Volume 5, Issue 3(II)
July - September 2018

ISSN 2394 - 7780

UGC
University Grants Commission
Journal No.: 63571

International Journal of
Advance and Innovative Research

Indian Academicians and Researchers Association
www.iaraedu.com

International Journal of Advance and Innovative Research

Volume 5, Issue 3 (II): July - September 2018

Journal - 63571

UGC Journal Details

Name of the Journal :	International Journal of Advance & Innovative Research
ISSN Number :	
e-ISSN Number :	23947780
Source:	UNIV
Subject:	Multidisciplinary
Publisher:	Indian Academicians and Researchers Association
Country of Publication:	India
Broad Subject Category:	Multidisciplinary

International Journal of Advance and Innovative Research

Volume 5, Issue 3 (II) : July – September 2018

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Research Papers

International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

A STOCHASTIC FRAMEWORK TO DETERMINE THE DEMAND FOR THE OPTIMAL RESERVE INVENTORY USING PARETO DISTRIBUTION

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ABSTRACT
National policy on employment does not allow any job holder to depose the worker once employed by the organization. It is very essential to recruit quality workers to meet the demand of the organization. An organization productivity is directly proportional to the quality and quantity of human resources. Only manpower planning can help the organization in this regard. Inefficient manpower planning could affect the overall goals of an organization. So need for trained employers are inevitable in any organization. Hence stochastic model is developed to determine the optimal size of reserve inventory of trained employers, considering three nodes namely training, placement in two section that is technical and administrative. The demand for manpower is of random character and hence random variables. The optimal size of reserve inventory of trained personnel is derived taking into account the concept of cost of overages and shortages. The basic inventory model discussed in Hanssmann(1962) is used.

Keywords: Manpower, Reserve inventory, Optimal size.

INTRODUCTION
An organization needs to efficiently utilize its workforce to maintain productively than to hire new employers to fulfill job needs within the organization. This process is an essential cornerstone in the efficient management of manpower stock or inventory. Therefore manpower planning process is an ongoing and continuous strategy through a systematic set of procedures.

The basic model obtain the optimal reserve inventory between two machines in series has been discussed by Hanssman (1962). Ramachandiran and Sathiyamoorthi (1981) have discussed a different model using the same concept. Sachithanantham, Ganesan and Sathiyamoorthi (2007) has discussed a model for optimal reserve between two machine with repair time satisfy the SCBZ property. Sehik Uduman etl.(2007) have discussed a model for the determination of optimal reserve inventory between two machines in series in order statistics.

During the time of breakdown the deficit of manpower will have a greater consequence on the potential profit of organization. Therefore a resource inventory of trained personal should be optimal between the first node J_1 and the two nodes in the second stage i.e., J_2^a and J_2^b. So that, the organization will bear a maximum potential profit. The expression for the optimal size of manpower inventory is obtained under the following assumptions.

(i) J_1 is the basic node and the persons are trained in their respective job.

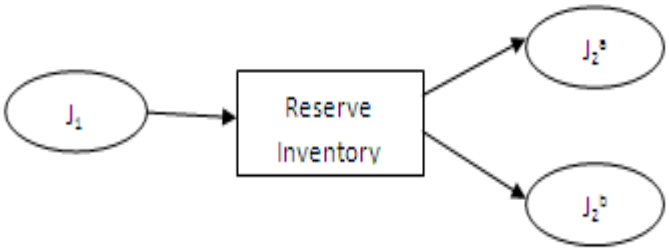
(ii) There are two nodes J_2^a and J_2^b where the trained personnel are employed to compute administration and technical work.

(iii) A reserve inventory of trained personal is kept in between the node J_1 and the two nodes J_2^a and J_2^b in the certain stage.

(iv) whenever there is a breakdown in J_1 for a random duration.

(v) The supply of the manpower to the two nodes J_2^a and J_2^b is from the reserve inventory of manpower.

The following is the diagram which depicts the model



The optimal size of the reserve inventory of the manpower. It derived assuming that, the duration of breakdown of node J_1 follows pareto distribution.

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NOTATIONS IN THE MODEL

S - is the reserve of level of manpower inventory

$\hat{S}$ - is the optimal reserve inventory.

X - a continuous random variable which denotes the breakdown duration of node N_1 with pdf *f(x)* and cdf *F(x)* and its follows skew logistic distribution.

μ - average of the interarrival times between breakdowns of node N_1.

$\frac{1}{\mu}$ - average number of breakdowns per unit time

τ - a random variable which denotes the duration of breakdown of system are node N_1.

h - cost of holding of reserve inventory of manpower per man hour.

d_1, d_2 - the cost of breakdown of work in nodes N_2^a and N_2^b respectively.

r_1, r_2 - the level of utilizations of manpower in the two nodes namely N_2^a and N_2^b.

MODEL DESCRIPTION AND RESULTS

IDLE TIME OF J_2^a AND J_2^b

The idle time of machines J_2^a and J_2^b during a breakdown of machine J_1 will be

$$t = \begin{cases} 0 & if \quad \tau < \frac{s}{r_1+r_2} \\ \tau - \frac{s}{r_1+r_2} & if \quad \tau > \frac{s}{r_1+r_2} \end{cases}$$

Consequently, the expected cost of idle time per breakdown is

$$(d_1 + d_2) \int_{\frac{s}{r_1+r_2}}^{\infty} (\tau - \frac{s}{r_1+r_2})\, g(\tau) d\tau$$

We get the optimal solution as below

$$E(c) = h(r_1 + r_2) \int_k^{\frac{s}{r_1+r_2}} (\frac{s}{r_1+r_2} - \tau)\, g(\tau) d\tau + \left(\frac{d_1+d_2}{\mu}\right) \int_{\frac{s}{r_1+r_2}}^{\infty} (\tau - \frac{s}{r_1+r_2})\, g(\tau) d\tau$$

Now, applying the Leibnitz's rule of differentiation of integrals and

equation $\frac{dE(c)}{ds} = 0$ for optimality,

$$= \frac{d}{ds}\left[h(r_1 + r_2) \int_k^{\frac{s}{r_1+r_2}} (\frac{s}{r_1+r_2} - \tau) \frac{\alpha k^{\alpha}}{\tau^{\alpha+1}} d\tau + \left(\frac{d_1+d_2}{\mu}\right) \int_{\frac{s}{r_1+r_2}}^{\infty} (\tau - \frac{s}{r_1+r_2}) \frac{\alpha k^{\alpha}}{\tau^{\alpha+1}} d\tau \right] \quad \ldots(1)$$

$$I_1 = \frac{d}{ds}\left[\int_k^{\frac{s}{r_1+r_2}} (\frac{s}{r_1+r_2} - \tau) \frac{\alpha k^{\alpha}}{\tau^{\alpha+1}} d\tau \right]$$

$$I_2 = \frac{d}{ds}\left[\int_{\frac{s}{r_1+r_2}}^{\infty} (\tau - \frac{s}{r_1+r_2}) \frac{\alpha k^{\alpha}}{\tau^{\alpha+1}} d\tau \right]$$

Differentiating (I_1) by using Leibnitz's rule of differentiation of an integral, we get,

$$I_1 = \frac{1}{r_1+r_2} f[0] + 0[\,] + \frac{d}{ds} \int_k^{\frac{s}{r_1+r_2}} (\frac{s}{r_1+r_2} - \tau) \frac{\alpha k^{\alpha}}{\tau^{\alpha+1}} d\tau$$

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$$= \frac{1}{r_1+r_2}\int_{k}^{\frac{s}{r_1+r_2}} \frac{\alpha k^{\alpha}}{\tau^{\alpha+1}}\,d\tau$$

$$= \frac{\alpha k^{\alpha}}{r_1+r_2}\int_{k}^{\frac{s}{r_1+r_2}} (\tau)^{-(\alpha+1)}\,d\tau$$

$$= \frac{\alpha k^{\alpha}}{r_1+r_2}\left[\frac{(\tau)^{-\alpha-1+1}}{-\alpha-1+1}\right]_{k}^{\frac{s}{r_1+r_2}}$$

$$I_1 = -\left(\frac{k}{s}\right)^{\alpha}\left[\frac{(r_1+r_2)^{\alpha}}{r_1+r_2}\right] + \frac{1}{r_1+r_2} \qquad \ldots. (2)$$

Differentiating (I_2) by using Leibnitz's rule of differentiation of an integral, we get,

$$I_2 = 0[\,] - \frac{1}{r_1+r_2}[0] + \frac{d}{ds}\int_{\frac{s}{r_1+r_2}}^{\infty}\left(\tau - \frac{s}{r_1+r_2}\right)\frac{\alpha k^{\alpha}}{\tau^{\alpha+1}}\,d\tau$$

$$= \frac{-1}{r_1+r_2}\int_{\frac{s}{r_1+r_2}}^{\infty} \frac{\alpha k^{\alpha}}{\tau^{\alpha+1}}\,d\tau$$

$$= \frac{-\alpha k^{\alpha}}{r_1+r_2}\int_{\frac{s}{r_1+r_2}}^{\infty} (\tau)^{-(\alpha+1)}\,dt$$

$$= \frac{-\alpha k^{\alpha}}{r_1+r_2}\left[\frac{(\tau)^{-\alpha-1+1}}{-\alpha-1+1}\right]_{\frac{s}{r_1+r_2}}^{\infty}$$

$$I_2 = = -\left(\frac{k}{s}\right)^{\alpha}\left[\frac{(r_1+r_2)^{\alpha}}{r_1+r_2}\right] \qquad \ldots.(3)$$

Substituting equation (2) and (3) in equation (1) we get ,

$$= h(r_1+r_2)\left[-\left(\frac{k}{s}\right)^{\alpha}\left[\frac{(r_1+r_2)^{\alpha}}{r_1+r_2}\right] + \frac{1}{r_1+r_2}\right] + \left(\frac{d_1+d_2}{\mu}\right)\left[-\left(\frac{k}{s}\right)^{\alpha}\left[\frac{(r_1+r_2)^{\alpha}}{r_1+r_2}\right]\right]$$

$$= -h\left(\frac{k}{s}\right)^{\alpha}(r_1+r_2)^{\alpha} + h - \left(\frac{d_1+d_2}{\mu}\right)\left(\frac{k}{s}\right)^{\alpha}\left[\frac{(r_1+r_2)^{\alpha}}{r_1+r_2}\right]$$

$$= \left(\frac{k}{s}\right)^{\alpha}(r_1+r_2)^{\alpha}\left[-h - \left(\frac{d_1+d_2}{\mu}\right)\frac{1}{r_1+r_2}\right] + h$$

ie, $\frac{dE(c)}{ds} = 0$

$$\Rightarrow \left(\frac{k}{s}\right)^{\alpha}(r_1+r_2)^{\alpha}\left[-h - \left(\frac{d_1+d_2}{\mu}\right)\frac{1}{r_1+r_2}\right] = -h$$

$$\Rightarrow \left(\frac{k}{s}\right)^{\alpha}(r_1+r_2)^{\alpha} = \frac{h}{\left[h + \left\{\frac{d_1+d_2}{\mu(r_1+r_2)}\right\}\right]}$$

$$\Rightarrow \left(\frac{k}{s}\right)^{\alpha} = \frac{h\mu(r_1+r_2)}{h\mu(r_1+r_2)+(d_1+d_2)} \times \frac{1}{(r_1+r_2)^{\alpha}}$$

$$\Rightarrow \frac{s^{\alpha}}{k^{\alpha}} = \frac{h\mu(r_1+r_2)+(d_1+d_2)}{h\mu(r_1+r_2)} \times \frac{(r_1+r_2)^{\alpha}}{1}$$

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$$\Rightarrow \frac{s^{\alpha}}{k^{\alpha}} = (r_1 + r_2)^{\alpha} + \frac{(d_1 + d_2)}{h\mu} \times \frac{(r_1 + r_2)^{\alpha}}{(r_1 + r_2)}$$

$$\Rightarrow s^{\alpha} = k^{\alpha}\,(r_1 + r_2)^{\alpha} + k^{\alpha}\,\frac{(d_1 + d_2)}{h\mu} \times \frac{(r_1 + r_2)^{\alpha}}{(r_1 + r_2)}$$

$$\Rightarrow \hat{s} = \left[\; k^{\alpha}\,(r_1 + r_2)^{\alpha} + k^{\alpha}\,\frac{(d_1 + d_2)}{h\mu} \times \frac{(r_1 + r_2)^{\alpha}}{(r_1 + r_2)} \;\right]^{\frac{1}{\alpha}}$$

$$\Rightarrow \hat{s} = k\,(r_1 + r_2)\left[\; 1 + \frac{(d_1 + d_2)}{h\mu} \times \frac{1}{(r_1 + r_2)} \;\right]^{\frac{1}{\alpha}}$$

NUMERICAL ILLUSTRATION

Table-1: The optimal value of $\hat{s}$ can be found out using the above equation. Effect the changes in "h" with all the other parameter being kept fixed.

h	20	30	40	50	60
$\hat{s}$	132.66	130.13	128.85	128.09	127.57

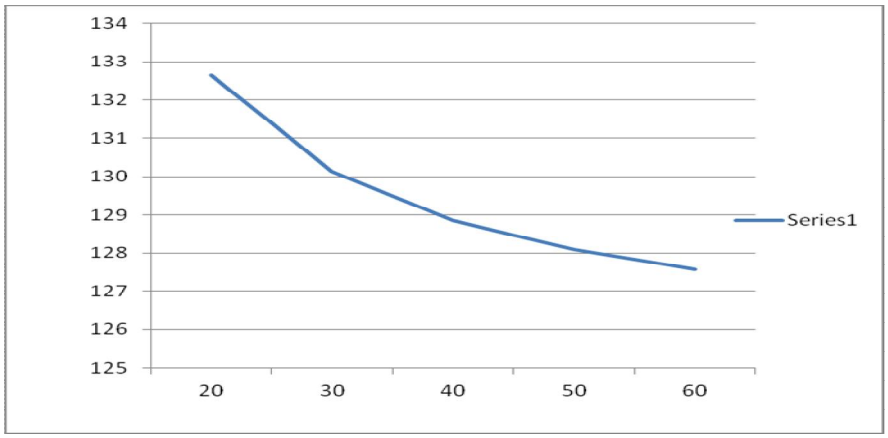

Fig-1

Table-2: The optimal value of $\hat{s}$ can be found out using the above equation. Effect the changes in "d" with all the other parameter being kept fixed.

d	40	50	60	70	80
$\hat{s}$	132.66	133.74	134.80	135.87	136.94

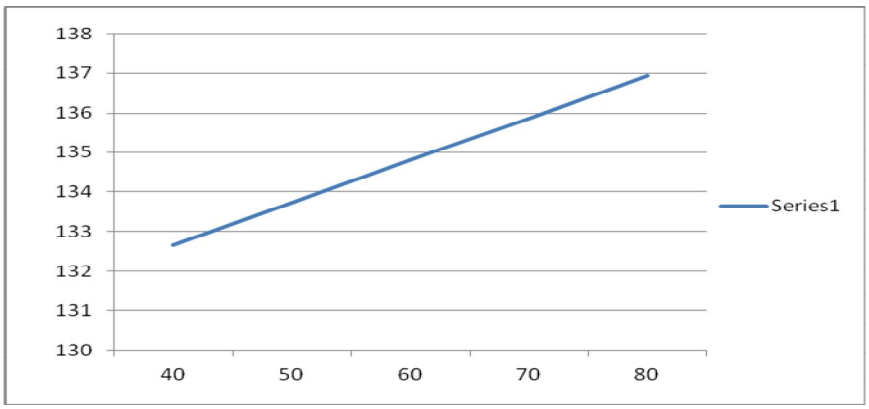

Fig-2

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Table-3: The optimal value of $\hat{s}$ can be found out using the above equation. Effect the changes in "μ" with all the other parameter being kept fixed.

μ	1.5	2.5	3.5	4.5	5.5
$\hat{s}$	132.66	129.62	128.31	127.57	127.11

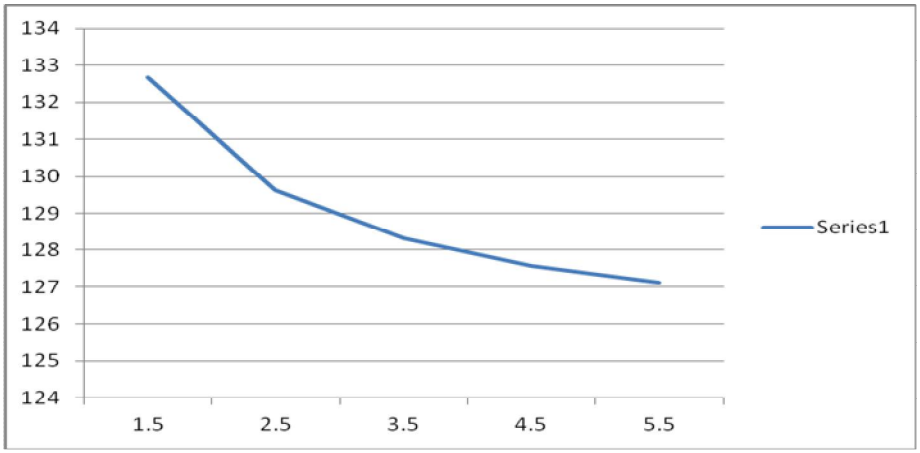

Fig-3

CONCLUSION

On the basic of the numerical examples worked out the following conclusion can be drawn

(i) If there is an increases in the inventory holding cost of manpower 'h' then ' $\hat{s}$ ' the optimal solution decreases . So smaller reserve of manpower is required as the cost of manpower holding is higher.

(ii) If 'd' cost of breakdown of work increases, then the value of ' $\hat{s}$ ' also increases. This shows, if the cost of shortage of manpower holding is higher, then a higher level of stock manpower is required.

(iii) μ denotes average time interval between the successive breakdowns of Job-1. If μ increases the time interval between breakdowns is on the increases. Therefore, the smaller reserve inventory of manpower is suggested.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

A STUDY ON CHALLENGES AND OPPORTUNITIES OF E-BANKING SERVICES IN INDIA

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ABSTRACT
Financial sector plays an important role in the economic development of a country. Banking is the lifeline of an economy. A strong and healthy banking system is important requirement for economic growth. he implementation of internet in banking organizations has modernized the banks. Implementing the internet banking approach has benefited the both i.e. consumers as well as banks. Considering the benefits, the banks all over the globe have implemented the internet banking and banking organizations in India are no exception. The competition among the banks has led to the increasing total banking automation in the Indian banking industry. E-Banking is a generic term encompassing internet banking, telephone banking, mobile banking etc. The E-Banking services are executed only upon the customer, and these e-banking services would fully integrate with the core banking solution that is already in usage. The objective of the present paper is to examine and analyze the progress made by Internet Banking in India.

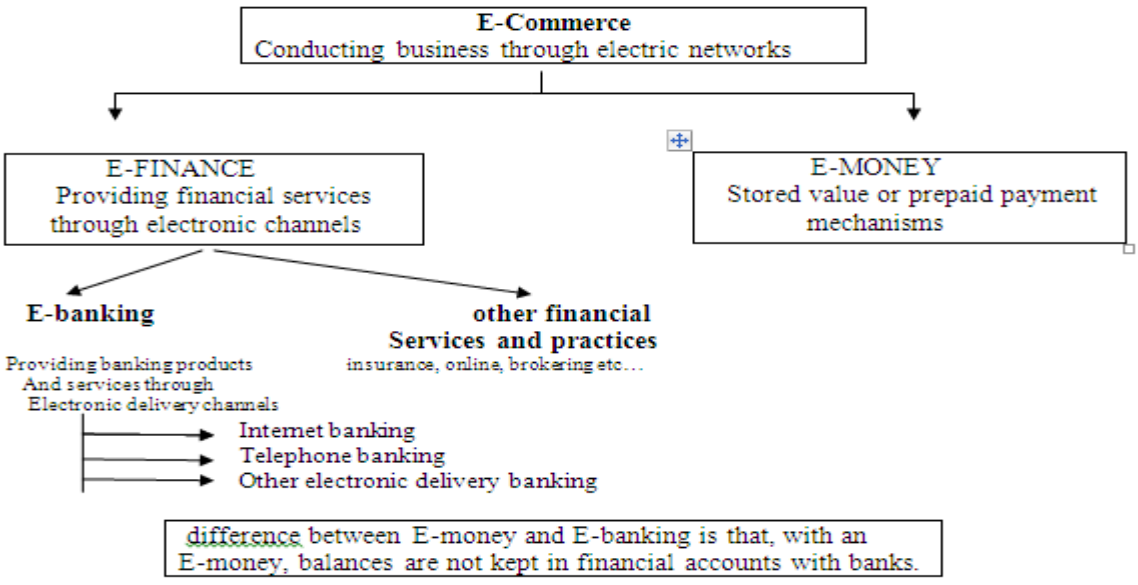
Keywords: Internet banking, Benefits, Challenges and Opportunities, India.

INTRODUCTION
The banks have become an essential component of most of the economies as banking services are described as "engines for economic growth" or act as "conduits towards promoting economic growth" . In recent years the world economy has gone through a new phenomenon which is considered as one the most important changes since the industrial revolution, i.e. The birth of "Internet-based Economy" . Considering the benefits of using internet the banks have started to invest in this newly created market. At the initial level, banks mainly focus on developing the commercial web- sites, with the purpose of promoting their products and services using the internet. Gradually, it was realized by banks that the Internet can be an effective distribution channel too. Now with the changing times the traditional approach of banking is being changed and banks are trying to match up with the recent advancement in the field of technology.

With the rapid development of technology, internet plays a significant role in changing the banking scenario. It provides an online platform for various banking transactions through which it offers various services like online payment, online fund transfer, online stock trading and online shopping etc. The use of internet as a delivery channel for banking services is increasing widely in banking sector. Internet banking facilities enable financial institution and customers to access their accounts, transactions and getting information on financial products & services. Now a day's most of the banks have launched various services through internet banking including latest service like opening, online saving accounts and demand for these services is increasing rapidly.

The concept of e-banking is fairly a new concept in India as compared to its developed counterparts. So the paper deals with defining the concept of Internet banking.

WHAT IS E-BANKING?



