance in English language courses. In the case of a new scholastic aptitude test, predictive validity evidence would involve administering the test to a sample of high school students and then putting the scores away until the students complete their first semester of college. When the students' college scores become available, one would correlate the test scores and college scores. If the correlation is high, one has evidence for the usefulness of the aptitude test for predicting college achievement.

Criterion validity is a second step in establishing validity of a measuring instrument, but is also not sufficient by itself. Therefore, construct validity must also be demonstrated to develop a complete valid tool. Construct validity relates to how well the items in the questionnaire represent the underlying conceptual structure. **Construct validity** refers to the degree to which the items of a measuring instrument relate to the relevant theoretical construct (Kane 2001; Devon 2007). Construct validity refers to the degree to which the items on meaning instrument relates to its theoretical construct. It is the degree to which a meaning instrument measures what it claims for the measurement purpose.

Campbell and Fiske (1959), Brock-Utne (1996) and Cooper and Schindler (2001) suggest that construct validity is addressed by convergent and discriminant techniques. Convergent and discriminant validity must also demonstrate by correlating the measure with related and/or dissimilar measures (Bowling 1997). Convergent techniques imply that different methods for researching the same construct should give a relatively high inter-correlation, while discriminant techniques suggest that using similar methods for researching different constructs should yield relatively low inter-correlations. Factor analysis is one of the best statistical technique for measuring the discriminant validity.

Factor analysis is a statistical technique which is very much used for the development of a measuring instrument in business research. This statistical technique clusters the items of a measuring instrument into common factors, interpret each factor of the measuring instrument to the items having a high loading on it and summaries the items into a small number of factors (Bryman & Cramer 1999). Loadings refers to the correlation between an item and a factor (Bryman & Cramer 2005). A factor is a list of items which belongs to the same group. Related items are grouped together under a factor, because they represent the construct and unrelated items that do not belong together, do not represent the construct and should be defected. (Munro 2005). In brief, factor analysis is that statistical method which clusters similar issues together and separates them from others.

III RELIABILITY

Reliability is the degree to which the measuring instrument is consistent or dependable. If we use this measuring instrument to measure the same construct multiple times, we do get pretty much the same result every time. Reliability refers to the degree to which a measuring instrument is consistent and dependable in measuring what it is intended to measure. This meaning of reliability is supported by Haladyna (1999) and Devon (2007). They define reliability, as consistency in the measurement of a questionnaire and how well the items fit together, conceptually. Validity is the primary necessity to test the reliability of a measuring instrument. If a test is not valid, then reliability is useless. Therefore, a measuring instrument may be reliable but not valid (Beanland et al. 1999; Pilot & Hunger 1999, Devon et al. 2007).

Reliability is the degree to which the measuring instrument is dependable, consistent and applicable over time, over the instruments and other groups of respondents. There are three principle types of reliability: stability, equivalence and internal consistency.

Reliability as stability is a measure of consistency over time and over similar samples. A reliable measuring instrument will yield similar data from similar respondents over a period of time. In the experimental research design this would mean that if a test and then retest are undertaken within an appropriate time span, then similar results would be obtained. This is a measure of temporal stability of the measuring instrument. This type of reliability is also called **test-retest reliability**. Test retest reliability can be measured by applying the same measurement instrument on the same sample at two different points of time on the assumption that there will be no change in the construct under study. (Trochim 2001; Devon, 2007). A high correlation between the scores at the two time points indicates the instrument is stable over time (Haladyna 1999; Devon et al. 2007).

The duration of time between the two tests is always debatable. The shorter the time interval, the higher the correlation between the two tests, the longer the time interval, the lower the correlation (Trochim, 2001). Generally, it is considered that a longer time gap may change the observation due to random error and it will provide lower test-retest reliability. In addition to stability over time, reliability can also be stabled over a similar sample. In the experimental research design this would mean that if we administer a test simultaneously to groups of students who are similar on significant characteristics, then similar results would be obtained.

Reliability as equivalence is measured in two ways. It may be achieved first through using equivalent forms or alternative forms of a measuring instrument. If equivalent forms of a measuring instrument yield similar results, then the measuring instrument can be

said to demonstrate this form of reliability. This type of reliability might also be demonstrated if the equivalent forms of a measuring instrument yield similar results if applied simultaneously to similar samples. Here reliability can be measured through a t-test, through the demonstration of a high correlation coefficient and through the demonstration of similar means and standard deviations between two groups. Second, reliability as equivalence may be achieved through inter-rater reliability. Inter-rater reliability is a measure of how reliable the score is when different people rate the same performance on a measurement instrument. It gives a score of how much homogeneity there is in the ratings given by different people for the same performance on the same measuring instrument. Low inter-rater reliability is a sign of poor measuring instrument and high inter-rater reliability is a sign of good measuring instrument.

Reliability as Internal consistency is a measure of consistency between different items of the same construct. Internal consistency examines the inter-item correlations within a measuring instrument and indicates how well the items fit together conceptually (Nunnally & Bernstein 1994; Devon et al. 2007). Internal consistency is measured in two ways: Split-Half reliability and Cronbach's alpha correlation coefficient (Trochim 2001).

Split-half reliability is a measurement of consistency between two equal parts of a measuring instrument. The items of the measuring instrument can be divided into two equal parts on any logical basis. It is a type of reliability in which a measuring instrument is divided into two parts and the score of the same sample is computed on both the parts. Coefficient of correlation between the two scores is the measure of split-half reliability. It is one of the easiest way of establishing reliability of a measuring instrument. This reliability is directly proportional to the length of the measuring instrument i.e reliability increases with the length of the measuring instrument and vice-versa.

Cronbach's alpha, a reliability measure designed by Lee Cronbach in 1951, is the most common statistic to estimate reliability for internal consistency. This statistic uses inter-item correlations to determine whether constituent items are measuring the same domain (Bowling 1997, Bryman & Cramer 1997, Jack & Clarke 1998). If the items show good internal consistency, Cronbach's alpha should exceed 0.70 for a developing questionnaire or 0.80 for a more established questionnaire (Bowling 1997, Bryman & Cramer 1997). The alpha is recommended ≥ 0.90 for measuring instruments used in clinical settings (Nunnally & Bernstein 1994) and $\alpha > 0.70$ is acceptable for a new measuring instrument (DeVellis 1991; Devon et al. 2007).

Cronbach's alpha is equivalent to the average of the all possible split-half estimates and is the most frequently used reliability statistic to establish internal consistency reliability (Trochim 2001; Devon et al. 2007). If an instrument contains two or more subscales, Cronbach's alpha should be computed for each subscale as well as the entire scale (Nunnally & Bernstein 1994; Devon et al. 2007). It is usual to report the Cronbach's alpha statistic for each subscale within a measuring instrument rather for the entire measuring instrument.

IV CONCLUSION

The paper discussed the procedures by which a reliable and valid measuring instrument can be developed. Validity and reliability are the two major psychometric characteristics of a measuring instrument. The researchers must understand the importance of validity and reliability when they use measuring instrument in any business research. If a piece of research is invalid and unreliable, then it is worthless. Validity and reliability is thus a necessary requirement of a measuring instrument. The paper is very useful for researchers who are interested in developing a valid and reliable measuring instrument in business research.

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E-Waste Management in Unorganized and Organized Recycling Sectors:A State of Art

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ABSTRACT

Over the past decade, electronic advancements have revolutionized the human lifestyle. These advancements result in huge amount of discarded or obsolete electronic items which need proper management and recycling. E-waste constitutes both hazardous and non-hazardous materials and therefore needs to be treated by an organized E-waste recycling sector having advanced machinery and adequate safety standards. Unfortunately, the present E-waste management agencies have not been able to eliminate the interference of unorganized E-waste recycling sector. Therefore, majority of E-waste is handled by unskilled poor labor who is completely unaware of the subsequent occupational hazardous. Unorganized E-waste recycling has also become a potential threat for the environment as it involves exposure to toxic chemicals and careless disposal methods. The present paper high lights various hazards of unorganized E-waste recycling and simultaneously give an insight about the organized E-waste recycling sector. Further, a three tier set of recommendations for government agencies, industrial sector as well as for the consumers has been proposed in this paper.

Keywords: E-waste, Unorganized sector, Organized sector, Hazardous, Recycling

I INTRODUCTION

In the modern world of technological advancements, natural environment is being greatly deteriorated due to human interference in variety of ways. As soon as any electronic device gets upgraded, its older version gets obsolete. This use and throw attitude of consumers has worsened the situation. Massive increase in population has also directly influenced the rate of production and utilization of electronic devices through various utility sectors such as information and technology, music and entertainment, virtual gaming, telecommunication and others. Waste Electronic and Electrical Equipment (WEEE) may be broadly classified as appliances used in household (washing machines and refrigerators), information technology (IT) and consumer equipment (monitors, personal computers, laptops, TVs, DVD players, mobile phones, mp3 players) and leisure and sporting equipment. The components of various appliances like batteries, circuit boards, activated glass, CRTs, plastic casings, and lead capacitors also come under the category of electronic waste. Hence any electronic equipment which reaches towards its end of life and is not capable to fulfill its usage purpose anymore falls in the category of WEEE or commonly referred to as E-waste.

II HAZARDOUS CONSTITUENTS OF E-WASTE AND ITS CATEGORIZATION

It constitutes both hazardous and non-hazardous materials which require careful recycling practices in order to avoid or minimize the environmental pollution. Some hazardous metals found in electronic waste are lead, cadmium, chromium, mercury, copper, manganese, nickel, arsenic, zinc, iron, and aluminum. Apart from these metals, E-waste includes variety of persistent organic pollutants such as brominated flame retardants, polybrominated diphenyls, dibrominated diphenylethers, polychlorinated biphenyls, poly chlorinated or poly brominated dioxins and

dibenzo furans dioxins, hexabromocyclododecanes, and perfluoroalkyls. The valuable components include gold, silver, palladium, platinum and other precious metals. However, extraction of these metals involves tedious and risky procedures.