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OBJECTIVES OF THE STUDY

- To study the current status of financial innovations in banking sector.
- To identify various e-banking services/products adopted by India.
- To study the opportunities and challenges available in E-banking.
- To recommend the government role on establishing E-Banking.
- To suggest policy implications to make E-Banking more effective.

CURRENT STATUS OF E-BANKING IN INDIA

Internet Banking has become an integral part of banking system in India. The few of the initiatives taken by the banks for internet banking are mentioned below:

1. The banks of India recently launched its card-less cash withdrawal service. This facility helps customers to send money to anyone using Internet banking or by using ATM, with the help of receivers mobile number.
2. The Business Transformation Program is being implemented by the Bank which will provide its customer convenience banking on a 24 X 7 basis in India and abroad with integrated delivery channels like Internet, Phone, Mobile, and others.
3. A number of banks have implemented Online Tax Accounting System (OLTAS) for collection of taxes on behalf of Central Board of Direct Taxes, Government of India.
4. The banks are making their presence on social media like Facebook and Twitter for targeting huge customer base as well as potential customers; there will be round-the-clock tweets and comments on the bank‟s products and services.
5. Bank has also introduced E-Locker for its customers.

The banks offer to their customers, the following e-banking products and services are

- Automated Teller Machines (ATMs)
- Internet Banking
- Mobile Banking
- Phone Banking
- Tele banking
- Electronic Clearing Services
- Electronic Clearing Cards
- Smart Cards
- Door Step Banking
- Electronic Fund Transfer

CHALLENGES IN E-BANKING

- **Security Risk:** The problem related to the security has become one of the major concerns for banks. A large group of customers refuses to opt for e-banking facilities due to uncertainty and security concerns. The internet users are not using internet banking in India because of security concerns. So it's a big challenge for marketers and makes consumers satisfied regarding their security concerns, which may further increase the online banking use.
- **The Trust Factor:** Trust is the biggest hurdle to online banking for most of the customers. Conventional banking is preferred by the customers because of lack of trust on the online security. They have a perception that online transaction is risky due to which frauds can take place.
- **Customer Awareness:** Awareness among consumers about the E-banking facilities and procedures is still at lower side in Indian scenario. Banks are not able to disseminate proper information about the use, benefits and facility of internet banking. Less awareness of new technologies and their benefits is among one of the most ranked barrier in the development of E-banking.

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- **Privacy risk:** The risk of disclosing private information & fear of identity theft is one of the major factors that inhibit the consumers while opting for internet banking services. Most of the consumers believe that using online banking services make them vulnerable to identity theft..
- **Strengthening the public support**: In developing countries, in the past, most e-finance initiatives have been the result of joint efforts between the private and public sectors. The World Bank, be developed to enable public support for e-finance related initiatives.
- **Availability of Personnel services**: In present times, banks are to provide several services like social banking with financial possibilities, selective up gradation, computerization and innovative mechanization, better customer services, effective managerial culture, internal supervision and control, adequate profitability, strong organization culture etc.
- **Implementation of global technology**: There is a need to have an adequate level of infrastructure and human capacity building before the developing countries can adopt global technology for their local requirements.
- **Non- Performing Assets (NPA)**: Non performing assets are another challenge to the banking sector. Vehicle loans and unsecured loans increases N.P.A. Every bank have to take care about regular repayment of loans.
- **Competition**: Competition in banking sector brings various challenges before the banks such as product positioning, innovative ideas and channels, new market trends, cross selling ad at managerial and organizational part this system needs to be manage, assets and contain risk.
- **Handling Technology**: Developing or acquiring the right technology, Early adopters of technology acquire significant competitive advances Managing technology is therefore, a key challenge for the Indian banking sector.

OPPORTUNITIES IN E-BANKING

- **Untapped Rural Markets**: Contributing to 70% of the total population in India is a largely untapped market for banking sector. In all urban areas banking services entered but only few big villages have the banks entered.
- **Multiple Channels**: Banks can offer so many channels to access their banking and other services such as ATM, Local branches, Telephone/mobile banking, video banking etc. to increase the banking business.
- **Competitive Advantage:** The implementation of e-banking is beneficial for bank in many ways as it reduces cost to banks, improves customer relation , increases the geographical reach of the bank , etc.
- **Internet Users & Computer Literacy:** To use internet banking it is very important or initial requirement that people should have knowledge about internet technology. so that they can easily adopt the internet banking services. The fast increasing internet users in India can be a very big opportunity and banking industry should encash this opportunity to attract more internet users to adopt internet banking services.
- **Worthy Customer Service**: Worthy customer services are the best brand ambassador for any bank for growing its business. Every engagement with customer is an opportunity to develop a customer faith in the bank. While increasing competition customer services has become the backbone for judging the performance of banks.
- **Internet Banking**: It is clear that online finance will pickup and there will be increasing convergence in terms of product offerings banking services, share trading, insurance, loans, based on the data warehousing and data mining technologies.

REVIEW OF LITERATURE

E-banking include: customer acceptance and satisfaction, privacy concerns, profitability, operational risks, and competition from nonbanking institutions. Between 1995 and 2003, e-banking increased eightfold. E-banking defined as the delivery of banking services through the open-access computer network directly to customers‟ home or private address. Simpson (2002) suggests that e-banking is driven largely by the prospects of operating costs minimization and operating revenues maximization. A comparison of online banking in developed and emerging markets reveal that in developed markets lower costs and higher revenues are more noticeable. E-banking links business to customers no matter their geographical location. It allows companies to make new business contacts from different global business alliances, test new products and services, and make market research and other enquiries all at a minimal cost both financial and otherwise (Shin, 2008).

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A more recent e-banking development is wireless internet applications of banking sometimes called m-banking (mobile banking) (Choi et al., 2006; Scornavacca and Hoehle, 2007). With the combination of two most recent technological advancements – internet and mobile phone, a new service (mobile data service) is thus enabledand K.T. Ahmed the first such wireless internet commercial transaction is performed by the banking industry (Barnes and Corbitt, 2003). E-banking also can increase competition among banks, and allows banks to penetrate new markets and thus expand their geographical reach.

RESEARCH METHODOLOGY

The research survey was answered by a mix group of people among the customers of the Banks. The survey was conducted through questionnaires to a group of people and only 100 respondents filled in our survey that focused on gathering information about awareness, usage of and expectations about the internet banking. In this study convenience-sampling method is used, thus the respondents were randomly selected.

A. Research Question

This study is aimed at finding out whether the respondents are aware about internet and banking services and whether they use their knowledge of hassle free banking or they are abided by habits customs and routines.

B. Sample size

Sample sizes of 100 respondents were selected for this study.

C. Data Collection

Data will be collected from both primary and secondary sources of information.

DATA ANALYSIS AND FINDING

The Following table describes the demographic profile of the respondents which consists of gender, age, level of education. From a total of 100 questionnaires received. According to our analysis of the demographic characteristics of the respondents we can say that, 36% of the respondents are between the ages of 20 and 29 and 29% is between the age of 30 and 39. 15% of the respondents are between the ages of 40 and 49, 14% of the respondents are between the ages of 50 and 59.Then the remaining 6% is higher than the 60 years old. Within the respondents 45% are female and remaining 55% is male. If we check the education level of the respondents we can say that, 45% hold Bachelor Degree, 35% hold Master degree & 20% hold PhD, it is found that Bachelor degree respondent are using highest e-banking.

	Internet banking users	**Percentage (%)**
GENDER		
Male	55	35 %
Female	45	65 %
Age		
20-29	36	36 %
30-39	29	29 %
40-49	15	15 %
50-59	14	14 %
60-69	6	6 %
Education		
Bachelor	45	45 %
Master	35	35 %
Ph.d	20	20 %

Finding shows that there is no any significance difference between Awareness of e-banking & usage of e-banking

Services	**ATM**	**Debit card**	**Credit card**	**Tele banking**	**Smart card**	**Mobile banking**
Users who use these services	94	52	68	51	31	74

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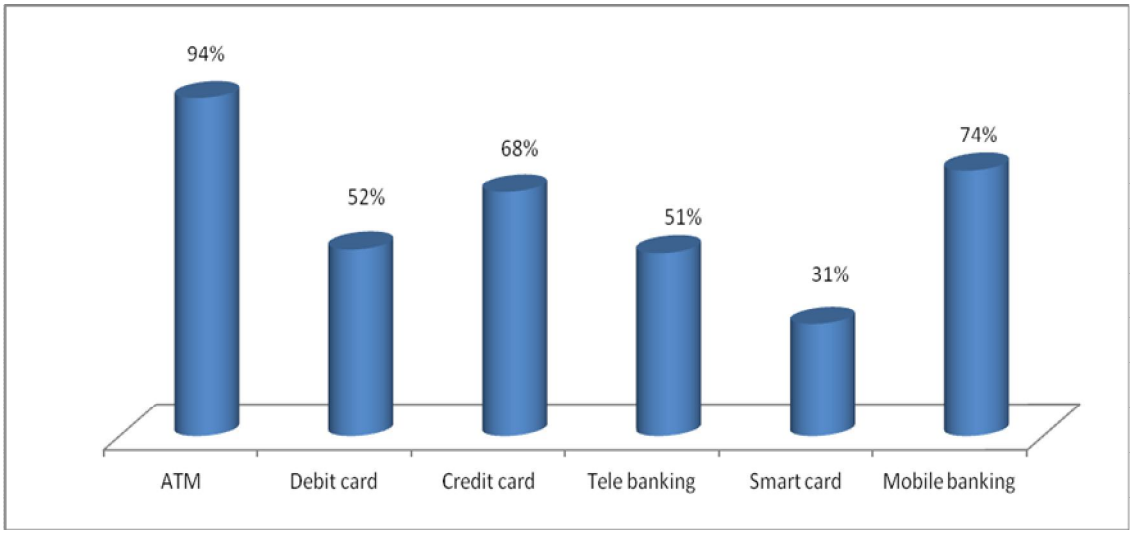

FINDINGS SHOWS THAT ALL CONSUMERS ARE USING WWW MORE THAN A ONE YEAR

- ✓ 88% consumers are visit 1-4 times in a month & 12% consumers are never visit branch of the Bank.
- ✓ There is 76% consumer are using ATM for 1-4 times in a month.& 18% consumer are use over period of 12 months & 6% consumers are never use ATM.
- ✓ There is 34% consumers are using debit card for 1-4 times in a month & 18% consumers are using 5-8 times in a month & 48 % respondents are not using a debit card services.
- ✓ There is 32% consumers are using tele-banking for 1-4 times in a month & 19% consumers are using 5-8 times in a month & 49% respondents are not using a tele-banking services
- ✓ There is 19% consumers are using smart card for 1-4 times in a month & 12% consumers are using 5-8 times in a month & 69% respondents are not using a smart card services.
- ✓ There is 32% consumers are using credit card for 1-4 times in a month & 36% consumers are using 5-8 times in a month & 32% respondents are not using a credit card services.
- ✓ There is 46% consumers are using mobile banking for 1-4 times in a month & 28 % consumers are using 5-8 times in a month & 26% respondents are not using a mobile banking services.
- ✓ Main reason for visiting a bank branch is to make a Deposit with highest % is 40 %.

SUGGESTIONS

The following suggestions are recommended for enhancing e-banking / internet banking services of banks to the customers

1) Banks should take necessary steps to create awareness among rural people about the advantages of e-banking / internet banking services available in the banks.
2) The e-banking / internet banking system should be enhanced to make the online enquiry and online payment much more easier to the customers.
3) Though e-banking / internet banking is convenient and easy to use, customers are afraid of adopting these services because they think that using these “services are difficult and complicated”. So, on-site training can be provided to the bank customers who intend to use e-banking / internet banking services.

CONCLUSION

There's no doubt that the advent of the internet has made a positive impact in the lives of many people. And not only individuals have benefited from this technological advancement because various industries have felt its great influence as well. The banking industry is just one of the many sectors on the commercial side that has embraced the internet. The adoption of Internet banking in India will have its own advantages to both the banks and the ultimate customers. The use of information technology will not only reduce the costs of operation but also would be effective, easy to maintain, speedier and highly competitive. The challenges posed by the Internet banking are mostly of procedural nature, which can be easily counterbalanced by adopting suitable technological and security measures. There can be no doubt about the enormous potential and emancipated opportunities offered by advances in technology. However, there are prerequisites and preparations, which have to be made before the full benefits of the technology can be harvested.

International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

APPLICATION OF STOCHASTIC PROCESS MODELS FOR SOFTWARE RELIABILITY ANALYSIS

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ABSTRACT
Stochastic process model for software reliability received much attention in recent literature. It is demonstrated that in certain cases the ML estimators do not exist despite the fact that sufficient information in the form of a large number of faults observed in many cases. The methods proposed yield satisfactory estimates of unknown parameters and can be also applied in some process models in which the ML estimators do not exist. In this paper, it is proposed study the estimation method for Stochastic Process models for software reliability. Numerical examples are also provided.

1. INTRODUCTION
Stochastic process model for software reliability received much attention in recent literature. It is demonstrated that in certain cases the ML estimators do not exist despite the fact that sufficient information in the form of a large number of faults observed in many cases. The methods proposed yield satisfactory estimates of unknown parameters and can be also applied in some process models in which the ML estimators do not exist. In this paper it is proposed study the estimation method for Stochastic Process models for software reliability.

CASE (i)

The Model

If {N(t), t ≥ 0} be a NHPP with intensity function, λ(t) and the mean value function then $\Delta(t) = \int_0^t \lambda(u)\,du$ (cumulative intensity) has bounded mean value function, this is the reason for which this model is more appropriate as a software reliability model than the NHPP's with unbounded mean value function, because a software system contains only a finite number of faults.

$$\gamma(t) = \lambda(t|F_{t-}) = \lim_{\Delta t \downarrow 0} \frac{P(\text{failure in a pont process in } [t, t+\Delta t)|F_{t-})}{\Delta t}, \quad t > 0, \quad and \quad \ldots (1)$$

As alternative to the ML method, for estimating parameters α and β of the NHPP with the mean value function (t; α, β) one can use the LS method. The LS and/or the CLS method can be applied to the models for which the ML method fails. The LS and CLS methods can also be used to predict the next failure time. The methods proposed will be applied to the general NHPP software reliability model defined by (1) and, in particular, to the NHPP software reliability model defined by the following

$$\Delta(t;\ \alpha,\beta) = \alpha\left[1 - \exp(-\frac{t}{\beta})\sum_{j=0}^{k}\frac{(\frac{t}{\beta})^j}{j!}\right], \quad \alpha,\beta > 0, \quad and \quad \ldots (2)$$

$$\lambda(t;\ \alpha,\beta) = \frac{\alpha(\frac{t}{\beta})^k}{\beta k!}\exp\left(-\frac{t}{\beta}\right) \quad \ldots (3)$$

The model defined by (2) is a special case of the equation (1) and was first mentioned in the paper of Khoshgoftaar (1988). It is called the k-stage Erlangian NHPP software reliability model .For a detailed study, refer to Khoshgoftaar (1988).

2. PROCEDURES OF RELIABILITY ANALYSIS
The procedures of reliability analysis based on the proposed software reliability models are shown as follows

(i). The software managers process the fault data in terms of the cumulative number of detected faults in the testing-phase of open source solution for reliability analysis.

(ii). The software managers estimate the unknown parameters a, b, w , and s included in the proposed stochastic differential equation model by using the method of maximum-likelihood.

(iii). The software managers can compare the proposed stochastic differential equation models with two typical conventional stochastic differential equation models using AIC, MSE, and the predicted relative error.

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(iv). It is useful for the software managers to understand the debugging progress in testing-phase of open source solution development by using the expected number of detected faults, the sample path of detected faults, the expected number of remaining faults, and mean time between failures as software reliability assessment measures.

3. RELIABILITY ANALYSIS TOOL

The specification requirement of the reliability analysis tool are shown as follows

(i). This tool should be operated by clicking the mouse button and typing on the keyboard to input the data through graphical user interface system.

(ii). Open source Flex software development kit should be used to implement the program. This tool is developed as a standalone

(iii). Adobe Integrated Runtime application on Windows, Unix, and Macintosh operating system operating system. Also, this tool operates as Web application.

(iv). This tool treats the proposed stochastic differential equation models for open source solution and the conventional stochastic differential equation models, and illustrate the expected number of detected faults, the sample path of detected faults, the predicted relative error, the expected number of remaining faults, and the cumulative mean time between failures as software reliability assessment measures.

Further it was pointed out that

(v). This tool processes the data file in terms of the software fault-detection count data in the testing-phase of the open source solution for reliability analysis.

(vi). The data set obtained from the testing-phase is analyzed.

(vii). This tool estimates the unknown parameters included in the proposed stochastic differential equation models and the conventional stochastic differential equation models. Also, the estimation results of model parameters are shown on the menu window of the developed tool.

(viii). This tool illustrates the expected number of detected faults, the sample path of detected faults, the predicted relative error, the expected number of remaining faults, and the cumulative mean time between failures as software reliability assessment measures.

4. ML METHOD FOR THE SOFTWARE RELIABILITY MODEL

In particular, for the NHPP with the mean value function _(t; ϑ), ϑ = (α, β), the likelihood function based on the observed arrival times $t_1, t_2, \ldots, t_{N(T)}$ and N(T) takes the form

$$L(\alpha,\beta) \propto \exp\left[-\alpha F(T/\beta)\right]\left(\frac{\alpha}{\beta}\right)^{N(T)}\prod_{i=1}^{N(T)} f\left(\frac{t_i}{\beta}\right)$$

and the log-likelihood function is

$$\log L(\alpha,\beta) \propto -\alpha F\left(\frac{T}{\beta}\right) + N(T)\log\left(\frac{\alpha}{\beta}\right) + \sum_{i=1}^{N(T)} f\left(\frac{t_i}{\beta}\right) \quad \ldots (4)$$

The value of α maximizing the log likelihood function is

$$\alpha = \frac{N(T)}{F(T/\beta)} = \alpha\, ML(\beta) \quad \ldots (5)$$

Substituting this value into formula (6.3) yields

$$\log L(\alpha\, ML(\beta),\beta) \propto -N(T) + N(T)\log\left[\frac{N(T)}{\beta F(T/\beta)}\right] + \sum_{i=1}^{N(T)} f\left(\frac{t_i}{\beta}\right)$$

The ML estimators $\hat{\alpha}$ ML and $\hat{\beta}$ ML of α and β are determined by

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$$\hat{\alpha}\ ML = \frac{N(T)}{F\left(T/\hat{\beta}\,ML\right)} \qquad \ldots (6)$$

and the $\hat{\beta}$ ML which maximizes

$$\frac{\hat{L}(\beta)=N(T)\log\left[\frac{N(T)}{\beta F\left(\frac{T}{\beta}\right)}\right]+\sum_{i=1}^{N(T)}\log(t_i)}{\beta} \qquad \ldots (7)$$

with respect to β.

In particular, for the k-stage Erlangian NHPP software reliability model defined in equ (2), formulae equ (6) and equ. (7) take the following form

$$\hat{\alpha}_{ML} = \frac{N(T)}{1-exp\left(-\frac{T}{\hat{\beta}}ML\right)\sum_{j=0}^{k}\frac{\left(\frac{T}{\hat{\beta}}ML\right)^j}{j!}} \qquad \ldots (8)$$

$$\hat{L}(\beta) = N(T)\log\left[\frac{N(T)}{\beta\left[1-exp\left(-\frac{T}{\beta}\right)\right]\sum_{j=0}^{k}\frac{\left(\frac{T}{\hat{\beta}}ML\right)^j}{j!}}\right]+\sum_{i=1}^{N(T)}\log\frac{(t_i/\beta)^k}{k!}-\sum_{i=1}^{N(T)}\left(\frac{t_i}{\beta}\right) \qquad \ldots (9)$$

For the model with k = 0, formulae (8) and (9) have the following simple form

$$\hat{\alpha}_{ML} = \frac{N(T)}{1-exp\left(-\frac{-T}{\hat{\beta}_{ML}}\right)} \qquad \ldots (10)$$

$$\hat{L}(\beta) = N(T)\log\left[\frac{N(T)}{\beta\left[1-exp\left(-\frac{T}{\beta}\right)\right]}\right]-\sum_{i=1}^{N(T)}\left(\frac{t_i}{\beta}\right) \qquad \ldots (11)$$

5. THE LS AND CLS METHODS AS ALTERNATIVES TO THE ML METHOD

The ML estimators of the parameters α and β of the equ. (12) do not always exist. In particular, it follows from of Zhao and Xie (1996) that for the model defined in equ. (2) the ML estimators do not exist with the probability $P\left(\frac{1}{N(T)}\sum_{i=1}^{N(T)}t_i \geq \frac{k+1}{K+2}T\right)$, where N(T) is the number of arrives up to time T and $t_1, \ldots, t_{N(T)}$ are the arrival times observed.

$\Delta(t; \alpha, \beta) = \alpha F(t/\beta)$, . . . (12)

$$S_{LS}^2(\theta) = \sum_{i=1}^{N(T)}[\Delta(t_i;\theta)-\Delta(t_{i-1};\theta)-1]^2 \qquad \ldots (13)$$

6. THE LS METHOD FOR THE SOFTWARE RELIABILITY MODEL

For the NHPP with the cumulative intensity function defined by equ.(12) the sum of squares of equ. (13) takes the following form

$$S_{LS}^2(\alpha,\beta) = \sum_{i=1}^{N(T)}[\Delta(t_i;\alpha,\beta)-\Delta(t_{i-1};\alpha,\beta)-1]^2$$

$$= \sum_{i=1}^{N(T)}\left[\alpha F\left(\frac{t_i}{\beta}\right)-\alpha F\left(\frac{t_{i-1}}{\beta}\right)-1\right]^2$$

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$$= \alpha^2 \sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right]^2 - 2\alpha F\left(\frac{t_{N(T)}}{\beta}\right) + N(T) \quad \ldots(14)$$

Equ. (14) regarded as a trinomial with respect to α is minimized by

$$\alpha = \alpha_{LS}(\beta) = \frac{F\left(\frac{t_{N(T)}}{\beta}\right)}{\sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right]^2}$$

Substituting this value into Equ. (14) gives

$$S_{LS}^2(\alpha_{LS}(\beta), \beta) = N(T) - \frac{F^2\left(\frac{t_{N(T)}}{\beta}\right)}{\sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right]^2}$$

The LS estimators $\hat{\alpha}_{LS}$ and $\hat{\beta}_{LS}$ of α and β are determined

$$\hat{\alpha}_{LS} = \frac{F\left(\frac{t_{N(T)}}{\hat{\beta}_{LS}}\right)}{\sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\hat{\beta}_{LS}}\right) - F\left(\frac{t_{i-1}}{\hat{\beta}_{LS}}\right)\right]^2} \quad \ldots(15)$$

and the $\hat{\beta}_{LS}$ which maximizes

$$\hat{S}_{LS}^2(\beta) = N(T) - \frac{F^2\left(\frac{t_{N(T)}}{\beta}\right)}{\sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right]^2} \quad \ldots(16)$$

with respect to β.