Due to presence of such large variety of materials, categorization of E-waste becomes complex. Categorization of E-waste is the foremost step in order to develop an efficient recycling mechanism. To sort this problem, EU (European Union, comprising of 17 developed nations) has listed ten different classifications as shown in figure 1. It can be clearly seen that the majority E-waste comes from large and small household devices, Information and technology, consumer electronic items and lightening furniture.

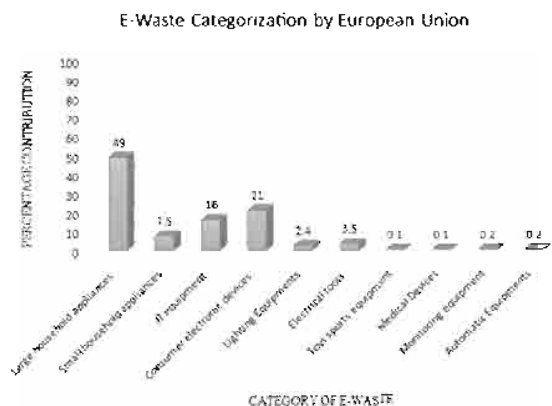


Fig.1: E-waste categorization as per EU directives

III E-WASTE GENERATION AND QUANTIFICATION

Sources for of E-waste generation in India can be broadly classified into domestic generation and foreign dumps. The domestic generation includes E-waste from all utility sectors established in various states of our country. About 70% of domestic E-waste generation is accounted for by public and private sectors where as the

individual municipal waste contributes only 15% of total domestic generation. Foreign dumps refer to the huge illegal imports of WEEE from developed nations to developing nations like India, China and other Asian countries. As per the reports of World Health Organization (WHO), about 75 to 80 percent of WEEE generated annually in developed countries is shipped to various Asian countries in the name of donations using the loopholes of present waste management guidelines. However certain problem solving initiatives such as Basel convention have come up with some useful actions in the form of Partnership for Action on Computing Equipment (PACE) that will surely limit the disguised illegal International trade of E-waste within different countries.

Global production of E-waste accounts about 72 Million tons (Mt) per year. Consumer usable items (such as Audio/video entertainments, laptops, tablet, mobiles etc) individually have produced 9.8 Mt of E-waste by year 2015. As per the reports of Central pollution Control Board (CPCB) in year 2005, per day of E-waste generation in India was 0.573 Mt. In year 2007, total E-waste generation was about 3.5 Mt. Besides, the total domestic E-waste generation is only about 8 million tons per year. At present production and consumption rate, it is expected that rate of E-waste generation will increase upto 33% by the year 2025. Figure 2 depicts the incremental E-waste generation trend in India since year 2007 to 2025. Expansion of consumer base, development in production technologies of electronic items and improvisations in marketing strategies will play a key role in increasing these quantities every year. Therefore, to avoid environmental as well as human health degradation, it is necessary to set up more a suitable E-waste management mechanism.

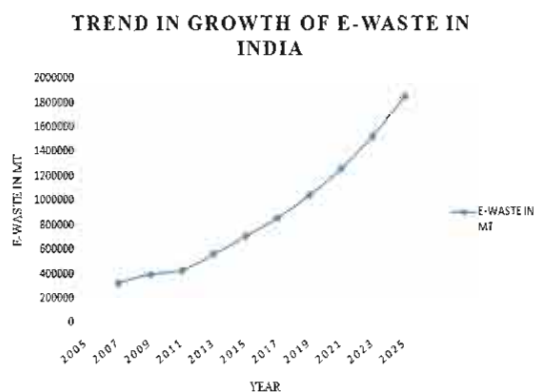


Fig.2: Incremental increase in generation E-waste

IV E-WASTE: END-OF-LIFE MANAGEMENT

E-waste management includes reuse, refurbishment of repairable items, segregation to obtain useful components, recycling and final disposal. The most appropriate management practice is always of reusing the functional as well as repairable items as it increases the utility life of these items. Recycling of discarded or

obsolete electronic items involves separation of all types of precious and hazardous components in controlled conditions. It also reduces the overall quantity of waste to be disposed off finally and therefore helps in environmental conservation. The objective of E-waste management is to evolve an effective management system at both ends of production as well as consumer utilization. Effective recycling of E-waste is a two way beneficial process. Firstly, it reduces the amount of toxic solids and fumes released into the environment and secondly it generates a good business market for the people to set up E-waste recycling plants which further helps to generate employment. Also, E-waste recycling provides easier access to various precious metals in comparison to typical ore metal extraction process. Despite having numerous benefits of effective E-waste management, the present global E-waste recycling through organized sector accounts for only 13%. Lack of awareness and feudal legislations are the prime factors responsible for driving E-waste recycling to informal unorganized sectors.