The estimator $\hat{\beta}_{LS}$ of the parameter β is a solution to the equation

$$F\left(\frac{t_{N(T)}}{\beta}\right) \sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right]\left[f\left(\frac{t_i}{\beta}\right)t_i - f\left(\frac{t_{i-1}}{\beta}\right)t_{i-1}\right]$$
$$- f\left(\frac{t_{N(T)}}{\beta}\right) t_{N(T)} \sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right]^2 = 0$$

7. THE CLS METHOD FOR THE SOFTWARE RELIABILITY MODEL

For the NHPP process considered the constraint given equ.(17) takes

$$\Delta\left(t_{N(T)}; \theta\right) = N(T) \quad \ldots(17)$$

$$\frac{1}{N(T)} \sum_{i=1}^{N(T)} [\Delta(t_i; \alpha, \beta) - \Delta(t_{i-1}; \alpha, \beta)] = \frac{\alpha}{N(T)} \sum_{i=1}^{N(T)} \left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right] = \frac{\alpha}{N(T)} F\left(\frac{t_{N(T)}}{\beta}\right) = 1$$

It then follows that

$$\alpha = \frac{N(T)}{F\left(\frac{t_{N(T)}}{\beta}\right)} = \alpha_{CLS}(\beta)$$

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Substituting this value into formula in equ. (14) we obtain

$$\hat{S}^2_{LS}(\alpha_{CLS}(\beta),\beta) = N(T)\left[\frac{N(T)\sum_{i=1}^{N(T)}\left[F\left(\frac{t_i}{\beta}\right) - F\left(\frac{t_{i-1}}{\beta}\right)\right]^2}{F^2\left(\frac{t_{N(T)}}{\beta}\right)}\right]$$

Thus we have the following. The CLS estimators α_{CLS} and β_{CLS} of α and β are determined by

$$\hat{\alpha}_{CLS} = \frac{N(T)}{F\left(\frac{t_{N(T)}}{\hat{\beta}_{CLS}}\right)} \qquad \ldots(18)$$

and the $\hat{\beta}_{CLS}$ which maximizes $\hat{S}^2_{LS}(\beta)$ given in equ. (16).

Let us recall that the CLS estimate $\hat{\beta}_{CLS}$ takes the same values as the estimate the $\hat{\beta}_{LS}$ in the LS method.

In general, the optimization problems consisting in finding the ML, LS and CLS estimators for a NHPP, with any mean value parametric function $\Delta(t;\alpha,\beta)$ can be defined by

$$(\hat{\alpha}_{ML},\hat{\beta}_{ML}) = \underset{(\alpha,\beta)\in R_+\times R_+}{\arg\max}\ \log L(\alpha,\beta) \qquad \ldots(19)$$

$$(\hat{\alpha}_{LS},\hat{\beta}_{LS}) = \underset{(\alpha,\beta)\in R_+\times R_+}{\arg\min}\ S^2_{LS}(\alpha,\beta) \qquad \ldots(20)$$

$$(\hat{\alpha}_{CLS},\hat{\beta}_{CLS}) = \underset{(\alpha,\beta)\in C}{\arg\min}\ S^2_{LS}(\alpha,\beta) \qquad \ldots(21)$$

respectively, where L(α, β) is the corresponding likelihood function, $S^2_{LS}(\alpha,\beta)$ is defined in equ. (13) with ϑ = (α, β), and the restriction set

$$C = \left\{(\alpha,\beta)\frac{1}{N(T)}\sum_{i=1}^{N(T)}[\Delta(t_i;\alpha,\beta) - \Delta(t_{i-1};\alpha,\beta)] = 1\right\}$$

In the case of the NHPP defined by equ. (1), the optimization problems equ.(19), equ. (20) and equ. (21) reduce to the following ones

$$\hat{\beta}_{ML} = \underset{\beta\in R_+}{\arg\max}\,\tilde{L}(\beta) \qquad \ldots(22)$$

$$\hat{\beta}_{(C)LS} = \underset{\beta\in R_+}{\arg\max}\,\tilde{S}^2_{LS}(\beta) \qquad \ldots(23)$$

Where $\tilde{L}(\beta)$ and $\tilde{S}^2_{LS}$ (β) are defined in equ. (7) and equ.(16), respectively. The ML, LS and CLS estimators $\hat{\alpha}_{ML}$, $\hat{\alpha}_{LS}$ and $\hat{\alpha}_{CLS}$ of the parameter α are determined by formulas equ. (6), equ. (15) and equ. (18), respectively.

8. THE K-STAGE ERLANGIAN NHPP SOFTWARE RELIABILITY MODEL

Let us consider the special case of the model defined by equ. (1), where

$$F(t/\beta) = 1 - \exp(-t/\beta)\sum_{j=0}^{k}\frac{(t/\beta)^j}{j!} \qquad \ldots(24)$$

and

$$F(t/\beta) = \frac{(t/\beta)^k}{k!}\exp(-t/\beta)$$

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Thus this is the k-stage Erlangian NHPP software reliability model with the cumulated intensity function $\Delta(t; \alpha, \beta)$ and intensity function $\lambda(t; \alpha, \beta)$ defined by equ. (2) and equ. (3), respectively. The parameter k is usually a small integer and it is assumed to be known.

The k-stage Erlangian software reliability model contains the exponential model proposed by Goel and Okumoto (1979) and the delayed s-shaped model studied by Yamada, Ohba and Osaki (1984) as special cases (with k = 0 and k = 1). These two models are the most widely used NHPP software reliability models in practice. The k-stage Erlangian NHPP we obtain the following result.

For the k-stage Erlangian NHPP defined in Equ. (2) the LS and CLS estimators of α and β are determined by

$$\hat{\alpha}_{LS} = \frac{1 - \exp\left(-t_{N(T)}/\hat{\beta}\right)\sum_{j=0}^{k}\frac{\left(t_{N(T)}/\hat{\beta}\right)^{j}}{j!}}{\sum_{i=1}^{N(T)}\left[\exp\left(-t_{i-1}/\hat{\beta}\right)\sum_{j=0}^{k}\frac{\left(t_{i-1}/\hat{\beta}\right)^{j}}{j!} - \exp\left(-t_{i}/\hat{\beta}\right)\sum_{j=0}^{k}\frac{\left(t_{i}/\hat{\beta}\right)^{j}}{j!}\right]^{2}}$$

$$\hat{\alpha}_{CLS} = \frac{N(T)}{1 - \exp\left(-t_{N(T)}/\hat{\beta}\right)\sum_{j=0}^{k}\frac{\left(t_{N(T)}/\hat{\beta}\right)^{j}}{j!}}$$

and the $\hat{\beta}$ which maximizes the function

$$S_{LS}^{2}(\beta) = \frac{1 - \exp\left(-t_{N(T)}/\beta\right)\sum_{j=0}^{k}\frac{\left(t_{N(T)}/\beta\right)^{j}}{j!}}{\sum_{i=1}^{N(T)}\left[\exp\left(-t_{i-1}/\beta\right)\sum_{j=0}^{k}\frac{\left(t_{i-1}/\beta\right)^{j}}{j!} - \exp\left(-t_{i}/\beta\right)\sum_{j=0}^{k}\frac{\left(t_{i}/\beta\right)^{j}}{j!}\right]^{2}}$$

with respect to β.

9. THE GOEL AND OKUMOTO MODEL

For the Goel and Okumoto model the LS and CLS estimators of α and β are determined by

$$\hat{\alpha}_{LS} = \frac{1 - \exp\left(\frac{-t_{N(T)}}{\hat{\beta}}\right)}{\sum_{i=1}^{N(T)}\left[\exp\left(\frac{-t_{i-1}}{\hat{\beta}}\right) - \exp\left(\frac{-t_{i}}{\hat{\beta}}\right)\right]^{2}} \qquad \ldots (25)$$

$$\hat{\alpha}_{CLS} = \frac{N(T)}{1 - \exp\left(-t_{N(T)}/\hat{\beta}\right)}$$

and the $\hat{\beta}$ which maximizes the function

$$S_{LS}^{2}(\beta) = \frac{\left[1 - \exp\left(-t_{N(T)}/\beta\right)\right]^{2}}{\sum_{i=1}^{N(T)}\left[\exp\left(-t_{i-1}/\beta\right) - \exp\left(-t_{i}/\beta\right)\right]^{2}} \qquad \ldots (26)$$

with respect to β.

10. NUMERICAL ILLUSTRATION

(i). ALGORITHM

MJN – the mean jump (fault) number (the estimate of the mean value of the process at time T),

MLJT – the mean last jump time,

DT – the difference time: T −MLJT,

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RDT – the relative difference time: (T −MLJT)/MLJT,

M'S– the percentage of no-existence of the ML estimator and existence of the (C)LS estimator,

MS'- the percentage of existence of the ML estimator and no-existence of the (C)LS estimator,

M' - the percentage of no-existence of the ML estimator,

S' - the percentage of no-existence of the (C)LS estimator.

For a given values of pairs of the parameters α and β in the Goel and Okumoto model we present some numerical results illustrating the accuracy of the proposed LS and CLS estimators of these parameters with comparison to the ML estimators. The numerical results are contained in Tables 1 – 16 for five observation times T = 0.3, 0.7, 2, 6, 8. The variability of an estimator $\hat{\eta}$ of an unknown parameter η was measured by the root mean squared error which is defined by $se(\hat{\eta}) = \sqrt{(se(\hat{\eta}))^2 + (mean(\hat{\eta}) - \eta)^2}$. The tables contain the numerical results obtained on the basis of 2000 generated random samples (trajectories of the NHPP) for each pair (α, β).

The values of estimators of α and β are evaluated using numerical constrained global optimization procedures to solve the problems in equ. (22) and in equ.(23) for the Goel and Okumoto model, i.e. for the functions $\ddot{L}(\beta)$and $\ddot{S}^2_{LS}(\beta)$ defined equ. (11) and equ. (26), respectively. The resulting estimates of β have been substituted in equ. (10), equ.(24) and equ. (25) to get estimates of α: $\hat{\alpha}_{ML}$, $\hat{\alpha}_{LS}$ and $\hat{\alpha}_{CLS}$, respectively. In constructing the executable computer program, procedures of the package Mathematica 8.0 were used.

The results given in Tables 1, 4 and 7 for short observation times T the ML estimators as well as the (C)LS estimators do not always exist. The ML estimator does not exist despite the fact that we have sufficient information in the form of a large number of faults observed in relatively short observation time.

Table 16 gives the LS and CLS estimates of α and β for some distinct cases in which the ML estimator does not exist, whereas the (C)LS estimator does exist. The table shows that in some cases when the ML method fails one could apply the CLS method yielding satisfactory estimates. In general, one observes a good performance of the CLS method. The numerical results show that the CLS method yields the estimates of α and β which are practically so accurate as the ML estimates. The LS method considerably underestimates the parameter α. Tables 1, 4, 7, 10 and 13 demonstrate that the percentage of non-existence of the ML as well as the (C)LS estimators of α and β tends to zero as T grows. The likelihood function for this process is analytically tractable and it follows from the results of Zhao and Xie (1996) that the ML estimators exist with probability 1 as $T \to \infty$.

Table-1: The simulation results.

T = 0.3										
No.	α	β	**MJN**	**MLJT**	**DT**	**RDT**	**M'S**	**MS'**	**M'**	**S'**
1	95	0.01	97	0.0436	0.4274	874.5641	0	0	0	0
2	95	0.1	97	0.3645	0.0864	19.6458	0	0	0	0
3	95	0.2	90	0.3965	0.0587	5.1457	0	0	0	0
4	95	0.4	61	0.4032	0.0081	4.1510	0.56	3.64	1.30	4.30
5	190	0.4	116	0.4184	0.0054	2.3495	0.04	1.26	0.04	1.46
6	190	0.5	72	0.4197	0.0051	1.6945	3.85	12.8	13.7	20.6
7	380	0.5	78	0.4265	0.0042	1.3954	8.35	14.6	24.5	36.8
8	580	2.6	91	0.4275	0.0039	1.2751	8.86	15.4	34.9	43.6
9	950	3.5	109	0.4286	0.0034	0.7452	9.08	13.8	41.6	45.4
10	950	4.2	95	0.4294	0.0031	1.0942	11.18	11.6	46.7	47.01

Table-2: The ML, LS and CLS estimates of α and β.

T=0.3							
No.	α	β	$\hat{\alpha}_{ML}$	$\hat{\beta}_{ML}$	$\hat{\alpha}_{LS}$	$\hat{\alpha}_{CLS}$	$\hat{\beta}_{(C)LS}$
1	95	0.01	98.0123	0.1203	50.3458	100.3409	0.0934
2	95	0.1	98.0431	0.0435	50.9087	100.3479	0.5671
3	95	0.2	99.3241	0.1209	51.0987	102.9802	0.5671
4	95	0.4	115.0345	0.3765	68.0563	136.0921	0.7891

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5	190	0.4	210.4908	0.4567	120.0456	210.0345	0.9786
6	190	0.5	356.0982	0.4569	132.0945	235.0912	1.3489
7	380	0.5	450.4321	0.6709	175.9087	321.0983	1.8930
8	580	2.6	610.3214	1.8765	220.9876	412.0982	2.7250
9	950	3.5	458.9043	2.8765	290.3451	589.0213	2.0945
10	950	4.2	547.0983	2.0897	210.3451	423.0345	2.9034

Table-3: The ML and CLS estimates of α and β and their measures of variability.

T = 0.3										
No.	α	$\hat{\alpha}_{ML}$	$\hat{\alpha}_{CLS}$	$se(\hat{\alpha}_{ML})$	$se(\hat{\alpha}_{CLS})$	β	β_{ML}	β_{CLS}	$se(\beta_{ML})$	$se(\beta_{CLS})$
1	95	98.0123	100.3409	9.8901	9.7809	0.01	0.1203	0.0934	0.0091	0.02131
2	95	98.0431	100.3479	9.9801	9.8765	0.1	0.0435	0.5671	0.0112	0.01819
3	95	99.3241	102.9802	10.2341	12.3409	0.2	0.1209	0.5671	0.0324	0.06168
4	95	115.0345	136.0921	10.9832	124.6709	0.4	0.3765	0.7891	0.04321	0.97258
5	190	210.4908	210.0345	72.0431	145.0963	0.4	0.4567	0.9786	0.5348	0.6578
6	190	356.0982	235.0912	73.0567	245.8901	0.5	0.4569	1.3489	0.3476	1.44561
7	380	450.4321	321.0983	210.4590	310.3409	0.5	0.6709	1.8930	1.3409	1.7903
8	580	610.3214	412.0982	309.9032	403.0987	2.6	1.8765	2.7250	1.6777	2.1023
9	950	458.9043	589.0213	345.0981	632.0912	3.5	2.8765	2.0945	2.0456	2.08773
10	950	547.0983	423.0345	621.4043	656.42133	4.2	2.0897	2.9034	3.34509	3.45789

Table-4: The simulation results

T = 0.7										
No.	α	β	**MJN**	**MLJT**	**DT**	**RDT**	**M'S**	**MS'**	**M'**	**S'**
1	95	0.01	100	0.0562	0.9237	1789.4532	0	0	0	0
2	95	0.1	100	0.5213	0.4568	90.5643	0	0	0	0
3	95	0.2	98	0.8563	0.1203	16.9056	0	0	0	0
4	95	0.4	87	0.9876	0.0167	2.8905	0	0.1	0	0.1
5	190	0.4	170	0.9876	0.0023	1.6754	0	0	0	0
6	190	0.5	120	0.9934	0.00123	1.2345	0.05	1.22	0.1	1.3
7	380	0.5	145	0.9912	0.0043	0.85674	2.50	8.90	6.78	14.01
8	580	2.6	165	0.9945	0.0002	0.7432	3.89	12.45	16.87	25.2
9	950	3.5	220	0.9949	0.0001	0.5634	6.90	13.89	23.89	29.89
10	950	4.2	173	0.9938	0.00001	0.6211	8.10	13.12	32.10	35.45

Table-5: The ML, LS and CLS estimates of α and β.

T=0.7							
No.	α	β	$\hat{\alpha}_{ML}$	$\hat{\beta}_{ML}$	$\hat{\alpha}_{LS}$	$\hat{\alpha}_{CLS}$	$\hat{\beta}_{(C)LS}$
1	95	0.01	99.7856	0.0012	50.2377	100.5806	0.0103
2	95	0.1	99.8901	0.0986	50.2367	100.4562	0.1003
3	95	0.2	97.0971	0.2004	50.4532	100.1341	0.2089
4	95	0.4	100.6543	0.5217	54.6709	103.6322	0.5786
5	190	0.4	200.0765	0.5082	101.3490	201.7890	0.5285
6	190	0.5	206.5689	1.1097	120.0287	230.7312	1.2445
7	380	0.5	450.7892	2.3470	231.0987	456.1349	2.3451
8	580	2.6	610.6743	3.0788	256.8927	534.0923	2.7680
9	950	3.5	910.1456	3.6578	416.8902	809.3214	3.2345
10	950	4.2	745.7802	3.6578	346.1934	702.7601	3.4121

Table-6: The ML and CLS estimates of α and β

T = 0.7										
No.	α	$\hat{\alpha}_{ML}$	$\hat{\alpha}_{CLS}$	$se(\hat{\alpha}_{ML})$	$se(\hat{\alpha}_{CLS})$	β	β_{ML}	β_{CLS}	$se(\beta_{ML})$	$se(\beta_{CLS})$
1	95	98.0123	100.3409	10.0021	10.2316	0.01	0.1203	0.0934	0.00101	0.00056
2	95	98.0431	100.3479	10.0101	10.2131	0.1	0.0435	0.5671	0.01001	0.03216
3	95	99.3241	102.9802	9.2341	10.3411	0.2	0.1209	0.5671	0.02318	0.0765
4	95	115.0345	136.0921	12.4351	20.2314	0.4	0.3765	0.7891	0.2349	0.2543
5	190	210.4908	210.0345	16.8734	21.6245	0.4	0.4567	0.9786	0.1265	0.1272
6	190	356.0982	235.0912	62.9876	109.9331	0.5	0.4569	1.3489	0.0776	0.8654

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7	380	450.4321	321.0983	231.8880	276.3213	0.5	0.6709	1.8930	0.5632	1.6743
8	580	610.3214	412.0982	301.4321	309.3456	2.6	1.8765	2.7250	1.8229	1.8750
9	950	458.9043	589.0213	443.7845	445.9055	3.5	2.8765	2.0945	2.0100	2.4320
10	950	547.0983	423.0345	432.79560	467.32375	4.2	2.0897	2.9034	2.2980	2.4906

Table-7: The simulation results.

T = 2										
No.	α	β	**MJN**	**MLJT**	**DT**	**RDT**	**M'S**	**MS'**	**M'**	**S'**
1	95	0.01	100	0.0234	1.9876	3654.7888	0	0	0	0
2	95	0.1	100	0.5643	1.4532	265.7890	0	0	0	0
3	95	0.2	100	1.0234	0.9843	91.9087	0	0	0	0
4	95	0.4	97	1.7800	0.1324	10.8976	0	0	0	0
5	190	0.4	195	1.8888	0.0354	4.6789	0	0	0	0
6	190	0.5	165	1.9564	0.0143	1.7689	0	0	0	0
7	380	0.5	243	1.9784	0.0059	0.7654	0	0.45	0	0.45
8	580	2.6	285	1.9934	0.0065	0.45321	0.45	4.00	1.15	4.7
9	950	3.5	376	1.9967	0.0066	0.33365	1.00	7.78	4.15	10.6
10	950	4.2	312	1.9925	0.0075	0.36789	3.87	12.34	12.56	21.5

Table-8: The ML, LS and CLS estimates of α and β.

T=2							
No.	α	β	$\hat{\alpha}_{ML}$	$\hat{\beta}_{ML}$	$\hat{\alpha}_{LS}$	$\hat{\alpha}_{CLS}$	$\hat{\beta}_{(C)LS}$
1	95	0.01	98.3421	0.010	50.2456	99.2234	0.0323
2	95	0.1	98.4021	0.100	50.4456	99.4560	0.3567
3	95	0.2	98.3011	0.2001	50.3245	99.4532	0.4598
4	95	0.4	98.0520	0.5987	50.6780	99.6078	0.8912
5	190	0.4	190.6302	0.5670	100.3409	200.4309	1.0034
6	190	0.5	190.5432	1.0452	101.3409	201.0345	2.0043
7	380	0.5	401.8203	2.1123	201.3409	420.3409	2.8901
8	580	2.6	632.6552	3.2300	304.4509	620.9067	3.3021
9	950	3.5	1043.0443	4.0098	512.4509	1031.3456	4.2053
10	950	4.2	990.1929	4.5690	445.0811	906.0236	4.0213

Table-9: The ML and CLS estimates of α and β and their measures of variability

T = 2										
No.	α	$\hat{\alpha}_{ML}$	$\hat{\alpha}_{CLS}$	$se(\hat{\alpha}_{ML})$	$se(\hat{\alpha}_{CLS})$	β	β_{ML}	β_{CLS}	$se(\beta_{ML})$	$se(\beta_{CLS})$
1	95	98.0123	100.3409	9.1207	9.2301	0.01	0.1203	0.0934	0.0012	0.00156
2	95	98.0431	100.3479	9.2013	9.5702	0.1	0.0435	0.5671	0.0231	0.2341
3	95	99.3241	102.9802	10.3202	9.3216	0.2	0.1209	0.5671	0.2102	0.1234
4	95	115.0345	136.0921	10.1002	10.3516	0.4	0.3765	0.7891	0.2310	0.3451
5	190	210.4908	210.0345	13.0125	13.5606	0.4	0.4567	0.9786	0.6781	0.3490
6	190	356.0982	235.0912	13.2134	13.6500	0.5	0.4569	1.3489	0.2362	0.2345
7	380	450.4321	321.0983	18.6402	19.4590	0.5	0.6709	1.8930	0.9823	0.2457
8	580	610.3214	412.0982	23.0234	24.7076	2.6	1.8765	2.7250	1.5670	1.2349
9	950	458.9043	589.0213	32.0430	36.0913	3.5	2.8765	2.0945	1.3890	1.4508
10	950	547.0983	423.0345	38.0231	45.0983	4.2	2.0897	2.9034	1.0237	1.4971

Table-10: The simulation results.

T = 6										
No.	α	β	**MJN**	**MLJT**	**DT**	**RDT**	**M'S**	**MS'**	**M'**	**S'**
1	95	0.01	98	0.0452	4.1722	8765.023	0	0	0	0
2	95	0.1	99	0.6532	4.0542	810.032	0	0	0	0
3	95	0.2	97	1.0042	3.0012	310.342	0	0	0	0
4	95	0.4	97	2.2100	2.1980	90.321	0	0	0	0
5	190	0.4	187	2.1032	2.0451	69.0432	0	0	0	0
6	190	0.5	189	4.2670	0.3241	8.9023	0	0	0	0
7	380	0.5	356	4.5021	0.0123	1.0321	0	0	0	0
8	580	2.6	456	4.7901	0.3210	0.0231	0	0	0	0

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9	950	3.5	701	4.0121	0.1020	0.0123	0	0	0	0
10	950	4.2	601	4.0321	0.2101	0.2139	0	0.5	0	0.5

Table-11: The ML, LS and CLS estimates of α and β.

T=6							
No.	α	β	$\hat{\alpha}_{ML}$	$\hat{\beta}_{ML}$	$\hat{\alpha}_{LS}$	$\hat{\alpha}_{CLS}$	$\hat{\beta}_{(C)LS}$
1	95	0.01	97.7012	0.0010	50.5672	100.3730	0.0103
2	95	0.1	99.24331	0.0212	50.0103	100.691	0.0143
3	95	0.2	97.4329	0.101	50.0034	100.3412	0.2012
4	95	0.4	97.3407	0.3148	50.3013	100.6708	0.4510
5	190	0.4	196.9875	0.3148	200.4107	97.3001	0.4519
6	190	0.5	196.4532	1.0000	200.1327	97.4301	0.8901
7	380	0.5	385.2136	1.5301	400.5601	196.0942	1.6754
8	580	2.6	503.3671	2.5410	600.6341	298.5288	2.0574
9	950	3.5	945.1321	3.5602	479.7010	475.6623	3.5603
10	950	4.2	991.6479	4.5783	1004.8722	990.5122	4.0316

Table-12: The ML and CLS estimates of α and β.

T = 6										
No.	α	$\hat{\alpha}_{ML}$	$\hat{\alpha}_{CLS}$	$se(\hat{\alpha}_{ML})$	$se(\hat{\alpha}_{CLS})$	β	β_{ML}	β_{CLS}	$se(\beta_{ML})$	$se(\beta_{CLS})$
1	95	98.0123	100.3409	9.3785	9.89673	0.01	0.1203	0.0934	0.0001	0.0010
2	95	98.0431	100.3479	9.6758	9.8310	0.1	0.0435	0.5671	0.0319	0.0212
3	95	99.3241	102.9802	9.6456	9.9075	0.2	0.1209	0.5671	0.3416	0.0543
4	95	115.0345	136.0921	10.0456	10.4301	0.4	0.3765	0.7891	0.0567	0.0671
5	190	210.4908	210.0345	13.3245	14.3000	0.4	0.4567	0.9786	0.0624	0.1201
6	190	356.0982	235.0912	13.4561	14.4802	0.5	0.4569	1.3489	0.0773	0.1130
7	380	450.4321	321.0983	20.4367	22.1045	0.5	0.6709	1.8930	0.1716	0.3212
8	580	610.3214	412.0982	34.2810	40.3316	2.6	1.8765	2.7250	0.3151	0.4532
9	950	458.9043	589.0213	67.6780	90.3103	3.5	2.8765	2.0945	0.3451	0.6542
10	950	547.0983	423.0345	100.5643	135.6322	4.2	2.0897	2.9034	0.6959	1.1042

Table-13: The simulation results.

T = 8										
No.	α	β	**MJN**	**MLJT**	**DT**	**RDT**	**M'S**	**MS'**	**M'**	**S'**
1	95	0.01	98	0.0561	8.9081	17642.7802	0	0	0	0
2	95	0.1	99	0.5136	8.6782	1765.71209	0	0	0	0
3	95	0.2	99	1.0004	7.8902	874.3297	0	0	0	0
4	95	0.4	96	2.3216	6.8902	280.5623	0	0	0	0
5	190	0.4	189	2.5609	5.0008	267.0901	0	0	0	0
6	190	0.5	189	4.8901	4.9031	67.9099	0	0	0	0
7	380	0.5	380	5.0012	3.0000	3.0612	0	0	0	0
8	580	2.6	567	9.0015	0.6475	5.0982	0	0	0	0
9	950	3.5	890	9.0034	0.4751	1.2601	0	0	0	0
10	950	4.2	745	9.0045	0.0347	0.0784	0	0	0	0

Table-14: The ML, LS and CLS estimates of α and β.

T= 8							
No.	α	β	$\hat{\alpha}_{ML}$	$\hat{\beta}_{ML}$	$\hat{\alpha}_{LS}$	$\hat{\alpha}_{CLS}$	$\hat{\beta}_{(C)LS}$
1	95	0.01	95.3409	0.1209	50.6710	100.5602	0.0104
2	95	0.1	99.5656	0.0231	50.2340	100.6012	0.1043
3	95	0.2	98.0567	0.1990	50.1350	100.8765	0.2008
4	95	0.4	99.0043	0.4321	50.3490	100.1690	0.5231
5	190	0.4	198.4501	0.4324	100.2309	201.0123	0.5632
6	190	0.5	198.0341	0.8760	100.3091	201.0982	1.0975
7	380	0.5	389.3408	1.3409	201.0210	300.6721	2.0348
8	580	2.6	560.3421	3.5600	301.8656	501.0912	3.0785
9	950	3.5	970.3456	3.9035	501.4502	1000.4123	4.0312
10	950	4.2	1001.3217	4.8071	505.1034	1007.4250	4.5621

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Table-15: The ML and CLS estimates of α and β.

T = 8										
No.	α	$\hat{\alpha}_{ML}$	$\hat{\alpha}_{CLS}$	$se(\hat{\alpha}_{ML})$	$se(\hat{\alpha}_{CLS})$	β	β_{ML}	β_{CLS}	$se(\beta_{ML})$	$se(\beta_{CLS})$
1	95	98.0123	100.3409	8.6500	8.8532	0.01	0.1203	0.0934	0.0009	0.00125
2	95	98.0431	100.3479	8.6731	9.1340	0.1	0.0435	0.5671	0.01017	0.01701
3	95	99.3241	102.9802	9.5409	10.6031	0.2	0.1209	0.5671	0.02037	0.02315
4	95	115.0345	136.0921	9.1032	10.3521	0.4	0.3765	0.7891	0.01034	0.06578
5	190	210.4908	210.0345	13.6023	14.8097	0.4	0.4567	0.9786	0.04561	0.06754
6	190	356.0982	235.0912	13.2201	14.4499	0.5	0.4569	1.3489	0.03111	0.05431
7	380	450.4321	321.0983	18.3409	20.5694	0.5	0.6709	1.8930	0.04572	0.16786
8	580	610.3214	412.0982	24.0912	24.3602	2.6	1.8765	2.7250	0.11268	0.22457
9	950	458.9043	589.0213	33.0971	33.5601	3.5	2.8765	2.0945	0.20762	0.30171
10	950	547.0983	423.0345	39.6215	39.0451	4.2	2.0897	2.9034	0.3353	0.34561

Table-16: The LS and CLS estimates of α and β when the ML estimator does not exist, whereas the (C) LS estimator does exist.

No.	α	β	**T**	**M'S**	$\hat{\alpha}_{LS}$	$\hat{\alpha}_{CLS}$	$\beta_{(C)LS}$
7	350	1	0.5	7.35	299.8854	586.5436	2.0851
8	550	2	0.5	9.01	330.1547	635.9076	2.3350
9	900	3	0.5	10.1	480.1543	956.3656	2.6824
10	900	4	0.5	10.5	325.1463	690.0149	2.4497
8	550	2	1	4.60	404.1256	845.9703	3.4487
9	900	3	1	7.10	540.0509	1108.8776	3.7378
10	900	4	1	9.00	482.6145	967.4567	3.8369
10	900	4	1	3.40	589.7233	1230.9145	6.0512

CASE (II)

(i). Notations

N(T) : The number of faults detected during the testing time t and is a random variable.

$E(N(t))$: Expected number of faults detected in the time interval (0, t] during testing phase.

a : Total fault content.

a_1, a_2, a_3: Initial fault content for simple, hard, and complex types of faults.

b_1, b_2, b_3: Fault detection rates for simple, hard, and complex faults.

$E(N_1(t\ E(N_2(t)$, $E(N_3(t)$: Mean number of fault for simple, hard, and complex faults.

σ_1, σ_2, σ_3: Positive constant that represents the magnitude of the irregular fluctuations for simple, hard, and complex faults.

$\gamma_1(t)$, $\gamma_2(t)$, $\gamma_3(t)$, : Standardized Gaussian White Noise for simple, hard, and complex faults.

P_1, P_2, P_3: Proportion of simple, hard, and complex faults in total fault content of the software.

B: Constant parameter representing a learning phenomenon in the Fault Removal Rate function.

(ii). Assumptions

(i). The Software fault-detection process is modeled as a stochastic process with a continuous state space.

(ii). The number of faults remaining in the software system gradually decreases as the testing procedure goes on.

(iii). Software is subject to failures during execution caused by faults remaining in the software.

(iv). The faults existing in the software are of three types: simple, hard, and complex. They are distinguished by the amount of testing effort needed to remove them.

(v). During the fault isolation/removal, no new fault is introduced into the system and the faults are debugged perfectly.

(iii). The model

Several Software Reliability Models are based on the assumption of NHPP, treating the fault detection process during the testing phase as a discrete counting process. Recently Yamada et al. (2003) asserted that if the size of

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the software system is large then the number of the faults detected during the testing phase is also large and change in the number of faults, which are corrected and removed through each debugging, becomes small compared with the initial faults content at the beginning of the testing phase. So, in order to describe the stochastic behavior of the fault detection process, a Stochastic Model with continuous state space. Since the latent faults in the software system are detected and eliminated during the testing phase, the number of faults remaining in the software system gradually decreases as the testing progresses. Therefore, it is reasonable to assume the following stochastic differential equation:

$$\frac{d\,N(T)}{dt} = r(t)[a - N(t)] \qquad \ldots(27)$$

where *r(t)* is a fault-detection rate per remaining fault at testing time *t*.

However, the behavior of $r(t)$ is not completely known since it is subject to random effects such as the testing effort expenditure, the skill level of the testers, and the testing tools and thus might have irregular fluctuation. Thus, we have

$$r(t) = b(t) + \text{noise} \qquad \ldots(28)$$

If $\gamma(t)$ be a standard Gaussian white noise and σ a positive constant representing a magnitude of the irregular fluctuations. So equ. (28) can be written as

$$r(t) = b(t) + \sigma\,\gamma(t) \qquad \ldots(29)$$

Hence equ. (27) becomes

$$\frac{d\,N(T)}{dt} = [b(t) + \sigma\,\gamma(t)\,]\;[a - N(t)] \qquad \ldots(30)$$

Equ. (30) can be extended to the following stochastic differential equation of an It$\hat{o}$ Type

$$d\,N(T) = \left[b(t) - \frac{1}{2}\,\sigma^2\right]\;[a - N(t)]dt + \sigma[a - N(t)]dw(t) \qquad \ldots(31)$$

where *W* (*t*) is a one-dimensional Wiener process, which is formally defined as an integration of the white noise $\gamma(t)$ with respect to time *t*. Use It $\hat{o}$ formula solution to (31) and use initial condition $N(0)= 0$ as follows

$$N(t) = a\left[1 - exp\left\{-\int_0^t b(x)dx - \sigma W(t)\right\}\right] \qquad \ldots(32)$$

. The Wiener process *W* (*t*) is a Gaussian process and it has the following properties:

$$Pr[w(0) = 0] = 1$$

$$E[w(t)] = 0 \qquad \ldots(33)$$

$$E[w(t)w(t')] = \min[t, t']$$

In practical situation it has been observed that a large number of simple (trivial) faults are easily detected at the early stages of testing while fault removal may become extremely difficult in the later stages. Total fault removal phenomenon of the proposed model is the sum of mean removal phenomenon for simple, hard, and complex faults, that is,

$$E\big(N(t)\big) = E\big(N_1(t)\big) + E\big(N_2(t)\big) + E\big(N_3(t)\big) \qquad \ldots(34)$$

This is the mean value function of superimposed removal phenomenon of simple, hard, and complex faults, respectively is gven by

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For proposed SRGM,

$$E(N(t)) = a_1\left[1-\left\{e^{-b_1 t\sigma_1^2 t/2}\right\}\right] + a_2\left[1-\frac{(1+\beta+b_2 t)\left\{e^{-b_2 t\sigma_2^2 t/2}\right\}}{1+\beta e^{-b_2 t}}\right] + a_3\left[1-\frac{(1+\beta+b_3 t+b_3^2 t^2/2)\left\{e^{-b_3 t\sigma_3^2 t/2}\right\}}{1+\beta e^{-b_3 t}}\right] \quad \ldots(35)$$

where $a_1 = ap_1$, $a_2 = ap_2$, and $a_3 = ap3$, where $p_3 = (1 - p_1 - p_2)$

14. Software Reliability Measures

The instantaneous MTBF for the proposed models is given by

$$(MTBF)_I = \frac{1}{a_1[(b_1-(1/2)\sigma^2)]e^{-(b_1-(1/2)\sigma^2)t}} \quad \ldots(36)$$

For hard faults,

$$(MTBF)_I = \frac{1}{a_2[(1+\beta+b_2 t)/(1+\beta e^{-b_2 t})][\mathcal{R}]e^{-(b_2-(1/2)\sigma_2^2)t}} \quad \ldots(37)$$

Where $\mathcal{R} = \frac{\left(b_2(1+\beta+b_2 t)-b_2\left(1+\beta e^{-b_2 t}\right)\right)}{\left((1+\beta+b_2 t)-\left(1+\beta e^{-b_2 t}\right)\right)} - (1/2)\sigma_2^2$

For complex faults,

$$(MTBF)_I = \frac{1}{a_3[(1+\beta+b_3 t+b_3^2 t^2/2)/(1+\beta e^{-b_3 t})][\mathcal{R}-(1/2)\sigma_3^2]e^{-(b_3-(1/2)\sigma_3^2)t}} \quad \ldots(38)$$

Where $\mathcal{R}$ denotes $\frac{\left(b_3(1+\beta+b_3 t+b_3^2 t^2/2)-b_3\left(1+\beta e^{-b_3 t}\right)(1+b_3 t)\right)}{\left((1+\beta+b_3 t+b_3^2 t^2/2)(1+\beta e^{-b_3 t})\right)}$

The cumulative MTBF is the average time between failure from the beginning of the test (i.e., $t = 0$) up to time t. The following cumulative mean time between software failures (denoted by $MTBF_C$) for the proposed models is given by

$$(MTBF)_C = \frac{t}{E(N(t))} \quad \ldots(39)$$

The cumulative MTBF of the model for simple faults is given by.

Simple faults:

$$(MTBF)_C = \frac{t}{a_1\left[1-\left\{e^{-\left(b_1 t+\frac{\sigma_1^2 t}{2}\right)}\right\}\right]} \quad \ldots(40)$$

Hard faults is given by

$$(MTBF)_C = \frac{t}{a_2\left[1-(1+\beta+b_2 t)\left\{e^{-\left(b_2 t+\frac{\sigma_2^2 t}{2}\right)}\right\}/(1+\beta+b_2 t)\right]} \quad and\ for \quad \ldots(41)$$

Complex faults is given by

$$(MTBF)_C = \frac{t}{a_3\left[1-(1+\beta+b_3 t+b_3^2 t^2/2)\left\{e^{-\left(b_3 t+\frac{\sigma_3^2 t}{2}\right)}\right\}/(1+\beta e^{-b_3 t})\right]} \quad \ldots(16)$$

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15. Estimation

Parameter estimation and model validation are important aspects of modeling. The mathematical equations of the proposed Stochastic models for software reliability analysis are nonlinear. Technically, it is more difficult to find the solution for non-linear models using Least Square method and requires numerical algorithms to solve it. Statistical software packages such as SPSS help to overcome this problem. For the estimation of the parameters of the proposed model, method of least square has been used.

16. Goodness of Fit Criteria

(a). The Mean Square Fitting Error (MSE)

The model under comparison is used to simulate the fault data, the difference between the expected values, $\hat{m}(t_i)$, and the observed data y_i is measured by Kapur, et.al (1999) is as follows. MSE = $\sum_{i=1}^{k}\left(\left((\hat{m}(t_i)-y_i)\right)^2/k\right)$, where k is the number of observations. The lower MSE indicates less fitting error, thus better goodness of fit.

(b). Coefficient of Multiple Determination (R^2)

The ratio of the sum of squares resulting from the trend model to that from constant model subtracted from equ. (1) that is, R^2 = 1 − residual SS/corrected SS. R^2 measures the percentage of the total variation about the mean accounted for the fitted curve. It ranges in value from 0 to 1. Small values indicate that the model does not fit the data well. The larger R^2 is, the better the model explains the variation in the data.

(c). Prediction Error (PE)

The difference between the observation and prediction of number of failures at any instant of time *i* is known as PE_i. Lower the value of prediction error, better the goodness of fit equ.(9).

(d). Bias

The average of PEs is known as bias. Lower the value of Bias, better the goodness of fit equ. (9).

(e). Variation

The standard deviation of PE is known as variation. Variation = $\sqrt{(1/(N(T))\sum(PE_i - Bias)^2}$ Lower the value of Variation, better the goodness of fit equ. (9).

(f). Root Mean Square Prediction Error

It is a measure of closeness with which a model predicts the observation. RMSPE= $\sqrt{(Bias^2 + Variation^2)}$. Lower the value of Root Mean Square Prediction Error, better the goodness of fit in equ. (9).

17. Model Validation

To check the validity of the proposed model and to find out its software reliability growth, it has been tested on three data sets. The Proposed Model has been compared with NHPP based Generalised Pareto Distribution Model, refer to Kapur et.al (1995, 1999). For the proposed software reliability model, the results are better for the given data sets. Following the approaches of Brooks and Motley (1980), Misra (1983), Tamura (2007) and the results were shown in table 17, table 18, table 19, and depicted in fig. 1, fig. 2 and fig. 3. The data description is as follows

(i). The fault data set as suggested by Brooks and Motley (1980), is for a radar system of size 124 KLOC _Kilo line of code tested for 35 weeks in which 1301 faults were removed and the results were shown in table 17 and fig. 1.

(ii). Following the approach of Misra (1983), the software was tested for 38 weeks during 2600 Compute hours were used and 231 faults were removed and the result were shown in table 18 and fig. 2.

(iii). Following the approch of Tamura (2007), based bug tracking system and the result were shown in table 19 and fig. 3.

For simulation analysis, the generalized Pareto distribution has been used.

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Table-17: Parameter estimation based on Brooks and Motley

Models under comparisons	Parameter estimation										
	a	**b1**	**b2**	**b3**	**β**	**p1**	**p2**	**p3**	**σ1**	**σ2**	**σ3**
Stochastic Reliability Model	1245	0.76	0.189	0.124	41	0.2456	0.5102	0.0643	0.141	0.001	0.012
Generalized Pareto Distribution	1352	0.234	0.00	0.135	-	0.011	0.00	0.374	-	-	-
	R^2			**MSE**		**Bias**		**Variation**		**RMSPE**	
	1.00			87.3341		-0.059215		8.1455		8.30118	
	0.7234			1100.4311		0.91154		33.221154		34.22085	

Table-18: Parameter estimation based on Misra

Models under comparisons	Parameter estimation										
	a	**b1**	**b2**	**b3**	**β**	**p1**	**p2**	**p3**	**σ1**	**σ2**	**σ3**
Stochastic Reliability Model	410	0.011	0.111	0.211	63.60	0.11	0.4327	0.021	0.029	0.115	0.623
Generalized Pareto Distribution	570	0.014	0.011	0.021	-	0.24	0.337	0.009	-	-	-
	R^2			**MSE**		**Bias**		**Variation**		**RMSPE**	
	0.933			6.11		-0.62326		2.12334		2.5354	
	0.9011			22.04		0.2345		4.01159		4.9345	

Table-19: Parameter estimation based on Tamura

Models under comparisons	Parameter estimation										
	a	**b1**	**b2**	**b3**	**β**	**p1**	**p2**	**p3**	**σ1**	**σ2**	**σ3**
Stochastic Reliability Model	225	0.195	0.212	0.247	8	0.21	0.621	0.165	0.434	0.061	0.425
Generalized Pareto Distribution	197	0.045	0.011	0.23	-	0.25	0.004	0.844	-	-	-
	R^2			**MSE**		**Bias**		**Variation**		**RMSPE**	
	0.994			6.7440		0.07042		3.64321		3.54570	
	0.897			8.2347		0.15736		3.93390		3.4567	

Table 17, table 18, and table 19 show the parameter estimates of proposed model and generalized Pareto Distribution model for data sets, the proportions of different types of faults are given in the data set and for other data sets proportions of different types of faults are estimated. With the prior knowledge of proportion of different types of faults, observed that the results shows that it is the better strategy for removing these faults.