(a) E-Waste Recycling in the Unorganized Sector

Unorganized E-waste recycling refers to an unauthorized recycling network which does not abide by any government agency. The recycling operations are performed by unskilled labor without using any precautionary measures. They get exposed to several gases, acids, toxic chemicals, contaminated ash and therefore suffer from various kinds of occupational hazards. Table 1 shows various sources of harmful constituents of E-waste and their corresponding impacts on health of workers. The working structure does not conform to any environmental and human health conservation regulations. Apart from the E-waste generated within the country, India accommodates a huge amount of E-waste imports every year. Unfortunately, due to lack of an effective E-waste management and legislations, almost 95% of E-waste is treated by the unorganized sector. The unorganized E-waste recycling is dominant in slums of various metropolitan cities like Delhi, Bombay and Pune. With due course of time, the roots of unorganized sector has penetrated deep into our community as it offers more profitable and easier services to consumers. Hence it has now established itself as a complex structure comprising of small scale businessmen and unemployed labor. The pollutants released during open-pit incineration contaminate the natural soil, water and air. Due to absence of any safety measures, workers usually face accidental injuries and burns. Long term exposure to Phthalates like Butylbenzyl phthalate causes problems related to reproduction.

In Delhi there a lot of people who have adopted manual dismantling of E-waste as full time family business. They work at home and hence expose their families as well as the surrounding environment to these hazardous materials. E-waste is collected by numerous isolated scrap dealers in all parts of the country. The collected material is sold to the scrap merchants with a suitable profit. The material then goes in the hands of illiterate and unskilled labor for manual dismantling to obtain

precious metals. E-waste recycling in unorganized sector is limited to metal extraction only. It involves careless use of gas torches and open acid baths in order to segregate metals from E-waste components. The efficiency of these processes is about 30% which is very less in comparison to the organized E-waste recycling methods. Hence, huge amount of left over waste including E-waste plastic and toxic materials are subjected to open incineration or landfills. These processes release various toxins such as polycyclic aromatic hydrocarbons (PAHs) and halogenated PAHs into the atmosphere. In certain places having nearby agriculture fields, the contaminants may also penetrate into soil and effect crop quality. Thus unorganized

recycling of E-waste causes potential hazards to human health and environment.

Grant Kristen et al carried a potential review study to analyze the impact on health of workers involved in unorganized E-waste recycling and people living in surrounding contact area. They studied the relationship between E-waste recycling exposure and the corresponding health hazards. It was observed that the people who came in contact with E-waste treatment procedures were found to have disturbed thyroid function, abnormalities in cellular functioning and adverse effects on lungs. Children from 8-13 years, pregnant ladies and premature babies were also reported to be affected. People residing in nearby regions were reported to have permanent DNA abnormalities.

Table 1
Occupational hazardous of unorganized E-waste recycling

Constituent	Source	Impact
Lead (Pb)	Soldering of PCBs, glass panels and gasket of computer monitors, CRTs	<ul style="list-style-type: none"> • Skin diseases, Headaches, nausea, ulcers, • Damage to central nervous system • Effect on reproductive health
Cadmium (Cd)	Computer batteries (rechargeable), switches, CRTs, semiconductors	<ul style="list-style-type: none"> • Accumulation in liver and kidney • Neural impairment of infants
Mercury (Hg)	Printed circuit boards, Relay switches, lighting devices on flat screens	<ul style="list-style-type: none"> • Damage to central nervous system • Psychological effects (depression and tremors) • Inhalation and dermatological problems
Chromium (Cr)	Determent of rusting of galvanized steel plates, hardener for steel housing, floppy disks	<ul style="list-style-type: none"> • Multiple organ failure • Hindered neurodevelopment • Asthma and damage to DNA
Polyvinyl Chloride (PVC)	Cabling and computer housing	<ul style="list-style-type: none"> • Respiratory problems • Damaged immune system • Hormonal imbalance • Reproductive and developmental problems
Brominated Flame Retardants (BFR)	electronic equipment and circuit boards plastic casings	<ul style="list-style-type: none"> • Harm to reproductive and immune system • Endocrine disorders
Barium (Ba)	Front panels of CRTs	<ul style="list-style-type: none"> • Loss of muscle strength • Heart, liver and spleen damage and Silicosis
Beryllium (Be)	Motherboard	<ul style="list-style-type: none"> • Cancer causing • Fume assimilation leads to berylliosis
Arsenic (As)	Light Emitting Diodes (gallium arsenide)	<ul style="list-style-type: none"> • Breathing problems • Cardiovascular, Renal and liver disease • Bladder cancer and Gastrointestinal aberration
Nickel (Ni)	Electron gun in CRTs, Nickel Cadmium batteries (rechargeable)	<ul style="list-style-type: none"> • Dermatological problems • Carcinogenic
Selenium (Se)	Old photo copying machines	<ul style="list-style-type: none"> • Gastrointestinal disturbances • Hair loss and Nail Sloughing • Irritability and lethargy
Lithium (Li)	Lithium batteries	<ul style="list-style-type: none"> • Gastrointestinal and nerve damage
Americium (Am)	Fire detectors, medical equipment	<ul style="list-style-type: none"> • Radiation induced damage
Zinc (Zn)	CRT screen interior	<ul style="list-style-type: none"> • Cytotoxicity and Ischemia
Chlorofluorocarbons (CFC)	Refrigerators, air conditioners, aerosols	<ul style="list-style-type: none"> • Danger to respiratory system • Ozone depletion which causes skin disorders
Polychlorinated Biphenyl (PCB)	Dielectric and coolant fluids in electronic appliances, PVC coatings of electrical cables	<ul style="list-style-type: none"> • Carcinogenic • Damage to immune system • Endocrine and reproductive disorders