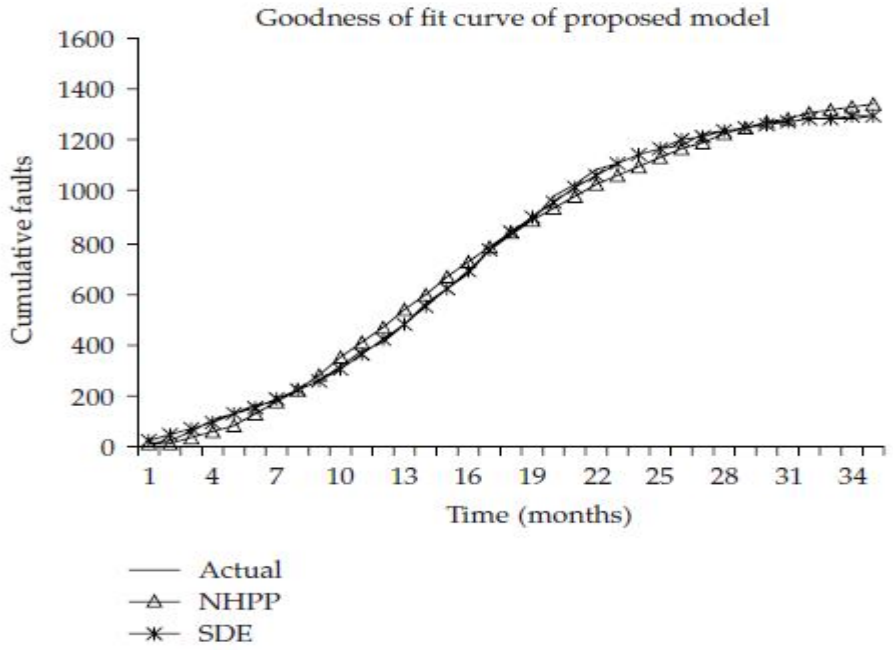

Fig-1: Goodness of Fit Curve for the model suggested by Brook and Motley

ISSN 2394 - 7780

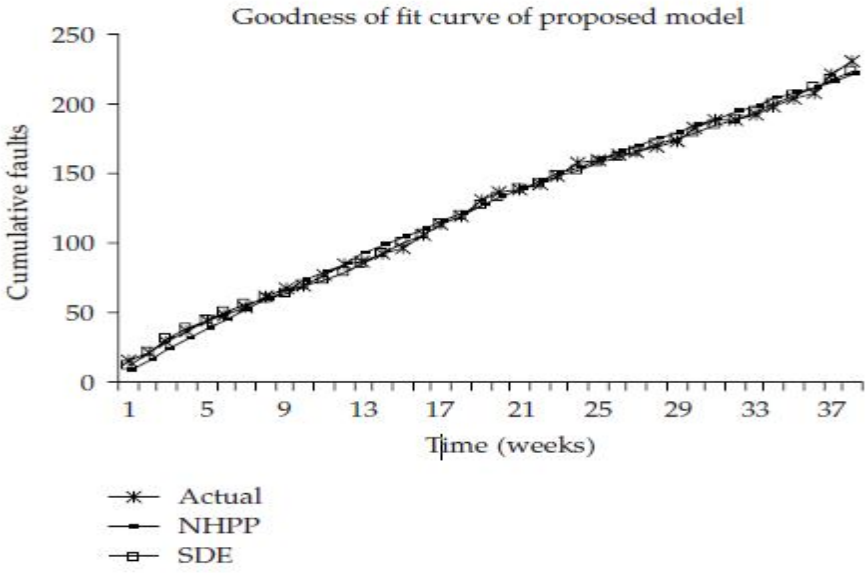

Fig-2: Goodness of Fit Curve for the model suggested by Misra.

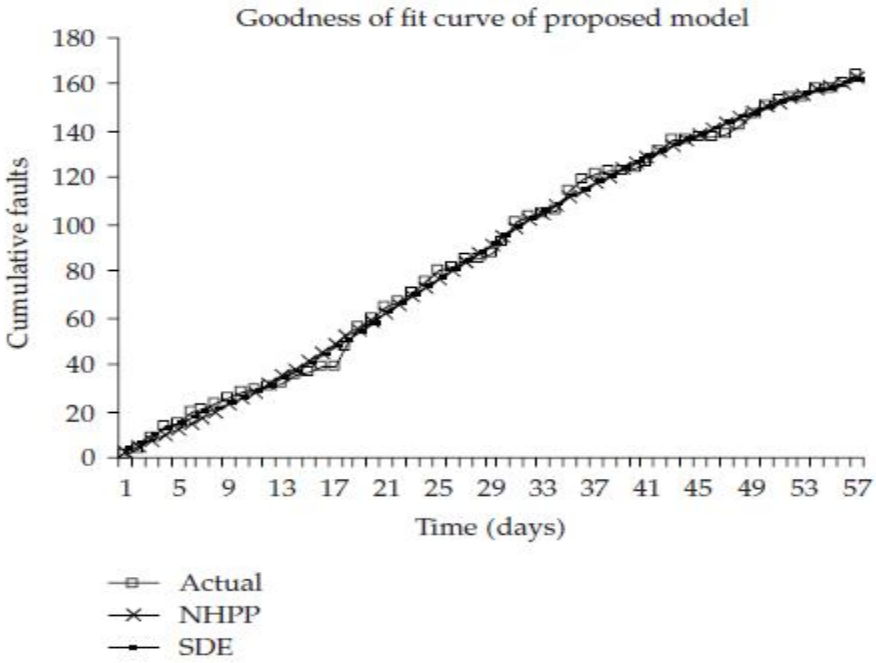

Fig-3: Goodness of Fit Curve for the model suggested by Tamura

Form table 17, table 18, and table 19 describe the comparison criteria results for proposed model and generalized Pareto distribution. It is clear from the table that proposed model results are better in comparison with generalized Pareto Distribution model for different comparison criteria parameters. The curves given in Figures 1 and 2 and 3 reflect the initial learning curve at the beginning, as test members become familiar with the software, followed by growth and then leveling off as the residual faults become more difficult to uncover.

18. CONCLUSION

This paper gives the results based on Stochastic model for software reliability analysis for different categories of faults based on Stochastic differential equations. The goodness of the fit analysis has been done on three real software failure datasets. The goodness-of-fit of the proposed model is compared with NHPP-based Generalized Pareto Distribution model. The results obtained show better fit and wider applicability of the model to different types of failure datasets. From the numerical illustrations, the proposed model provides improved results with better predictability because of lower MSE, variation, RMSPE, Bias and higher R^2. The usability of Stochastic software reliability analysis is not only restricted to the model described presented in this paper but it can also be extended to improve the results of any other software reliability model. The proposed model can also be used by incorporating error generation and various testing effort functions.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

BASE STOCK SYSTEM FOR OPTIMAL RESERVE INVENTORY BETWEEN MACHINES IN SERIES WITH CORRELATED INTERARRIVAL TIMES OF SUCCESSIVE BREAKDOWNS

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ABSTRACT
The series system is also an important branch of inventory control theory. The machine in series is very common in production processes. In this paper it is assumed that there is one machine M_1 in the first stage and two machines M_2^a and M_2^b are in the second stage. The base stock system for machines in series is derived under the assumption that the correlated interarrival times between breakdowns. The base stock system for reserve inventory is the obtained, that the inter arrival times between successive breakdowns of M_1 is a random variable which undergoes a change point. Numerical illustration also provided.

Keywords: Series System, Base Stock System, Correlated Interarrival Times, Successive Breakdowns.

INTRODUCTION
In inventory control theory the socalled base stock system for patient customer is an interesting model and it has been discussed by many authors. The basic model is discussed in Hannssman (1962). The distribution function of exchangeable, exponential, constantly correlated variables is given by Gurland (1955). A model in which the lead time taken to be random variable is discussed in Ramanarayanan et.al(1988). The concept of change of distribution has been discussed by Stangl (1995). Suresh Kumar (2006) has used this concept in the shock model approach. This expression is used in the study of base stock system for patient customers to obtain in optimal level of the base stock inventory which minimizes the holding and shortage costs when the interarrival times of demands during lead time are correlated.

Base stock system for patient customers in inventory control introduces a new type of ordering mechanism. The inventory process begins with an initial inventory of B units. Whenever a customer order for r units is received, an inventory replenishment order for r units is placed immediately. Replenishment orders are filled up after a lead time L. The customer order is filled, as far as possible from the supply on hand. If the total unfilled customer demand exceeds the supply on hand, then assume the customers will not cancel the orders but await the arrival of sufficient stock. In this paper it is assumed that there is one machine M_1 in the first stage and two machines M_2^a and M_2^b are in the second stage. The base stock system for machines in series is derived under the assumption that the correlated interarrival times between breakdowns. It is may be noted that when the interarrival times between breakdowns during the lead time 'L' are distributed as identically and independently distributed random variables, then by renewal theory arguments, the probability of exactly n breakdowns during L is given by $G_n(L) - G_{n+1}(L)$, where $G_n(L)$ is the distribution function of the partial sum $U_1+ U_2+ U_3+\ldots U_n$, where U_i 's are the interarrival times between breakdowns. Hence $G_n(L)$ is the convolution of G(L). If U_i 's i= 1, 2, …, n are correlated random variables, the expression for $G_n(L)$ has been derived by Gurland (1955). In doing so, it has been assumed as the random variables U_i's exponential, constantly correlated and exchangeable. The expression for $G_n(L) - G_{n+1}(L)$ has been derived and used in the present model. The optimal size of base stock is derived and numerical illustration also given.

ASSUMPTIONS
1. The lead time is a continuous random variable.
2. The interarrival times between successive breakdowns are exponential, constantly correlated and exchangeable.
3. The density function of the lead time random variable undergoes a change point after a particular point.

NOTATIONS
B: the base stock **level**

L: A random variable denoting the lead time and the pdf is K(y).

U: Random variable denoting the interarrival, times between successive breakdown are exponential, constantly correlated and exchangeable with pdf g(.) and G(,)

$G_n(.)$: The n convolution of G(.).

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X_i: A random variable denoting the magnitude of breakdown at the i^{th} breakdown epoch with pdf f(.) and F(.) is the cdf.

h: Inventory holding cost / unit / time

d_1 : Shortage cost / unit / time of breakdown of machine M_2^a

d_2 : Shortage cost / unit / time of breakdown of machine M_2^b

CASE I

The base stock level is B and L is deterministic. The interarrival time of breakdown are independently identically distributed with cdf G(.).

The magnitude of breakdown that occur during N epochs of the lead time are random variable with distribution function F(.). Here N is random variable indicating the breakdown epochs during the lead time L.

Let X be the total breakdown during L. where $X = x_1 + x_2 + \ldots + x_N$

The probability that the total breakdown duration is it most X during L is given by

$P[N=n/L] = G_n(L) - G_{n+1}(L)$

The total expected cost is,

$$E(C) = \alpha \int_0^B (B - X) dp(X \le x) + (d_1 + d_2) \int_B^\infty (X - B) dp(X \le x) \quad \ldots (1)$$

$$\frac{dE(C)}{dB} = 0 \Rightarrow F(\hat{B}) = \frac{d_1 + d_2}{h + d_1 + d_2}$$

$$P(X \le B) = \frac{d_1 + d_2}{h + d_1 + d_2}$$

$$\sum_{n=0}^{\alpha} (G_n(L) - G_{n+1}(L)) F_n(B) = \frac{d_1 + d_2}{h + d_1 + d_2} \quad \ldots (2)$$

Any value of B which satisfies (2) is the optimal base stock.

For the purpose of convenience assume that L=Y. we have, the probability of having the total breakdown on n breakdown epoch during lead time (0, t] is given.

$$P(X \le x) = \sum_{n=0}^{\infty} \int_0^{\infty} (G_n(y) - G_{n+1}(y)) K(y) dy \, F_n(x) \quad \ldots (3)$$

Then the optimum base stock level can be obtained by minimizing E(C) with respect to B and the optimal is given. Hence,

$$\sum_{n=0}^{\infty} F_n(B) \int_0^{\infty} (G_n(y) - G_{n+1}(y)) K(y) dy = \frac{d_1 + d_2}{h + d_1 + d_2} \quad \ldots (4)$$

If the lead time random variable L which is denoted as Y is such that it undergoes a change point after a particular point. The expression for the optimal base stock can be obtained by finding $\frac{dE(C)}{dB} = 0.$

$$\sum_{n=0}^{\infty} F_n(B) \int_0^{X_0} (G_n(y) - G_{n+1}(y)) \lambda_0 e^{-\lambda_0 x_1} dx + \int_{X_0}^{\infty} (G_n(y) - G_{n+1}(y)) \lambda_1 e^{-\lambda_0 \tau} e^{-\lambda_1 (x-\tau)} = \frac{d_1 + d_2}{h + d_1 + d_2}$$

$\ldots (5)$

Where is $F_n(B)$ is the 'n' convolution of F(B).

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Here $G_n(y)-G_{n+1}(y)$ given the probability that there are exactly n breakdown epochs during the lead time Y as derived in renewal theory.

Now it is assumed that the interarrival times between breakdown epochs are not independent, but correlated. They are exchangeable, exponential and constantly correlated random variables. Hence using the expression for $G_n(y)$ as foun in Gurland (1955),

$$G_n(y)=\sum_{i=0}^{\infty}\frac{(1-R)(nR)^i}{(1-R+nR)^{i+1}}\frac{\psi(n+i,x/b)}{(n+i-1)!}$$

$$G_{n+1}(y)=\sum_{i=0}^{\infty}\frac{(1-R)((n+1)R)^i}{(1+nR)^{i+1}}\frac{\psi(n+i+1,x/b)}{(n+i-1)!}$$

$$G_n(y)-G_{n+1}(y)=\left\{\begin{array}{l}(1-R)\left(\sum_{i=0}^{\infty}\frac{1}{(1-R+nR)}\left(\frac{nR}{1-R+nR}\right)^i\frac{\psi(n+i,x/b)}{(n+i-1)!}\right)\\ -(1-R)\left(\sum_{i=0}^{\infty}\frac{1}{(1+nR)}\left(\frac{(n+1)R}{1+nR}\right)^i\frac{\psi(n+1+i,x/b)}{(n+i-1)!}\right)\end{array}\right\} \quad \ldots (6)$$

$$=\int_0^{x_0}(G_n(y)-G_{n+1}(y))\lambda_0 e^{-\lambda_0 x_1}dx$$

$$=(1-R)\sum_{i=0}^{\infty}\left\{\begin{array}{l}\frac{1}{(1-R+nR)}\left(\frac{nR}{1-R+nR}\right)^i\int_0^{x_0}\frac{\psi(n+i,x/b)}{(n+i-1)!}\lambda_0 e^{-\lambda_0 x_1}dx\\ -\frac{1}{(1+nR)}\left(\frac{(n+1)R}{1+nR}\right)^i\frac{1}{(n+i)!}\int_0^{x_0}\psi(n+1+i,x/b)\,\lambda_0 e^{-\lambda_0 x_1}dx\end{array}\right\} \quad \text{K}(7)$$

Now let take

$$\int_0^{x_0}\frac{\psi(n+i,x/b)}{(n+i-1)!}\lambda_0 e^{-\lambda_0 x_1}dx=\int_0^{x_0}\frac{\lambda_0}{(n+i-1)!}\left(\int_0^{x/b}e^{-\tau}\tau^{n+i-1}d\tau\right)e^{-\lambda_0 x_1}dx \quad \ldots (8)$$

$$=\int_0^{x_0}\lambda_0\left(\int_0^{x/b}\frac{e^{-\tau}\tau^{n+i-1}}{(n+i-1)!}d\tau\right)e^{-\lambda_0 x_1}dx$$

$$=\lambda_0\int_0^{x_0}\left(1-\sum_{k=0}^{n+i-1}\frac{(x/b)^k}{k!}e^{-x/b}\right)e^{-\lambda_0 x_1}dx$$

Since

$$\Rightarrow\int_0^t\frac{\lambda^n x^{n-1}}{(n-1)!}e^{-\lambda x}dx=1-\sum_{k=0}^{n-1}\frac{(\lambda t)^k}{k!}e^{-\lambda t}$$

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$$= \lambda_0 \int_0^{x_0} e^{-\lambda_0 x_1} dx - \lambda_0 \sum_{k=0}^{n+i-1} \frac{1}{k!} \int_0^{x_0} \left(x/b\right)^k e^{-x/b\left(1+b\lambda_0\right)} dx$$

$$= \left(1 - e^{-\lambda_0 x_0}\right) - \lambda_0 \sum_{k=0}^{n+i-1} \frac{1}{k!} \int_0^{x_0} \left(x/b\right)^k e^{-x/b\left(1+b\lambda_0\right)} dx$$

Let $z = x/b \Rightarrow x = bz$ $\qquad dx = bdz$

$$x = 0, \qquad z = 0$$

$$x = x_0, \qquad z = x_0/b$$

$$= \left(1 - e^{-\lambda_0 x_0}\right) - b\lambda_0 \int_0^{x_0/b} e^{-z\left(1+b\lambda_0\right)} \sum_{k=0}^{n+i-1} \frac{z^k}{k!} dz$$

Consider

$$\int_0^{x_0/b} e^{-z\left(1+b\lambda_0\right)} \left(1 + z + \frac{z^2}{2!} + \frac{z^3}{3!} + \Lambda + \frac{z^{n+i-1}}{(n+i-1)!}\right) dz$$

Let

$$I_{n+i-1} = \int_0^{\frac{x_0}{b}} e^{-z\left(1+b\lambda_0\right)} \frac{z^{n+i-1}}{(n+i-1)!} dz$$

$$= \int_0^{x_0/b} \frac{(1+b\lambda_0)^{n+i}}{(1+b\lambda_0)^{n+i}} \frac{z^{n+i-1}}{(n+i-1)!} e^{-z\left(1+b\lambda_0\right)} dz$$

On simplification

$$I_{n+i-1} = \frac{1}{\left(1+b\lambda_0\right)^{n+i}} \left(1 - \sum_{k=0}^{n+i-1} \frac{\left[x_0\left(\lambda_0 + 1/b\right)\right]^k}{k!} e^{-x_0\left(\lambda_0 + \frac{1}{b}\right)}\right) \qquad \ldots (9)$$

$$\therefore \qquad \int_0^{\frac{x_0}{b}} e^{-z\left(1+b\lambda_0\right)} \left(1 + z + \frac{z^2}{2!} + \frac{z^3}{3!} + \Lambda + \frac{z^{n+i-1}}{(n+i-1)!}\right) dz = I_0 + I_1 + I_2 + \Lambda + I_{n+i-1}$$

Where

$$I_0 = \frac{1}{\left(1 + b\lambda_0\right)} \left(1 - e^{-x_0\left(\lambda_0 + 1/b\right)}\right)$$

$$\int_0^{x_0} \frac{\psi\left(n+i, x/b\right)}{(n+i-1)!} \lambda_0 e^{\lambda_0 x} dx = \lambda_0 \int_0^{x_0} \frac{\psi\left(n+i, x/b\right)}{(n+i-1)!} e^{\lambda_0 x} dx$$

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$$= \left(\left(1 - e^{\lambda_0 x_0}\right) - b\lambda_0\left(I_0 + I_1 + I_2 + \Lambda + I_{n+i-1}\right)\right) \quad \ldots (10)$$

Similarly $\int_0^{x_0} \frac{\psi\left(n+i, x/b\right)}{(n+i-1)!} \lambda_0 e^{\lambda_0 x} dx \quad \ldots (11)$

$$= \lambda_0 \int_0^{x_0} \left(\int_0^{x/b} \frac{\psi\, e^{-\tau} \tau^{n+i}}{(n+i-1)!} \right) e^{-\lambda_0 x} dx$$

$$= \lambda_0 \int_0^{x_0} \left(1 - \sum_{k=0}^{n+i} \frac{\left(x/b\right)^k e^{-x/b}}{k!} \right) e^{-\lambda_0 x} dx$$

$$= \lambda_0 \left\{ -\frac{1}{\lambda_0}\left(e^{-\lambda_0 x_0} - 1\right) - \sum_{k=0}^{n+i} \int_0^{x_0/b} \frac{\left(x/b\right)^k}{k!} e^{-x/b\left(1+b\lambda_0\right)} \right\}$$

Let $z = x/b \Rightarrow x = bz \qquad dx = bdz$

$$= \lambda_0 \left\{ \frac{1}{\lambda_0}\left(1 - e^{-\lambda_0 x_0}\right) - b \int_0^{x_0/b} e^{-z\left(1+b\lambda_0\right)} \sum_{k=0}^{n+i} \frac{\left(z\right)^k}{k!} dz \right\}$$

$$= \lambda_0 \left\{ \frac{1}{\lambda_0}\left(1 - e^{-\lambda_0 x_0}\right) - b \sum_{k=0}^{n+i} \int_0^{x_0/b} \frac{\left(z\right)^k}{k!} e^{-z\left(1+b\lambda_0\right)} dz \right\}$$

Let $I_k = \int_0^{\frac{x_0}{b}} \frac{\left(z\right)^k}{k!} e^{-z\left(1+b\lambda_0\right)} dz$

$$= \int_0^{x_0/b} \frac{\left(1+b\lambda_0\right)^{k+1}}{\left(1+b\lambda_0\right)^{k+1}} \frac{\left(z\right)^k}{k!} e^{-z\left(1+b\lambda_0\right)} dz$$

$$= \frac{1}{\left(1+b\lambda_0\right)^{k+1}} \left(1 - \sum_{j=0}^{k} \frac{\left(\left(x_0/b\right)\left(1+b\lambda_0\right)\right)^j}{j!} e^{-x_0/b\left(1+b\lambda_0\right)} \right)$$

Therefore

$$I_k = \frac{1}{\left(1+b\lambda_0\right)^{k+1}} \left(1 - \sum_{j=0}^{k} \frac{\left(\left(x_0/b\right)\left(1+b\lambda_0\right)\right)^j}{j!} e^{-x_0/b\left(1+b\lambda_0\right)} \right) \quad \ldots (12)$$

$$\therefore \quad \lambda_0 \int_0^{x_0} \frac{\psi\left(n+1+i, x/b\right)}{(n+i)!} e^{-\lambda_0 x} dx$$