(b) E-Waste Recycling in the Organized Sector

E-waste recycling in organized sector includes utilization of environmentally sound recycling techniques that protect nature from the hazardous end products of E-waste recycling. The mechanism is also helpful to the workers as it incorporates all kinds of safety equipment. The equipment and technology requirements for setting up an organized recycling plant with all safety and quality standards is quite expensive. Apart from the initial investment, employment of skilled persons and machinery running cost is also high. Therefore, installation of such E-waste management plants is difficult in developing countries. In India, only 10% of E-waste is treated by organized sector. Interference of unorganized sector in various stages of collection and recycling is another challenge for successful functioning of the organized sector. According to Central Pollution Control Board (CPCB) database, India has 178 authorized E-waste recycling units. There are only 27 high processing units having an annual E-waste handling capacity of 5000 metric tons or more. Karnataka has the maximum number of small E-waste recycling units (39), followed by Maharashtra (23) and Uttar Pradesh (9).

Organized sector provides effective E-waste treatment facilities. Effective E-waste recycling refers to a set of processes that is capable to handle hazardous waste product in an eco-friendly way. The procedures followed do not deteriorate human health and environment in any way. Effective E-waste recycling is a many-fold process: the first step after collection of E-waste is to categorize the huge heaps as per set standards. The next step includes dismantling or disassembly-mechanical pretreatment which involves segregation of useful as well as hazardous components in collection centers. Further, concentrating these separated components using various mechanical or metallurgical procedures. The third step is to refine the segregated components by extracting of large quantities of various expensive metals such as gold, silver, palladium, copper, iron, nickel, silicon, copper, aluminum, and steel. The final step is to ensure careful disposal of the residues as per industrial standards. Figure 3 depicts the organized E-waste recycling and disposal under controlled conditions.

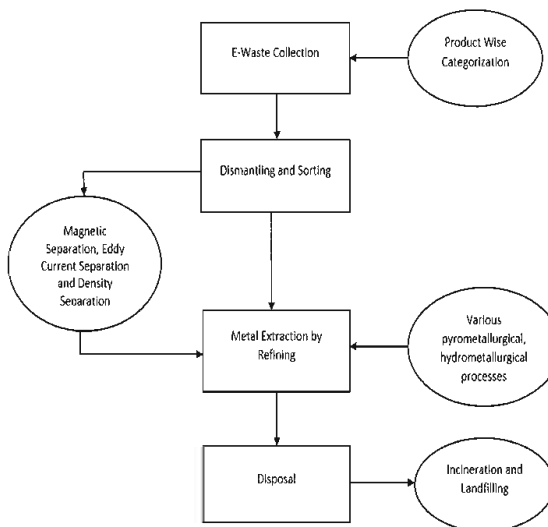


Fig. 3: Organized E-waste recycling and disposal

Some popular methods of E-waste refining are pyrometallurgy, hydro-metallurgy, and bio-leaching. Pyrometallurgy involves changing the physical and chemical composition of the E-waste scrap by thermal treatment. It incorporates numerous sub processes such as calcining, roasting, smelting and refining and hence this method proves to be a bit uneconomical. The technique used in hydro-metallurgy is chemical leaching by using different ligands or acids like cyanide, halide, thiourea, sulphuric acid and others. Refining of electronic products may also carried by hydrometallurgical etching by using various chlorides and other organic solvents. Bioleaching is a method in which micro-organisms are used to accelerate rate of leaching from metallic mineral source. There are two types of mechanisms that may be used for the purpose. Direct action mechanism in which minerals are directly oxidized by microorganisms and the indirect action mechanism which involves oxidation of minerals and simultaneous rejuvenation of ferric ions by microorganisms. These processes are based on scientific studies and have been adopted after successful experimentation. Therefore, E-waste recycling in properly organized treatment plants ensures safety of human health and environment. They are also much more efficient as compared to the unorganized sector and provide 99% recovery of precious and special metals from various electronic components.