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$$= \lambda_0 \left\{ \frac{1}{\lambda_0}\left(1-e^{-\lambda_0 x_0}\right) - b\sum_{k=0}^{n+i} \frac{1}{(1+b\lambda_0)^{k+1}} \left\{ 1 - \sum_{j=0}^{k} \frac{\left((x_0/b)(1+b\lambda_0)\right)^j}{j!} e^{-\frac{x_0}{b}(1+b\lambda_0)} \right\} \right\}$$

On simplification

$$= \lambda_0 \left\{ \frac{1}{\lambda_0}\left(1-e^{-\lambda_0 x_0}\right) - b(i+n+1)(1+b\lambda_0)^{-k-1} \left\{ 1 - \frac{\Gamma\left(k+1\left(\lambda_0+\frac{1}{b}\right)x_0\right)}{\Gamma(k+1)} \right\} \right\} \quad \ldots (13)$$

$$\therefore \quad \int_0^{x_0} \left(G_n(y) - G_{n+1`}(y)\right)\lambda_0 e^{-\lambda_0 x_1} dx =$$

$$\left\{ \begin{array}{l} (1-R)\sum_{i=0}^{\infty}\left(\frac{1}{(1-R+nR)}\left(\frac{nR}{1-R+nR}\right)^i \left\{\left(1-e^{-\lambda_0 x_0}\right) - b\,\lambda_0\left(I_0 + I_1 + I_2 + \Lambda\ I_{n+i-1}\right)\right\}\right) \\ -(1-R)\sum_{i=0}^{\infty}\left(\frac{1}{(1+nR)}\left(\frac{(n+1)R}{1+nR}\right)^i \left\{\left(1-e^{-\lambda_0 x_0}\right) - b\,\lambda_0\left(I_0 + I_1 + I_2 + \Lambda\ I_{n+i-1}\right)\right\}\right) \end{array} \right\}$$

$$\int_0^{x_0} \left(G_n(y) - G_{n+1`}(y)\right)\lambda_0 e^{-\lambda_0 x_1} dx =$$

$$\left\{ \begin{array}{l} (1-R)\sum_{i=0}^{\infty}\left(\frac{1}{(1-R+nR)}\left(\frac{nR}{1-R+nR}\right)^i \left\{\left[1-e^{-\lambda_0 x_0}\right] - b\,\lambda_0(i+n+1)(1+b\lambda_0)^{-k-1} \left\{ 1 - \frac{\Gamma\left(k+1\left(\lambda_0+\frac{1}{b}\right)x_0\right)}{\Gamma(k+1)} \right\}\right\}\right) \\ -(1-R)\sum_{i=0}^{\infty}\left(\frac{1}{(1+nR)}\left(\frac{(n+1)R}{1+nR}\right)^i \left\{\left[1-e^{-\lambda_0 x_0}\right] - b\,\lambda_0(i+n+1)(1+b\lambda_0)^{-k-1} \left\{ 1 - \frac{\Gamma\left(k+1\left(\lambda_0+\frac{1}{b}\right)x_0\right)}{\Gamma(k+1)} \right\}\right\}\right) \end{array} \right\} \quad \ldots (14)$$

Now consider $\int_{x_0}^{\infty} \left(G_n(y) - G_{n+1`}(y)\right)\lambda_1 e^{-\lambda_0 \tau} e^{-\lambda_1 (x-\tau)} dx =$

$$\left\{ (1-R)\sum_{i=0}^{\infty}\left(\begin{array}{l} \frac{1}{(1-R+nR)}\left(\frac{nR}{1-R+nR}\right)^i \frac{1}{(n+i-1)!}\int_{x_0}^{\infty}\psi\left(n+i, x/b\right)\lambda_1 e^{-\lambda_0\tau} e^{-\lambda_1(x-\tau)} dx \\ -\frac{1}{(1+nR)}\left(\frac{(n+1)R}{1+nR}\right)^i \frac{1}{(n+i)!}\int_{x_0}^{\infty}\psi\left(n+1+i, x/b\right)\lambda_1 e^{-\lambda_0\tau} e^{-\lambda_1(x-\tau)} dx \end{array} \right) \right\} \quad \ldots (15)$$

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$$\text{Take } \lambda_1 \int_{x_0}^{\infty} \frac{\psi\left(n+i, x/b\right)}{(n+i-1)!} e^{-\lambda_0 \tau} e^{-\lambda_1 (x-\tau)} dx$$

$$= \lambda_1 e^{-\lambda_1 (x-\tau)} \int_{x_0}^{\infty} \frac{1}{(n+i-1)!} \left(\int_0^{x/b} e^{-\tau} \tau^{n+i-1} d\tau \right) e^{-\lambda_0 \tau} dx$$

$$= \lambda_1 e^{-\lambda_1 (x-\tau)} \left(\frac{-1}{\lambda_0} \left(e^{-\lambda_0 \tau} \right)_{x_0}^{\infty} - \sum_{k=0}^{n+i-1} \frac{1}{\mathrm{k!}} \int_{x_0}^{\infty} \left(\tfrac{x}{b} \right)^k e^{-x/b (1+b\lambda_0)} dx \right)$$

Let $\quad z = x/b \Rightarrow x = bz \qquad\qquad dx = bdz$

$$= \lambda_1 e^{-\lambda_1 (x-\tau)} \left(\frac{e^{-\lambda_0 x_0}}{\lambda_0} - b \sum_{k=0}^{n+i-1} \frac{1}{\mathrm{k!}} \int_{x_0/b}^{\infty} z^k e^{-z(1+b\lambda_0)} dz \right)$$

On simplification

$$= \frac{\lambda_1 e^{-\lambda_1 (x-\tau)}}{\lambda_0} \left(e^{-\lambda_0 x_0} - b\lambda_0 \sum_{k=0}^{n+i-1} \frac{1}{(1+b\lambda_0)^{k+1}} \sum_{\mathrm{j}=0}^{\mathrm{k}} \frac{\left(\left(x_0/\mathrm{b} \right) (1+b\lambda_0) \right)^j}{\mathrm{j!}} e^{-x_0/b (1+b\lambda_0)} \right)$$

$$\lambda_1 \int_{x_0}^{\infty} \frac{\psi\left(n+i, x/b\right)}{(n+i-1)!} e^{-\lambda_0 \tau} e^{-\lambda_1 (x-\tau)} dx =$$

$$= \frac{\lambda_1 e^{-\lambda_1 (x-\tau)}}{\lambda_0} \left(e^{-\lambda_0 x_0} - b\lambda_0 \sum_{k=0}^{n+i-1} \frac{1}{(1+b\lambda_0)^{k+1}} \sum_{\mathrm{j}=0}^{\mathrm{k}} \frac{\left(\left(x_0/\mathrm{b} \right) (1+b\lambda_0) \right)^j}{\mathrm{j!}} e^{-x_0/b (1+b\lambda_0)} \right) \quad \ldots (16)$$

$$\text{Similarly } \int_{x_0}^{\infty} \frac{\psi\left(n+1+i, x/b\right)}{(n+i)!} \lambda_1 e^{-\lambda_0 \tau} e^{-\lambda_1 (x-\tau)} dx = \lambda_1 e^{-\lambda_1 (x-\tau)} \int_{x_0}^{\infty} \left(\int_0^{x/b} \frac{e^{-\tau} \tau^{n+i}}{(n+i)!} d\tau \right) e^{-\lambda_0 \tau} dx$$

$$= \lambda_1 e^{-\lambda_1 (x-\tau)} \left(\left(\frac{e^{-\lambda_0 \tau}}{-\lambda_0} \right)_{x_0}^{\infty} - \sum_{k=0}^{n+i} \frac{1}{\mathrm{k!}} \int_{x_0}^{\infty} \left(x/b \right)^k e^{-(x/b)(1+\lambda_0)} dx \right)$$

Let $\quad z = x/b, \qquad dx = bdz$

$$= \lambda_1 e^{-\lambda_1 (x-\tau)} \left(\frac{e^{-\lambda_0 x_0}}{\lambda_0} - b \sum_{k=0}^{n+i} \frac{1}{\mathrm{k!}} \int_{x_0/b}^{\infty} z^k e^{-z(1+b\lambda_0)} dz \right)$$

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$$= \frac{\lambda_1 e^{-\lambda_1(x-\tau)}}{\lambda_0}\left(e^{-\lambda_0 x_0} - b\lambda_0 \sum_{k=0}^{n+i} \frac{1}{(1+b\lambda_0)^{k+1}} \sum_{j=0}^{k} \frac{\left((x0/b)(1+b\lambda_0)\right)^j}{\text{j!}} e^{-\frac{x_0}{b}(1+b\lambda_0)} \right)$$

Therefore (15) becomes

$$= \left\{ \begin{array}{l} (1-R)\dfrac{\lambda_1 e^{-\lambda_1(x-\tau)}}{\lambda_0} \sum_{i=0}^{\infty} \left(\begin{array}{l} \dfrac{1}{(1-R+nR)} \left(\dfrac{nR}{1-R+nR} \right)^i e^{-\lambda_0 x_0} - b\lambda_0 \sum_{k=0}^{n+i-1} \dfrac{1}{(1+b\lambda_0)^{k+1}} \\ \sum_{j=0}^{k} \dfrac{\left((x_0/b)(1+b\lambda_0)\right)^j}{\text{j!}} e^{-\frac{x_0}{b}(1+b\lambda_0)} \end{array} \right) \\ -(1-R)\dfrac{\lambda_1 e^{-\lambda_1(x-\tau)}}{\lambda_0} \sum_{i=0}^{\infty} \left(\begin{array}{l} \dfrac{1}{(1+nR)} \left(\dfrac{(n+1)R}{1+nR} \right)^i e^{-\lambda_0 x_0} - b\lambda_0 \sum_{k=0}^{n+i} \dfrac{1}{(1+b\lambda_0)^{k+1}} \\ \sum_{j=0}^{k} \dfrac{\left((x_0/b)(1+b\lambda_0)\right)^j}{\text{j!}} e^{-\frac{x_0}{b}(1+b\lambda_0)} \end{array} \right) \end{array} \right\} \quad \ldots(17)$$

On simplification

$$= \left\{ \begin{array}{l} (1-R)\dfrac{\lambda_1 e^{-\lambda_1(x-\tau)}}{\lambda_0} \left(\begin{array}{l} \dfrac{1}{(1-R+nR)} \left(\dfrac{-nR+R-1}{R-1} \right) e^{-\lambda_0 x_0} \\ -\left(1-(b\lambda_0+1)^{-n-i} \right) \left(\dfrac{\Gamma\left(k+1\left(\lambda_0 + \dfrac{1}{b} \right) x_0 \right)}{\Gamma(k+1)} \right) \end{array} \right) \\ -(1-R)\dfrac{\lambda_1 e^{-\lambda_1(x-\tau)}}{\lambda_0} \left(\begin{array}{l} \dfrac{1}{(1+nR)} \left(\dfrac{-nR-1}{R-1} \right) e^{-\lambda_0 x_0} \\ -b\lambda_0(i+n+1)(b\lambda_0+1)^{-k-1} \left(\dfrac{\Gamma\left(k+1\left(\lambda_0 + \dfrac{1}{b} \right) x_0 \right)}{\Gamma(k+1)} \right) \end{array} \right) \end{array} \right\}$$

Thus Eq. (5)$\Rightarrow$

$$\sum_{n=1}^{\infty} F_n(B)\left(f_1(n+i-1,\lambda_0) - f_2(n+i,\lambda_0) + f_3(n+i-1,\lambda_2) - f_4(n+i,\lambda_2) \right) = \frac{d_1+d_2}{h+d_1+d_2} \quad \ldots (18)$$

$$f_1(n+i-1,\lambda_0) = (1-R)\left\{ \begin{array}{l} \dfrac{1}{(1-R+nR)} \left(\dfrac{-nR+R-1}{R-1} \right) \left(1-e^{-\lambda_0 x_0} \right) \\ -\left(b\lambda_0(i+n+1)(1+b\lambda_0)^{-k-1} \left\{ 1 - \dfrac{\Gamma\left(k+1\left(\lambda_0 + \dfrac{1}{b} \right) x_0 \right)}{\Gamma(k+1)} \right\} \right) \end{array} \right\}$$

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$$f_2(n+i,\lambda_0)=(1-R)\begin{Bmatrix}-\frac{1}{(1+nR)}\left(\frac{-nR-1}{R-1}\right)\left(1-e^{-\lambda_0 x_0}\right)\\ -b\lambda_0(i+n+1)(1+b\lambda_0)^{-k-1}\left\{1-\frac{\Gamma\left(k+1\left(\lambda_0+\frac{1}{b}\right)x_0\right)}{\Gamma(k+1)}\right\}\end{Bmatrix}$$

$$f_3(n+i-1,\lambda_2)=\frac{\lambda_1 e^{-\lambda_1(x-\tau)}}{\lambda_0}(1-R)\begin{pmatrix}\frac{1}{(1-R+nR)}\left(\frac{-nR+R-1}{R-1}\right)e^{-\lambda_0 x_0}\\ -\left(1-(b\lambda_0+1)^{-n-i}\right)\left(\frac{\Gamma\left(k+1\left(\lambda_0+\frac{1}{b}\right)x_0\right)}{\Gamma(k+1)}\right)\end{pmatrix}$$

$$f_4(n+i,\lambda_2)=\frac{\lambda_1 e^{-\lambda_1(x-\tau)}}{\lambda_0}(1-R)\begin{pmatrix}\frac{1}{(1+nR)}\left(\frac{-nR-1}{R-1}\right)e^{-\lambda_0 x_0}\\ -b\lambda_0(i+n+1)(b\lambda_0+1)^{-k-1}\left(\frac{\Gamma\left(k+1\left(\lambda_0+\frac{1}{b}\right)x_0\right)}{\Gamma(k+1)}\right)\end{pmatrix}$$

$$F_n(B)=\int_0^B\frac{\mu^n y^{n-1}}{(n-1)!}e^{-\mu y}dy=1-\sum_{1=0}^{n-1}\frac{(\mu B)^1}{1!}\mathrm{e}^{-\mu\mathrm{B}} \qquad \ldots (19)$$

$$\sum_{n=1}^{\infty}\int_0^B\frac{\mu^n y^{n-1}}{(n-1)!}e^{-\mu y}\begin{Bmatrix}f_1(n+i-1,\lambda_0)-f_2(n+i,\lambda_0)\\ +f_3(n+i-1,\lambda_2)-f_4(n+i,\lambda_2)\end{Bmatrix}dy=\frac{d_1+d_2}{\alpha+d_1+d_2}$$

$$\sum_{n=1}^{\infty}\left(1-\sum_{1=0}^{n-1}\frac{(\mu B)^1}{1!}\mathrm{e}^{-\mu\mathrm{B}}\right)\begin{Bmatrix}f_1(n+i-1,\lambda_0)-f_2(n+i,\lambda_0)\\ +f_3(n+i-1,\lambda_2)-f_4(n+i,\lambda_2)\end{Bmatrix}=\frac{d_1+d_2}{h+d_1+d_2}$$

on simplification

$$\hat{B}=\frac{\log\left(\frac{d_1+d_2}{(h+d_1+d_2)\left(f_1(n+i-1,\lambda_0)-f_2(n+i,\lambda_0)+f_3(n+i-1,\lambda_2)-f_4(n+i,\lambda_2)\right)}-1\right)}{\mu\log e} \qquad \ldots (20)$$

The value of B which satisfies the above equation (20) for fixed value of h, d_1, d_2, λ_1, λ_2, μ, x_0, n, R, is the optimal value of base stock inventory $\hat{B}$ and it can be obtained numerically.

NUMERICAL ILLUSTRATION

The variations in the value of $\hat{B}$ corresponding to the changes in h, d_1 and d_2 values are obtained by keeping all the other parameter fixed.

By taking μ=2 and keeping all the other parameters fixed the variations in $\hat{B}$ consequent to the changes in h and similarly d_1 and d_2 are given in the following table.

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Form table 1 and Fig 1 it is observed that as the value of h which is the inventory holding cost increases then there is decrease in the value of $\hat{B}$ which is optimal inventory.

Table-1: Optimal value of the Reserve Inventory when holding cost is fixed

h	5	10	15	20	25
$\hat{B}$	0.444	0.338	0.273	0.229	0.197

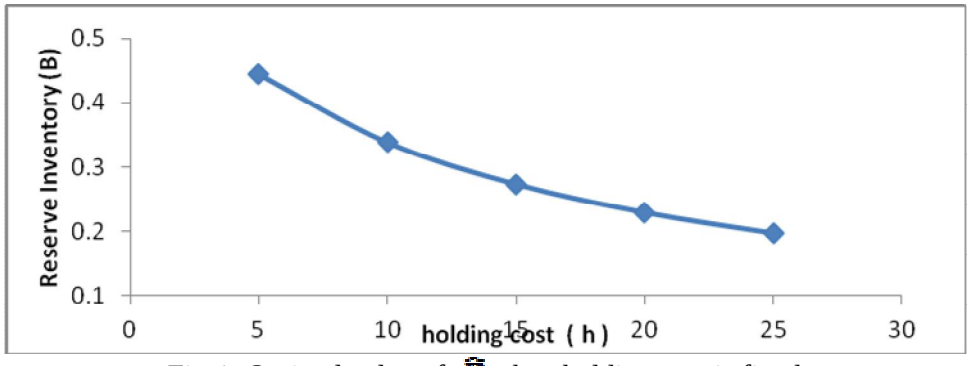

Fig-1: Optimal value of $\hat{B}$ when holding cost is fixed

If the value of d_1 which is shortage cost for M_2^a increases an increase in the values of $\hat{B}$ is suggested as indicate in table 2 and Fig 2.

Table-2: Optimal value of the Reserve Inventory when Shortage cost for M_2^a is fixed

d_1	5	10	15	20	25
$\hat{B}$	0.444	0.482	0.508	0.527	0.541

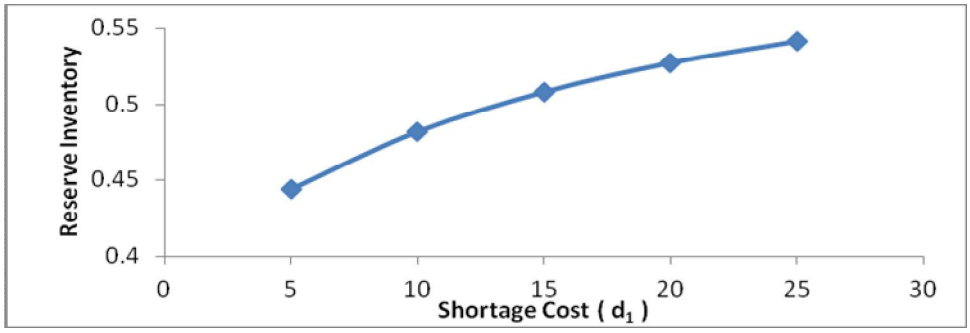

Fig-2: Optimal value of $\hat{B}$ when shortage cost for M_2^a is fixed

If the value of d_2 which is shortage cost for M_2^b increases an increase in the values of $\hat{B}$ is suggested as indicate in table 3 and Fig 3.

Table-3: Optimal value of the Reserve Inventory when Shortage cost for M_2^b is fixed

d_2	10	20	30	40	50
$\hat{B}$	0.444	0.508	0.541	0.562	0.576

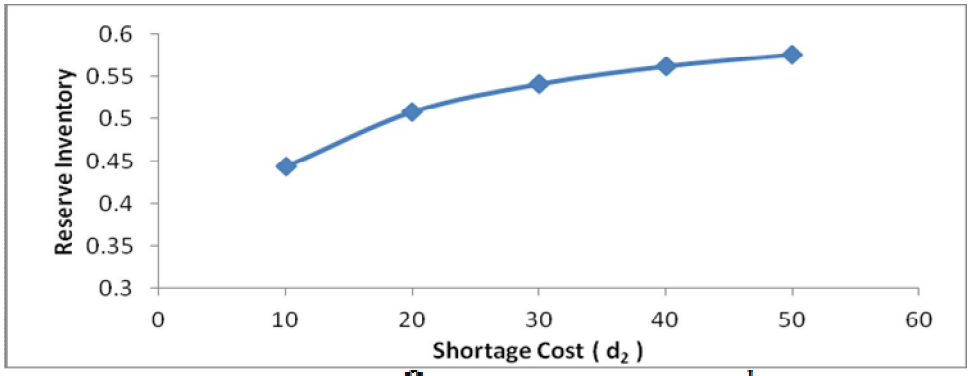

Fig-3: Optimal value of $\hat{B}$ when shortage cost for M_2^b is fixed

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By taking μ=1 and keeping all the other parameters fixed the variations in $\hat{B}$ consequent to the changes in h and similarly d_1 and d_2 are given in the following table

Form table 4 and Fig 4 it is observed that as the value of h which is the inventory holding cost increases then there is decrease in the value of $\hat{B}$ which is optimal inventory.

Table-4: Optimal value of the Reserve Inventory when holding cost is fixed

h	5	10	15	20	25
$\hat{B}$	0.227	0.173	0.139	0.117	0.101

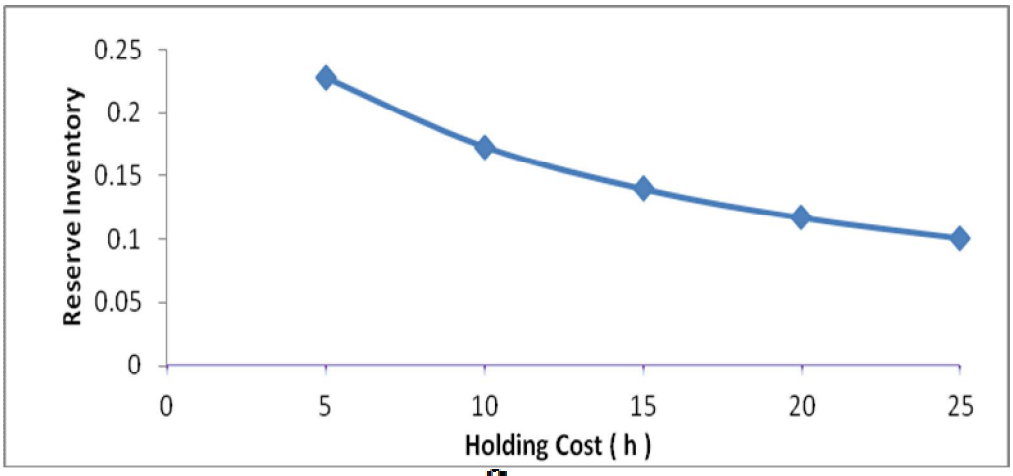

Fig-4: Optimal value of $\hat{B}$ when holding cost is fixed

If the value of d_1 and d_2 which is shortage cost for M_2^a increases an increase in the values of $\hat{B}$ is suggested as indicate in table 5 and Fig 5.

Table-5: Optimal value of the Reserve Inventory when Shortage cost for M_2^a is fixed

d_1	5	10	15	20	25
$\hat{B}$	0.227	0.246	0.260	0.269	0.277

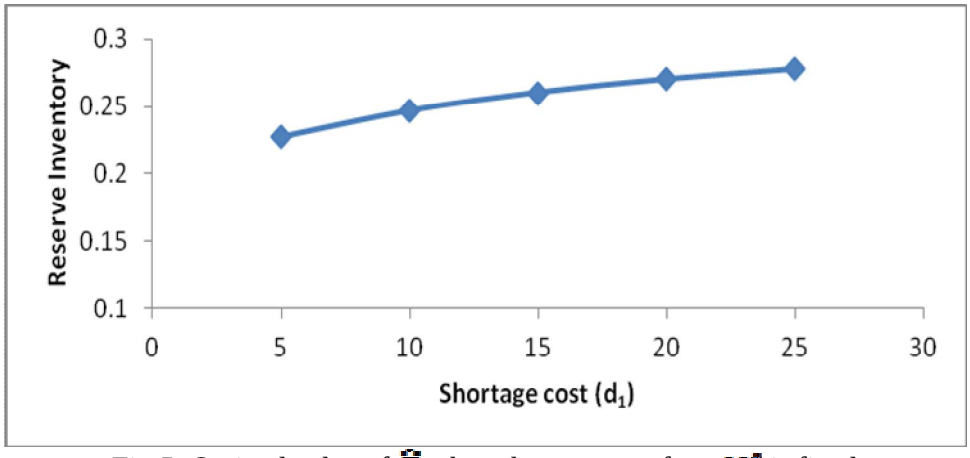

Fig-5: Optimal value of $\hat{B}$ when shortage cost for M_2^a is fixed

If the value of d_2 which is shortage cost for M_2^b increases an increase in the values of $\hat{B}$ is suggested as indicate in table 6 and Fig 6.

Table-6: Optimal value of the Reserve Inventory when Shortage cost for M_2^b is fixed

d_2	10	20	30	40	50
$\hat{B}$	0.227	0.260	0.277	0.287	0.295

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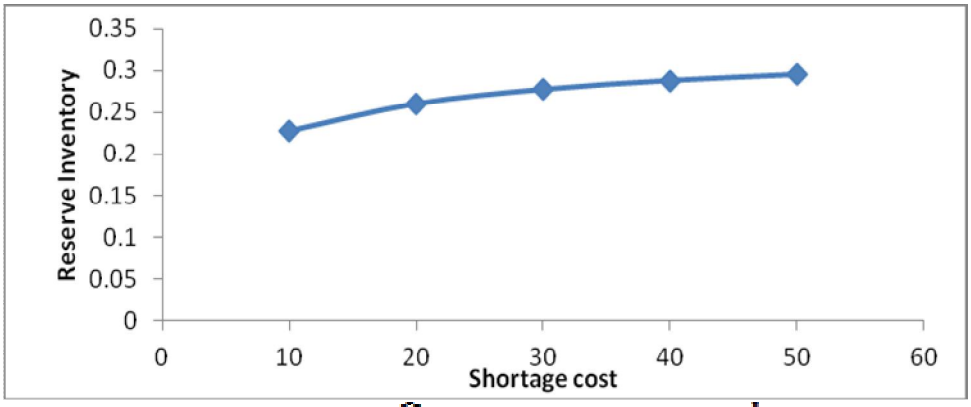

Fig-6: Optimal value of $\hat{B}$ when shortage cost for M_2^1 is fixed

CONCLUSIONS

It may be noted from the above numerical examples that

1. As the value of the inventory holding cost increases there is a decrease in $\hat{B}$ this suggests less of base stock. Similarly if the value of d_1 and d_2 namely the shortage cost increases there is a corresponding increases in $\hat{B}$ values and so larger base stock size is suggested.
2. If the value of μ, which is the parameter of the distribution of interarrival times is taken as μ=1 then the changes in $\hat{B}$ consequent to the increase in h, d_1 and d_2.

It may be noted that μ=2, the $\hat{B}$ values are relatively smaller for h, d_1 and d_2 in comparison with when μ=1. This implies that when the interarrival times between breakdowns are smaller then the size of base stock should be smaller. This indicates that the impact of the interarrival times between breakdown over the size of the base stock to be maintained.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

CHANGING SCENARIO OF INDIAN TELECOM SECTOR WITH THE ENTRY OF JIO

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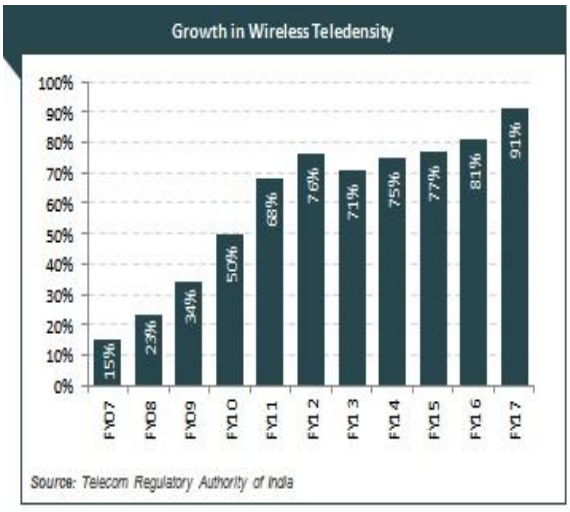
ABSTRACT
Indian telecom Industry is the largest growing industry. Before 2008, the Indian telecom sector was one of the most profitable markets with high growth rates and reasonably concentrated market. Spectrum was not auctioned but given on subscriber-linked criteria. The system was not perfect and it could be misused by telecom operators. This led to the entry of new players in 2009 which resulted in significant decrease in tariffs and profitability. After the crash in tariffs, the rising capex for spectrum led to increase in financial stress which has limited the incumbent telcos ability to invest. Thus with the entry of Reliance Jio, industry consolidation to augment capacities is the only viable solution. The entry of Jio is deeply impacting the market in every way. The present paper studies the impact of Jio on Indian Telecom Scenario.

INDIAN TELECOM INDUSTRY
Indian telecom Industry, largest growing industry, has massive potential to serve people and improving day by day. With awareness in young generation about this sector, the public demand is all time high and still increasing. With up gradation in technology and demand all major services providers from across the world entered in this sector. Government also makes liberal policies to facilitate investors and also setup a fair and proactive regulatory framework.

- India is currently the 2nd largest telecommunication market and has the 3rd highest number of internet users in the world
- India's telephone subscriber base expanded at a CAGR of 19.16 per cent, reaching 1188.5 million during FY17.
- Tele-density (defined as the number of telephone connections for every 100 individuals) in India, increased from 17.9 in FY07 to 92.59 in FY17.
- The mobile segment's teledensity surged from 14.6 per cent in FY07 to 90.70 per cent in FY17.
- GSM services continue to dominate the wireless market with a 98.66 per cent share (as of December 2016); while CDMA services accounted for the remaining 1.34 per cent share.



Source: Telecom Regulatory Authority of India

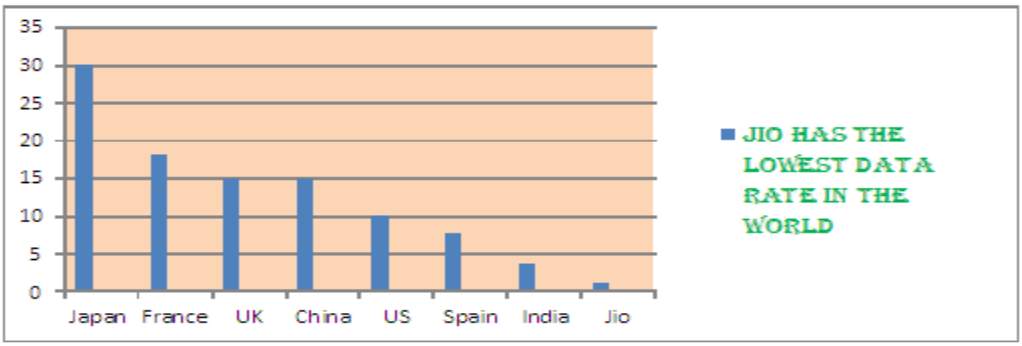
THE PRESENT STRUCTURE OF TELECOM SECTOR
Intense competition in the Indian Telecom sector is resulting in a sea change for the last 8 years. During this period the contribution of telecom services to GDP has declined from 2% of GDP in FY09 to just 1.2% in FY17. There is decrease in return ratios for the telecom players and all the telecom companies are not able to cover their cost of capital because of continuous investments in spectrum purchases. The industry is at its lowest point because of the high degree of financial leverage and margins influenced by rising competition from new player Reliance Jio. In the present situations, the industry has lots of challenges which is pushing the firms towards industry consolidation.

ISSN 2394 - 7780

Before 2008, the Indian telecom sector was one of the most profitable markets with high growth rates and reasonably concentrated market. Spectrum was not auctioned but given on subscriber-linked criteria. The system was not perfect and it could be misused by telecom operators. This led to the entry of new players in 2009 which resulted in significant decrease in tariffs and profitability. After the crash in tariffs (which never recovered), the rising capex for spectrum led to increase in financial stress which has limited the incumbent telcos ability to invest. Thus with the entry of Reliance Jio, industry consolidation to augment capacities is the only viable solution. The industry in totality has over capacity and the only way the demand versus supply will match in the future is through industry consolidation.

ENTRY OF RELIANCE JIO IN TELECOM SECTOR

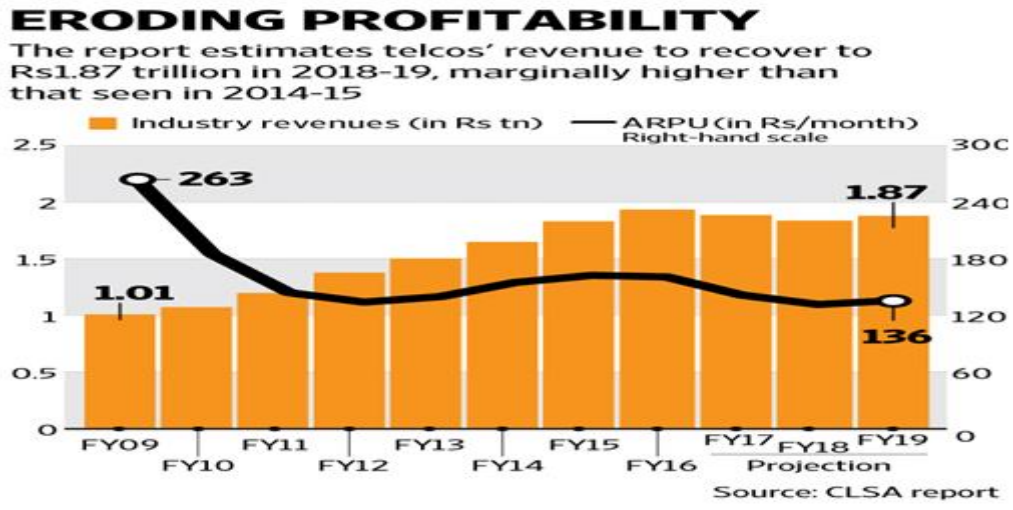
Reliance Jio Infocomm Limited announced the launch of its digital services with JIO in Mumbai on 1st September 2016 with Jio Welcome Offer. "JIO" is the business name of the Reliance JIO Infocomm Limited (RJIL). It is an LTE(Long-term Evolution) mobile operator in India. JIO aims to provide 4G LTE service network without 3G/2G based service. It is a 4G only service and does not use lower bands for data transmission (unlike other networks). It is the only Voice Over Long-term Evolution (VoLTE) service in India. In June 2010, Reliance Industries(RIL) bought a 96% stake in Infotel Broadband Services Limited(ISBL) for 48 billion. The IBSL was later renamed to Reliance JIO Infocomm Limited(RJIL) in January 2013. The trial version was launched on 27th Dec 2015 for the employees It was made commercial on 5th Sept 2016. Reliance JIO is the world's largest startup at Rs. 1.5 lakh crore investments. It aims at providing premium data service at low cost. It plans to have a partnership with thousands of small and emerging Indian entrepreneurs.



REVENUE ESTIMATION OF JIO

Reliance Jio is likely to break even by end of Q3FY18 and by 2021, it is expected to contribute around half of the revenues – 40-50 per cent—for RIL. Reliance Jio 's loss was Rs 270.6-crore net loss in its maiden standalone financial numbers against market expectations of around Rs 2,000 crore. Jio's consolidated value of services stood at Rs 7,213 crore, while revenue from operations stood at Rs 6,147 crore. The total wireless data traffic stood at 378 crore GB and the average voice traffic at 267 crore minutes per day. Total investment into Jio so far is Rs 1.49 trillion and has Rs 62,000 crore in capital work in progress. The latest entrant into the competitive telecom space, which has disrupted the industry through its aggressive pricing, had its average revenue per user or ARPU at Rs 156.4, the highest in the industry

The annual revenue of Indian telecom firms declined for the first time since 2008-09 to Rs1.88 trillion in 2016-17 (from Rs1.93 trillion the previous year), and it is estimated to decline further to Rs1.84 trillion in 2017-18.



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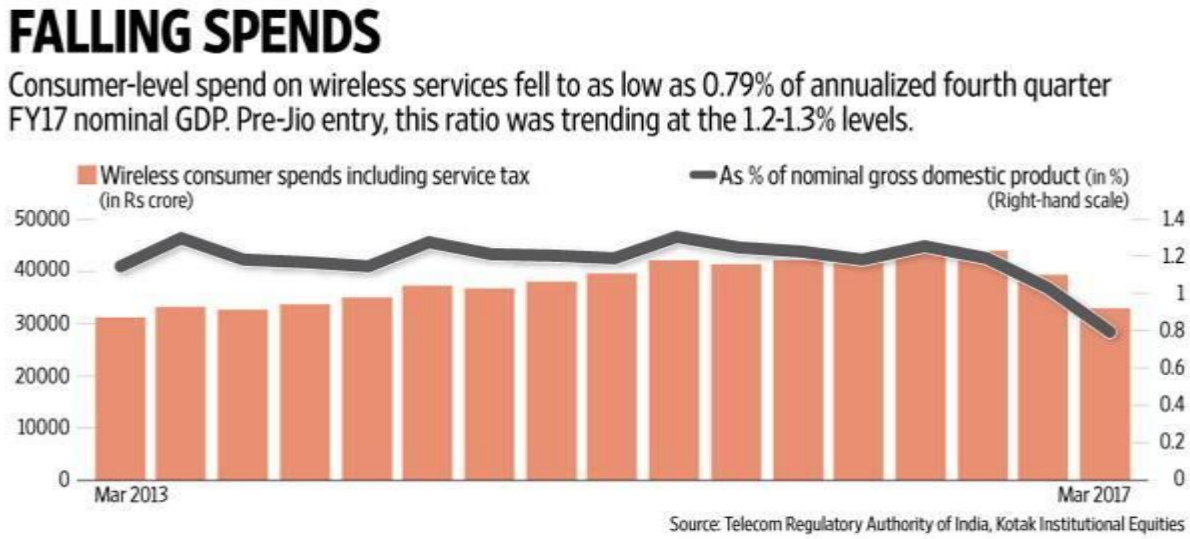
CONSUMER SPENDING

Consumer-level wireless spending (including service tax) fell to Rs33,000 crore in the March 2017 quarter. That's down from Rs 43,700 crore a year ago and a peak of Rs 44,600 crore in the June 2016 quarter, the last ex-Jio quarter. As such, the reduction in wireless bills works out to Rs11,600 crore on a quarterly basis, or Rs46,400 crore on an annualized basis. On average, based on this data, consumer spending has fallen by 26% since Reliance Jio's launch.



IMPACT ON EMPLOYMENT

One of the effects of the consolidation is on jobs. Most of the deals are distressed sales by loss-making companies, including Tata Tele, Telenor, Videocon and Tikona Wireless. The failed merger between Reliance Communications and Aircel adds to the woes as there is now uncertainty over their operations, which could force them to shut operations at least partially. According to one market estimate, as many as 30,000 jobs could be at stake. Jio's entry precipitated exits by the weaker players and a merger of smaller incumbents (Idea and Vodafone). Since Jio's entry, the incumbents have seen a reduction of 30-35 per cent in EBITDA and 800-1,000 bps in margins as they have tactically matched Jio's tariffs.

IMPACT OF JIO ON NON PERFORMING ASSETS

The share of the telecom sector in the non-performing assets (NPAs) has now increased. the share of NPAs of telecom sector in total NPAs of infrastructure sector increased to 8.7% in 2016-17 from 5% in 2015-16. The sector has debt of nearly Rs5 lakh crore and the banking sector – which pegs the debt at Rs 7.29 lakh crore - are worried that the ongoing competition will lead to defaults. As per the survey, the mobile industry in India accounts for 6.5% (USD 140 billion) of the country's GDP, and employs over 4 million people direct and indirectly.

CONSOLIDATION IN TELECOM SECTOR

The ongoing shake-up in the telecom sector has set the stage for a three-way battle between Airtel, Reliance Jio and the Vodafone-Idea combine. India's data services market is estimated to be Rs. 95,000 crore by 2020, growing at a compounded annual rate of 21 per cent. While Airtel has become the No. 1 player with the acquisition of Tata Teleservices' mobile business. Vodafone and Idea are also on the line of merger. Once the merger goes through, the Vodafone-Idea combine will become the largest operator in terms of subscribers, but Airtel will keep its position in terms of revenue market share and spectrum holding. From having 9-10 mobile operators in each circle just a few years ago, the Indian telecom sector is all set for a major consolidation that would reduce the number of players to 3-4. The industry has settled at around four operators. India has taken time to consolidate to the right number, but it is finally happening. India's telecom sector has had several rounds of consolidation earlier. Between 2001 and 2004, there were several deals that saw the exit of regional players like Koshika Telecom and Escotel and the emergence of pan-India operators. The difference between then and now is that the current consolidation has led to huge value destruction. It has been painful for those exiting.

THE INDUSTRY IS NOW COMPOSED OF THREE SETS OF PLAYERS

1. Established incumbents like Bharti, Vodafone and Idea Cellular which have executed well in the past and have strong brands. Vodafone merger with Idea will solve the capacity constraints of both the players.

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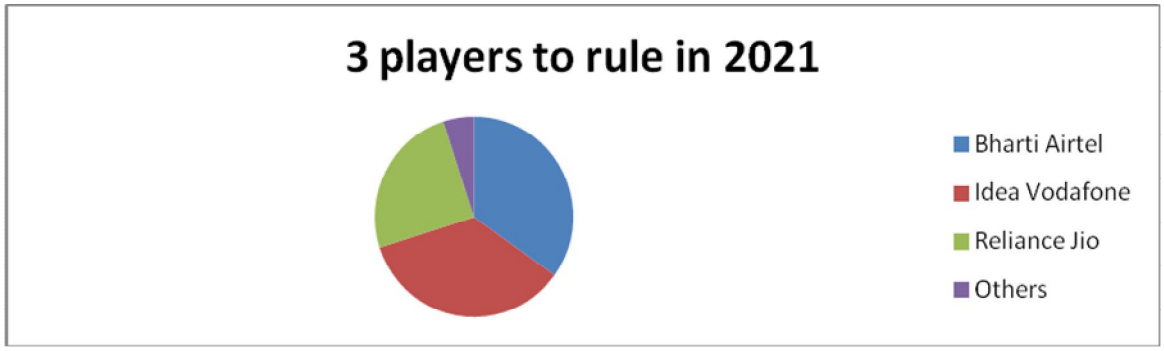
2. Weaker players like Telenor, MTS, RCOM, BSNL, MTNL and Aircel which are exiting or are consolidating for survival. Even after consolidation, the operators ability to invest will pose a challenge
3. Reliance Jio which has defined the technological and strategic landscape.



CONCLUSION

The Indian Telecom Sector is moving from a level playing field, a monopolistic competitive market towards oligopoly market and then may be ultimately to monopoly market. It is estimated that by 2021 only three telecom players will rule the market which will truly create an oligopoly market. The prices are being created by Jio and other telecom players are just following it. The Indian telecom industry is at a critical juncture and faster improvement in profitability will be crucial for long-term health of the sector. Industry consolidation is critical but government interventions to improve industry profitability will help the sector immensely. The Indian telecom sector has immense potential for growth but realising the potential is in the hands of government and regulator. In future, the industry will see slower investments and more consolidation. With so much supply in the market, revenue will grow with usage albeit with a lag. We expect 11 per cent revenue CAGR over the next 5 years but most of the growth will be back ended post industry consolidation. The weaker players will have to exit but their debt presents a structural problem for an exit. In this regard, the government might need to step in to improve the industry profitability to ease the exit of players and solve the structural debt issue. The government has many levers to improve the industry profitability which include reducing service tax to spectrum usage charges. All or any of these measures can improve the industry profitability significantly.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018

ISSN 2394 - 7780

CYBERCRIME: A CRIMINAL OFFENCE

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ABSTRACT

The dawn of digitalization and the IT Revolution has brought with itself the perils of mushrooming cyber-crimes on the internet and the computers. This increasing threat to the digitally stored data has rendered it vulnerable and as a consequence has managed to grab eyeballs world- wide.The existing laws being practiced in most parts of the world today, are less-likely to be enforceable against cyber-crimes. This growing curtailment of legal protection means that both government and the firms must rely on the few technical measures to safeguard their stored valuable information against embezzlement, hacking and destruction. Nations, mostly the ones that are developing or are under developed, where the cybercrime protection is not up to the mark will be most likely to fall prey to this menace and also will be less able to keep pace with the growing global economy.