V RECOMMENDATIONS

(a) Recommendations For Industrial Sector

E-waste is a relatively new type of waste product in comparison to any other waste. Recycling and efficient treatment is a separate solution. Manufacturers should use innovative designing techniques that can allow the users to upgrade all kinds of electronic products in relevance to latest technological advancements. This will motivate them to use the product for a much longer time.

The future production of electronic items should come up with some technological advancement which allows easier dismantling and recovery of the basic components of any electronic product. Such advancement will increase rate of refurbishing of electronic products and subsequently reduce E-waste recycling.

The use hazardous metals and traditional printed circuit boards should be avoided. These come up with fire inhibitors and require a large amount of soldering and fabrication. Instead, manufacturer should motivate the utilization of thick film technologies and ceramic printed boards. This will reduce soldering material and provide easy dismantling to obtain useful raw materials. Design Improvisation is essential for the outer casings and body cover as well. Electronic manufacturing should avoid using traditional paints as they reduce the plastic impact resistance which significantly affects recycling and remolding of electronic plastic. Use of water based paints can certainly solve this problem.

Apart from that, the present production techniques uses different kind of plastics such as High Impact Polystyrene (HIPS), Acrylonitrile-Butadiene Styrene (ABS), Polypropylene (PP) and others for manufacturing a single electronic product only. This makes the recycling process complex and tedious. Future production must make efforts to minimize this variation in fabrication of electronic products.

(b) Recommendations For Government Agencies

The government waste management legislations must motivate the researchers to evolve sustainable E-waste disposal ideas that can counter this problem and are economically feasible. The latest discussion is about incorporation of E-waste plastic residues in road construction. Therefore, various institutional agencies should promote and finance such innovative ideas.

Government legislations need to be more stringent in order to improve the working and co-ordination of centre and state pollution control boards. This will help to channelize the structural framework, minimize the financial leakage and achieve the desired recycling targets.

Various environmental and health management government initiatives such as Swatch Bharat Abhiyaan should create awareness among consumers about all the possible choices of E-waste recycling.

At the same time agencies should make E-waste collection easier for the recycling units. One alternative is to send pre-paid mail services to the consumer thus motivating them to bring their obsolete electronic products to recycling units.

Another initiative can be installation of self-serving automatic E-waste collection booths at various places. These should be capable of receiving E-waste, evaluate the waste electronic product and providing the evaluated money to the consumer instantaneously.

ecoATM company is one such example which provides this service to people. If this initiative is supported by the government and allowed to flourish in society, it can surely dominate the interference of unorganized sector (Kabariwala's) and contribute to the aim of sustainable disposal of E-waste products.

Currently only limited number of investors have invested in organized E-waste recycling sector. The probable reasons are lack of awareness about economic aspects, value contribution towards sustainable development and assurance of constant useful material feed. Government schemes such as Make in India, Stand up India and others should setup a suitable framework to enlighten the investors about all these aspects. This will surely attract the investors to step in the business of eco-friendly E-waste recycling.

The upcoming E-waste management legislations should try to integrate the unorganized and organized E-waste recycling sectors. The unorganized sector has very strong collection and accumulation network. It also comprises millions of experienced workers who can easily handle the treatment technologies.

(c) Recommendations For Consumers

The most effective mitigation for E-waste management would be to minimize E-waste generation at the consumer end. People should know about this emerging hazard and realize their responsibility to avoid unnecessary E-waste generation. Before discarding any electronic product, consumer should check whether it can be reused or if it can be donated. This will ensure a much longer life span of these items.

At last if the electronic product becomes completely obsolete or waste, consumer must seek for all possible ways for organized E-waste recycling of their product. Discarded E-waste should not be mixed with other solid household waste because it becomes a tedious task to segregate it at later stages.

People should understand the process of sustainable E-waste disposal and make efforts to deliver the segregated E-waste at authorized centers rather than giving it to local scrap collectors to make easy money. Mostly consumers who use electronic products are literate; therefore they may use internet sources to encourage free cyclic use of electronic products. People can make groups on various social networking platforms and in this way the discarded electronic product from one user can become useful for another. Consumer should promote use of eco-friendly electronic products. This means that they should purchase products which are manufactured by using environment friendly raw materials.

VI CONCLUSION

Unorganized E-waste recycling exposes people to various chronic diseases. The illiterate or unskilled labor is usually unaware of the consequent occupational hazards. Rate of E-waste generation is greater in developed countries in comparison to the developing

countries. In the present scenario, organized E-waste recycling legislations in the developed nations are very strong thereby making the process expensive for the investors. Despite the clear guidelines of Basel convention, these constraints have encouraged illegal exports of E-waste items to various developing countries. E-waste handling and management legislations which are already prevailing in India have proved to be insufficient in implementing enforcements on unorganized E-waste recycling sector. The upcoming regulations should focus on improved implementation and better integration of center and state pollution control agencies. Government and various non-profitable agencies must be vigilant to enforce Extended Producer Responsibility (EPR) and reduction in use of hazardous substances. Further, it is essential to integrate unorganized and organized E-waste recycling sector in order to access all financial benefits of E-waste recycling but with an environmentally sound mechanism. Although present E-waste management is a problematic issue but with combined efforts of the government, industrialists and consumers it can be easily sorted.

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Major Focus on Preventing MRSA Superbug in Hospital by the Help of Nurse

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ABSTRACT

Methicillin-safe Staphylococcus aureus (MRSA) infection is a worldwide health care issue. Healthcare laborers may secure methicillin-safe Staphylococcus aureus (MRSA) from patients, both hospital and home conditions, other healthcare specialists, family, and public associates, and pets. There is an accord of case reports and arrangement which currently firmly support the job for MRSA-conveying healthcare work force to fill in as a store and as a vehicle of spread inside healthcare settings. Health care experts, to great extent nurses working long in health organizations, are inclined to get tainted with MRSA. In this manner, their unawareness about MRSA is a more serious hazard in health establishments as they will in general spread MRSA infection to their patients This article expects to give a review of the various ways to deal with the control of MRSA and the job of nurses in it.

I. INTRODUCTION

MRSA means 'meticillin- (or methicillin-) safe Staphylococcus aureus'. This is a typical sort of bacterium (Staphylococcus aureus) that is never again killed by meticillin (otherwise called 'methicillin', an anti-microbial) or different antibiotics that are every now and again used to treat infections.

Prior to the innovation of antibiotics, it was a typical reason for frequently fatal hospital-gained infections. The disclosure of penicillin in 1928 made ready for the creation of anti-toxin drugs and the conviction that these would annihilate irresistible sicknesses. However as time passes, microscopic organisms have opposed anti-microbial treatments by building up protection from their method of activity.

Staphylococcus aureus (from staphyl, Greek, which means grape-like, and coccus, Greek, which means berry, aurum, Latin, which means gold) is a standout amongst the most significant human pathogens. Staphylococcus aureus created protection from nicilin during the 1940s, and its successor, methicillin, endured a similar destiny after it was presented during the 1950s, prompting the advancement of methicillin safe Staphylococcus aureus (MRSA).

This microbe is available in many situations frequented by people and is promptly separated from fomites (non-living material, for example, bed cloth). MRSA can live on individuals without making them ill, and without them demonstrating any symptoms, however is hazardous when it contaminates individuals who are unwell.

MRSA is effectively moved to start with one patient then onto the next in hospitals, where it causes serious infections and can cause demise. This transmission happens primarily through healthcare laborers when

their hands, garments, or gear become contaminated with MRSA during routine consideration of patients who have MRSA.



Figure 1: Electron micrograph of Staphylococcus aureus.

Contact is the principal method of transmission. Staphylococcus aureus is the strongest of all non-spore-shaping pathogens; staying suitable following quite a while of air-drying, it opposes numerous disinfectants and antibiotics, and can travel impressive separations through aeronautical dispersal. It is predominantly conveyed in the nostrils and, to a lesser degree, in the skin, nasopharynx and digestive system. Carriage can be transient in nature, gained from someone else or item, or it may be an inhabitant part of the ordinary greenery.

Sophistication in medical treatments, broad utilization of antibiotics, different factors, for example, expanding populaces at high danger of ailment, for example, more seasoned individuals and the individuals who are immunocompromised, delayed survival of numerous patients with ceaseless crippling sickness, expanded

utilization of obtrusive techniques, substantial utilization of antibiotics on ranches, where domesticated animals are regularly given drugs for non-therapeutic purposes, builds the dimension of safe microorganisms.

The genetic occasions regularly in charge of drug obstruction are either chromosomal mutations or move of extrachromosomal DNA from a safe animal types to a touchy one. The whole bacterial world can wager thought of as one gigantic multicellular life form in which the cells trade their qualities easily.

Chromosomal mutations happen suddenly in the quality that codes for drug opposition, however this is to a lesser degree a clinical issue than genetic exchange, due to the lower recurrence at which it happens. Genetic exchange can happen through an assortment of methods, which incorporate conjugation, change, transduction and transposons.

Staphylococcus aureus has turned out to be impervious to methicillin and other beta-lactam antibiotics by delivering a modified penicillin-restricting protein. This protein has an utilitarian job in the biosynthesis of the cell divider and methicillin has the impact of inactivating it. In safe strains an extra penicillin-restricting protein with a low liking to methicillin is created, rendering it ineffective (Michel and Gutmann 1997). Because of the various drug obstruction in numerous strains of MRSA, treatment is once in a while restricted to the glycopeptides vancomycin or teicoplanin.

II. EFFECT OF MRSA ON HEALTH PROFESSIONALS AND PATIENTS

Effect of MRSA Infection from a safe life form expands grimness and mortality chance for the patient just as healthcare costs. Contrasted with a methicillin-defenseless *S. aureus* (MSSA) infection, MRSA infections are related with an expansion in seriousness of illness (APACHE II Classification System), here and there requiring extra concentrated medical treatments (ventilation, careful debridement, hyperbaric therapy, detachment, and so on.), a decline in choices for anti-toxin therapy that is all the more expensive, frequently progressively harmful to the patient and now and again not as effective, an increment in hospital length of remain, and once in a while results with incapacitating grimness and even passing.

Mortality rates for passings including MRSA expanded more than 15-overlay during the period 1993to 2002. The quantity of death from Meticillin-safe Staphylococcus aureus (MRSA) fell by 20% from 364 out of 2011 to 292 out of 2012 by effective hand hygiene, clean environment and proper protective clothing.

In various investigations colonized or tainted health-care laborers were briefly expelled from patient consideration for shifting spans until documentation of negative follow-up culture was gotten. In addition, expulsion from patient consideration was actualized for longer timeframe if result stays positive. In the event that backslide happened, or if clear breaks in infection control norms were watched, similar to the case in a health-care laborer with incessant sinusitis engaged with a flare-up in a working theatre. One of the nurses positive with MRSA associated nearness with MRSA in her tonsils and had evacuated that on the grounds that to be flawless in healthcare workplace. Despite the fact that it was unsure whether MRSA was really present in her organ or not but rather after medical procedure she wound up MRSA negative.

III. MEASURES TO BE TAKEN FOR THE PREVENTION OF MRSA INFECTION

Effective hand hygiene is fundamental since contact is the principle method of infection. Handwashing is viewed as the most significant method of averting nosocomial infection. It evacuates transient living beings effectively and, when joined with a germ-free specialist, can considerably lessen quantities of occupant life forms. Be that as it may, healthcare specialists don't generally wash their hands as much of the time or as effectively as they should. This has been credited to an absence of time, deficiency of sinks and carelessness. At the point when time is at a higher cost than normal, liquor hand rubs have been observed to be effective.

Educating staff patients and hospital guests about significance of hand hygiene in hospital. Gould and Chamberlain (1995) additionally found an absence of learning and poor training to contribute factors in the spread of MRSA. This should be tended to, in any case, instructive projects have been hard to actualize in the work on setting, and momentary projects have been observed to be ineffective. Proceeding with training projects are required if this issue is to be maintained a strategic distance from.

Individual security Equipment (PPE) can be accomplished by wearing gloves and protective dispensable covers when handling patients and in their prompt environment. Wearing gloves does not block the requirement for handwashing, which ought to be performed when using.

Protective clothing Protective clothing ought to likewise be worn to help counteract the spread of small scale life forms through contact. The utilization of gloves has been examined above, yet nurses' garbs likewise become vigorously contaminated over the span of their

work. Outfits are not worn as insurance, in this way, dispensable covers or outfits ought to be worn. These ought to be disposed of between patients to forestall spread. Callaghan (1998) found that expendable covers had no effect on bacterial carriage on nurses' garbs. Notwithstanding, she presumed this was to some extent because of wrong use and an absence of comprehension of nosocomial infections and called for proceeding with instruction programs. Further examinations are required critically to discover the genuine effectiveness of wearing protective covers.

Clean environment - The job of the environment, which incorporates gear, in the transmission of MRSA ought not be overlooked. It has been recognized as a wellspring of infection since it goes about as a supply for MRSA. Staphylococcus aureus is a solid creature and has been disconnected on an assortment of articles. These incorporate the floor, bed cloth, patient outfits, bed tables, pulse sleeves and, all the more truly, the hands of staff who have had contact with the patient's environment, however not with the patient. In this way, specific consideration ought to be given to guarantee that the environment is clean fittingly, particularly any level surface. Indeed MRSA can be utilized as a marker to show the general effectiveness of cleaning. In any case, concerns have been express about the improvement of opposition disinfectant specialists and care should be practice in their utilization to avoid this.

IV. CONCLUSION

The pervasiveness of MRSA has been on the expansion since the 1980s. It is winding up perpetually hard to control, expanding the mortality and bleakness of patients and the expense of treating. Furthermore, there is the danger of an ascent in the right now untreatable vancomycin-safe Staphylococcus aureus, which could deliver dimensions of dreariness and mortality like that found in the pre-anti-microbial period.

The Nurses challenge is, accordingly, to stop the transmission of current safe living beings and counteract any new opposition creating. This could be accomplished by guaranteeing exacting adherence to the fundamental standards of infection control and creating proceeding with instructive projects that went for expanding the awareness of microorganisms and their control. The outcomes of not doing as such may be unfortunate.

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