As nowadays cybercrime is increasingly rupturing different borders, many countries are now under the risk of having their information blocked by the network. There is now a growing urge for the government of the countries to examine their current status to determine whether they are sufficient to combat with the vulnerable cybercrimes that are practiced in today's era. Cybercrimes can be defined as: "Offences that are committed against individuals or groups of individuals with a criminal motive to intentionally harm the reputation of the victim or cause physical or mental harm, or loss, to the victim directly or indirectly, using modern telecommunication networks such as Internet & networks including but not limited to Chat rooms, emails, notice boards and groups and mobile phones. In addition to this the various consequences of different criminal practices can be more far reaching than before as they are not restricted by any national boundaries. Cyber crime is done at many organisations in many business units big or small and this is because of the employees at the organisation their working habits are also responsible for cyber activities. The recent spread of computer viruses all over the globe has provided the proof of this reality. Cybercrime as a whole consists of unique methods that deal with computer networks, hacking and the reinforcement of various other crimes through use of the modern era electronic brain. Cybercrime issues have become a global threatening that is surrounding hacking, copyright infringement through wares, and child grooming via child pornography. There are also dilemmas of privacy when confidential data is forfeited or intercepted, lawfully or otherwise. The rise in popularity of the Internet for both firm and the government has resulted in a analogous rise in the number of cybercrimes, which demand to be dealt with a strong hand before it develops in to a widespread catastrophic phenomenon, plaguing worldwide security and privacy.

Keywords: Cybercrimes, methods, innovation, threat, catastrophic, human resource, employee.

1.0 INTRODUCTION

Today's society has to do with fast pace and progress. Part of this progressive mentality is the constant improvement of technology. The whole life of many people revolves around technology and often they do not notice it at all. In today's age of technology, it is becoming increasingly difficult to keep our personal information private. The truth is that highly classified details are becoming more available to public databases because we are more interconnected than ever before. Our data is visible to everyone thanks to this connection. This creates a negative stigma that the use of technology is dangerous because virtually everyone can access his private information at a price. Technology continues to promise to make our daily life easier; However, there are dangers in the use of technology. One of the greatest threats to the use of technology is the threat of cybercrime. Cybercrime is becoming a growing problem in this technological era. The growing dependence of the world on technology is also driving the vulnerability of the world. Measures have been taken to protect and prevent cybercrime, but as technology evolves, existing precautionary measures must evolve. Cybercrime involves a wide range of crimes and makes crimes that are often easier to commit than ever before.

Ordinary Internet users may not be aware of cybercrime, not to mention what to do if they are attacked by cyber criminals. Many innocent people are victims of cybercrime around the world, especially because technology is developing rapidly. Cybercrime is a crime that harms another person using a computer and a network. Cybercrime can occur due to privacy and confidentiality issues. If privacy and confidential information are lost or illegally interrupted by individuals, they are replaced by high-profile crimes such as hacking, cyber-terrorism, espionage, financial theft, copyright infringement, spamming, cyber warfare and many crimes. beyond the boundaries. Cybercrime can happen to anyone when their information has been damaged by an illegal user.

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2.0 THE PROBLEM

Currently, when people talk about cybercrime, they can not understand the extent of these crimes. Many questions arise when the term cyber crime is questioned. Some of the questions are: "Cybercrime only occurs on the Internet?", "Cybercrime is for computers only" and so on, but traditional crimes such as theft and fraud have been perpetrated with digital resources and are now considered cybercrime. But what is cybercrime?

A common definition of this term is that cybercrime is a "crime committed through the use of a computer and the Internet to steal a person's identity or to sell illegal victims or to harass or stop illegal operations malicious programs. Cybercrime.) Other definitions, however, have limitations on the expansive meaning of further describing the word "cyber crime".

Some of these definitions as follow

2.1 New World Encyclopaedia defines it as "is a term used broadly to describe activity in which computers or computer networks are the tool, target, or place of criminal activity. These categories are not exclusive and many activities can be characterized as falling in one or more categories." www.newworldencyclopedia.org/entry/Cybercrime

2.2 Bukisa defines it as "It is this access to the technical specifications of how the Internet and Internet technologies are implemented that allows an attacker to subvert systems, networks and the Internet for their own ends."www.bukisa.com/articles/206_internet-security-concepts

2.3 Webopedia defines it as "Cybercrime encompasses any criminal act dealing with computers and networks (called hacking). Additionally, cybercrime also includes traditional crimes conducted through the Internet. For example; hate crimes, telemarketing and Internet fraud, identity theft, and credit card account thefts are considered to be cybercrimes when the illegal activities are committed through the use of a computer and the Internet."http://www.webopedia.com/TERM/C/cyber_crime.html

2.4 Wise Geek defines it as "Cybercrimes are generally defined as any type of illegal activity that makes use of the Internet, a private or public network, or an in-house computer system. While many forms of cybercrime revolve around the appropriation of proprietary information for unauthorized use, other examples are focused more on an invasion of privacy. As a growing problem around the world, many countries are beginning to implement laws and other regulatory mechanisms in an attempt to minimize the incidence of cybercrime." http://www.wisegeek.com/what-is-cybercrime.htm

2.5 Search Security defines it as "for any illegal activity that uses a computer as its primary means of commission. The U.S. Department of Justice expands the definition of cybercrime to include any illegal activity that uses a computer for the storage of evidence. (Source:http://searchsecurity.techtarget.com/definition/cybercrime)

2.6 Wikipedia defines it as "Computer crime, or cybercrime, refers to any crime that involves a computer and a network. The computer may have been used in the commission of a crime, or it may be the target.Net crime refers, more precisely, to criminal exploitation of the Internet. Issues surrounding this type of crime have become high-profile, particularly those surrounding hacking, copyright infringement, child pornography, and child grooming. There are also problems of privacy when confidential information is lost or intercepted, lawfully or otherwise." (Source: http://en.wikipedia.org/wiki/Computer_crime).

While there are many different definitions of cybercrime they all have a few key concepts throughout. These key concepts are criminal activity and the use or abuse of computers. With these concepts in mind cyber crime can be easily defined as using a computer to commit a criminal act.

3.0 CYBER CRIME AND ITS TYPES

3.1Computer Trespass

One of the most common cybercriminals is "illegal access to a computer or computer system with the intention of committing a crime or illegal access to a computer or computer system". Computer trespass is often referred to as hacking, which is often considered a hobby for those who make it a crime. They know that what they do is illegal, they just enjoy the challenge of doing it. In this technology-driven world, there are many people learning while watching different TV shows.

3.2 Fraud

Fraud is the "fraudulent means or action that is used to deceive a person, a company or an authority". Fraud is one of those crimes involving many variations and existed long before technology. Fraud is one of the many crimes that technology makes it easier to compromise. A good example comes from the concept of Internet

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banking and how easy it is now for someone to have access to someone else's information to take what they want from them.

3.3 Identity Theft

Identity theft is the act of "stealing identifying information from a real person (real name) or theft based on the creation of a fictitious identification of a person (synthetic identity)". Identity theft is directly related to fraud and is greatly simplified by online banking and purchasing processes, making personal information vulnerable on the Internet.

3.4 White-Collar Crime

The crime of employees is "a class or type of criminal behavior whose sole purpose is the economic gain of the offender". Economic crime can often be associated with fraud and identity theft if the perpetrator tries to conquer others for personal gain. Economic crime is spreading on all continents and is a major problem in the United States. "In China, bank fraud is a serious collective crime that causes billions of losses every year and is considered a crime that can be punished with death if the case involves corruption." In the United States, white throat crime is not a death penalty, but leads to so many losses. This, like many other crimes, is a big problem because often nobody notices what happens until a large amount of money is missing.

3.5 Stalking

Stalking is to Harassment "follow, observe and disturb (someone) constantly in a frightful and dangerous way, etc." This definition seems to be more in line with the traditional meaning of harassment, which is to physically follow and harass another person. However, harassment has evolved with the progress of technology. The best definition of stalking which would be more appropriate for cybercrime, would be "compulsive persecution and harassment" ("stem", 2015). Social media have committed the crime of computer harassment and, if not more, physically following someone. At the same time, social media has facilitated physical harassment with the ability to persecute someone through their states.

4.0 CAUSES OF CYBERCRIME AND METHODS OF COMMITTING

Cybercrime can occur in many ways. Here are some of the causes and methods of cybercrime: hacking, information theft in electronic format, e-mail bombardment, data theft, denial of service attacks, virus / worm attacks, Trojan attacks. , Internet Time Trial and Webjacking.(http://www.naavi.org/pati/pati_cybercrimes_dec03.htm).

4.1 Hacking: In other words, it can be called unauthorized access to any computer system or network. This method can occur if the computer hardware and software have a vulnerability that can be infiltrated if the hardware or software does not have a patch, security check, configuration, or password.ϖ

4.2 Theft of information contained in electronic form: this type of process occurs when information stored in computer systems is infiltrated and modified or physically confiscated by hard disks; Removable storage media or other virtual media.

4.3 Email bombing: this is another form of Internet abuse where people send a large number of e-mails to the victim or an address that attempts to flood the inbox, which may be a single or a person or even collision-based mail server. There are two methods for sending a mail bomb containing mass mailings and a link to the list.ϖ

4.4 Data diddling: this is the modification of data before or during penetration into the computer system. This type of incident moves raw data before a computer can process it and manipulate it once processing is complete.

4.5 Denial of Service attack: Basically, when a computer system is no longer available to allow the end user. This form of attack usually refers to computer networks in which the victim's computer is overwhelmed with more requests than it can handle, which in turn blocks the PC.

4.6 Virus / worm attacks: viruses are programs that can be encapsulated in any file. As a result, the program copies itself and spreads to other computers in a network, which affects, modifies or removes everything. However, worms are not like viruses, they do not need to join the host, but they make useful copies and they do it consistently until they consume all the available space in the computer's memory.

4.7 Trojan attacks: the term suggests that a program or programs pretend to be valuable tools but perform malicious activities on your computer. These programs are illegal, take control of someone else's system and play the role of an authorized program. The most common form of a Trojan is via email.

4.8 Internet time theft: this type of diversion is the fraudulent use of the victim's Internet surfing time, which can be supplemented by access to the login ID and password.

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4.9 Web Jacking: this is where the hacker accesses and can check someone else's website where he can destroy or modify the information on the site in his sole discretion. This type of cybercrime method is used to implement political programs or purely monetary means. An example of this method is that MIT (Ministry of Information Technology) was hacked by Pakistani pirates, while another case of "gold fish" was the site was hacked and the information was changed for the goldfish and was request the sum of $ 1 million. , http://www.naavi.org/pati/pati_cybercrimes_dec03.htm.

5.0 CYBER CRIME AND HUMAN RESOURCE

In today's era of cyber world, we have seen an increasing need of technology, which has left the world to open to severe threats of cyber crime. In the recent years it is being observed that some of the major cyber crimes that took place in India include the ones where many organisations get affected because of the illegal actions of their own trusted employees working at the companies.

As we all know that we that cyber crime is nothing but the wrong use of technology for the benefit. It is not just a benefit but the benefit for the human, it is the human brain which works behind the technology and disrupts the working of the employee which at the end hinders the organisation growth. Computer is just a machine but it the Human who plays a major role in cyber activities with the human resource.

Cyber theft violations are destructive and may lead to huge loss to the most of the organisations whether they are small or big. The most important facts are that there are nearly 50% of the employees who tries to steal confidential data after their exit from the companies. Also, employees attribute to a huge contribution of cyber crime breaches at working places. Thus, businesses needs to be careful enough that not only they must be careful from the cyber threats but also that the cyber crime breaches may take place within the organisation from their own staff

Business process outsourcing sector (BPO), which provides employment to people in India and which is also responsible for the inflow of foreign exchange into India, is the major threat from cyber crimes. One of the increasing problems among this data processing organisation is the susceptibility to the business from cyber threats originating from within the organization as we can see that employees misuse the confidential data entrusted to them at work. The employees working within the organization or companies have a strong understanding of technology and it it becomes easier for the employees to hack the system in comparison to other factors.

6. 0 THEFT CRIME AND CYBER TERRORISM

Cyber terrorism can be defined as the deliberate use of disruptive activities or the risk of using a virtual machine in order to make a public, political, spiritual, radical or threatening person (Denning, D). Theft offenses may include: Credit / debit card fraud, identity theft, fake services

6.1 Credit/Debit Card Fraud-is the unlawful use of a credit/debit card to falsely attain money or belongings. Credit/debit card numbers can be stolen from leaky web sites, or can be obtained in an identity theft scheme.

6.2 Identity theft –this is when someone seizes another's individual information without his or her awareness to commit theft or fraudulency. Typically, the victim is led to believe they are revealing sensitive private data to a genuine business, occasionally as a response to an e-mail to modernize billing or membership information etc.

6.3 Phony Escrow Services–this is where auction participants were persuade by the fraudster where he or she will recommend the use of a third-party escrow service to help the exchange of money and merchandise. The victim is unmindful the impostor has deceived a legitimate escrow service the victim sends payment or products to the phony escrow and obtains nothing in return

7.0 CONCLUSION

Cybercrime will remain a constant challenge despite the progress of many countries. Most countries have their own laws against cybercrime, but they do not have new laws, but they depend on land law to prosecute these crimes. Therefore, there is no significant prevention of cybercrime in cybercrime for offenders. Therefore, countries must meet at global level and decide what cybercrime is and develop methods to prosecute criminals in different countries. This is the only line of defence that can be established when there are individual countries and the global methods of persecuted criminals. Every day, people and businesses must make sure that they are the next victim of cybercrime. This basic knowledge about the cyber ethics can help prevent possible cyber crimes against them.

Cyber crime in cyberspace can hardly be reduced. If we look back we can see that that there are no such obligations or legislation which has thrived in overall elimination of cybercrime from across the world. The best

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possible way can be that is to make people known of their basic rights and duties and further making more blameworthy laws which is more demanding to check them. This further tells that there is a need to pass on the modifications in the Information Technology Act so it can be more effective to combat against cybercrimes.We must pay attention to educational institutions in favor of legislation that the requirements of cybernetic laws are not so rigorously prepared to delay the growth of trade.

Even though, business entity should employ practices and activities which employees should follow and take safety measures to ensure that integrity and secrecy of collected data to fight cybercrimes. Safety practices like ensuring that staying away from malicious sites during company hours where viruses can be downloaded, or password sharing should be prohibited. With all these safety measures put forward, it can be said that the safety of many people stored is optimal.

8.0 PREVENTION AND PROCEDURE: ISSUES OF CONCERN

In this modern age, it seems almost impossible to avoid becoming a victim of cybercrime, with all the technological advances that facilitate cybercrime. In light of this, there are ways to avoid becoming victims of cybercrime. Most Internet browsers use e-mail service, and Internet providers offer anti-spam functionality to prevent unwanted e-mails, fraudulent e-mails and phishing e-mails from reaching your inbox. . However, every user must make sure not to switch them off completely. For example, users must install and manage antivirus programs, firewalls, and spyware verifiers. In addition to keeping them up-to-date, users must ensure that they run regular scans. There are many companies that provide free software, but there are many others that can be produced by the major commercial service providers; In addition, these companies offer a free version of their paid or subscription antivirus software.

Another good precaution is to bring those who disclose your personal information. Try to avoid unknown websites, especially those that require your name, mailing address, bank account number or social security number. When you make online purchases, make sure the URLs start with "https" and / or have the fiduciary seal or VeriSign. If you do not see it anywhere on the site, you run the risk of sending credit card information.

Educate children about the appropriate use of the computer and internet and make sure to monitor their online activities. They should only have access to a computer located in a central area of the house and one must regularly check all browser and email activity. Other way can be to use the parental control software that keeps an eye on the type of websites the user is allowed to gain access to. In schools, there should be restrictions that will help protect the user and its entity from cybercrime. Likewise, companies must improve their workplace and use of the network to reduce the risk of cyber crime for the company.

A more precise way not to fall prey to cybercrime is that there should not be any network internet connection.. If no internet, you do not have to worry about cyber attacks. However, this option is not the most logical in our online society. It is up to you to take the necessary measures to avoid possible computer crimes.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

EXPLORING THE LINK BETWEEN RESOURCING STRATEGY AND HUMAN RESOURCE OUTCOMES – AN EMPIRICAL INVESTIGATION

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ABSTRACT
The purpose of this research paper is to examine the link between resourcing strategy and human resource outcomes. The Resourcing strategy comprises of strategic human resource practices which includes human resource planning, recruitment and selection practices. The three human resource outcomes that are studied are commitment and satisfaction levels and reduced turnover intentions of employees. The study is conducted on the managerial level employees of nine large-scale manufacturing companies representing three industries - chemicals & petrochemicals industry, railway equipment and locomotive industry, and automotive industry operating in Karnataka State. In total 303 usable responses were obtained resulting in a response rate of 42.08 per cent which is considered as acceptable in industrial surveys. The findings of the study revealed that resourcing strategy makes a low impact on commitment levels & reduced turnover intentions of employees and a moderate impact on the satisfaction levels of employees. However, when all the three human resource outcomes are taken collectively, it was seen that resourcing strategy makes a significant positive impact on human resource outcomes hence suggesting that resourcing strategy best predicts and is a good explanatory variable of the three human resource outcomes.

Keywords: Commitment, Reduced turnover intentions, Resourcing strategy, Satisfaction

1. INTRODUCTION

Resourcing strategy of a company aims at planning, recruiting and selecting the best available human force with the required qualities, knowledge and capabilities and the potential to grow along with the organisation. This invariably leads the organisation to achieve competitive advantage. The important human resource (HR) practices that aim at fulfilling the goals of resourcing strategy are human resource planning, recruitment and selection practices. Resourcing strategy of a company stems from its business strategy and takes account of the direction in which the company is moving. Armstrong M., (2006) in his book 'Strategic Human Resource Management: A Guide to Action', opines that a good resourcing strategy must determine the following:

- The number of people required to meet business needs;
- The skills and behaviour required to support the achievement of business strategies;
- The impact of organisational restructuring as a result of decentralisation, delayering, mergers, product or market development, or the introduction of new technology;
- Plans for changing the culture of the organisation in such areas as ability to deliver, performance standards, customer services, team working and flexibility that indicate the need for people with different attitudes, beliefs and personal characteristics.

However these factors are determined by the type of activity and business strategy adopted by the organisations. If the organisations do not implement resourcing strategy judiciously, it may result in negative organisational outcomes along with poor commitment and satisfaction levels among the employees and high rate of employee turnover which in turn impacts organisation's performance. Thus, organisations need to avoid and minimise voluntary and involuntary separations since they prove to be expensive, especially the top performers of the organisation (Noe, et. al 2006). To add to the problems, recruitment and selection practices in reality are heavily influenced by personal relations, rather than by objective assessment of the suitability of the job applicant, resulting in family affiliation and friendship having substantial influence on hiring process (Fashoyin, 2005). This type of negligent hiring practices will lead to adverse implications on the organisation's effectiveness. Thus, resourcing strategy has two strategic implications. Firstly to maximise employee value and minimise employee costs to the organisations and secondly to elicit favourable human resource outcomes in the form of heightened commitment, increased levels of satisfaction and reduction in turnover intentions which will ultimately result in achieving the organisation's objective of wealth maximisation through profit maximisation. Keeping this as the back-drop, this study tries to find out the link between resourcing strategies and three human resource outcomes viz., commitment and satisfaction level of employees and their turnover intentions. The study is conducted on the managerial level employees of nine large-scale manufacturing companies

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representing three industries - chemicals & petrochemicals industry, railway equipment and locomotive industry, and automotive industry operating in Karnataka State.

2. LITERATURE REVIEW

This section of the research paper tries to outline the concepts of resourcing strategy, commitment, reduced turnover intentions and satisfaction followed by a brief review of the empirical studies undertaken by researchers in this field.

2.1 Concept of resourcing strategy

Resourcing strategy includes all those strategic HR practices that are related to human resource planning, recruitment and selection of the best available human resource. Human Resource Planning is the process of developing plans to arrange the size and skills of human resources as per the present and future needs of the organization. It helps the organization to forecast, recruit, retain and optimise the deployment of personnel needed to meet business requirements and objectives, and to respond to the changes in the external environment. It is one of the key practices in the resourcing strategy of an organisation. Another key resourcing strategy is the recruitment process that aims at searching for and securing applicants for various job positions so that the right people in the right number can be selected to fill the job positions which arise from time to time in the organization. Thus, recruitment in this study refers to the process of discovering potential candidates by generating a pool of qualified applicants for organisational jobs (Mathias & Jackson, 2004). Another important area in resourcing strategy is the selection process that focusses on choosing the most suitable candidates out of a pool of acceptable candidates who have applied for the job in the organization, from both within as well as outside the organization. Selection is a decision-making activity and as such the psychological calculation of suitability (Price, 2004). Thus, selection in this study refers to the process of making a 'Hire' or 'No Hire' decision regarding each qualified applicant for a job and forms an important part of resourcing strategy of an organisation.

2.2 Concept of Commitment

Commitment is referred to as the employee's state of being committed to assist in the achievement of the organisation's goals, and involves the employees' levels of identification, involvement, and loyalty (Caught & Shadur, 2000). This study adopts the definition given by Caught & Shadur (2000) to define commitment.

2.3 Concept of Reduced turnover intentions

Turnover can either be voluntary turnover or involuntary turnover. When the employee leaves the organisation on his own it is called as voluntary turnover and when the company asks the employee to leave it is called as involuntary turnover. This study focuses only on voluntary turnover and as such reduced turnover intention is treated as the desire of an employee to stay with the organisation for a longer period of time without any intention to quit.

2.4 Concept of Satisfaction

Satisfaction in this study is defined as per the definition of Locke (1976). He defines job satisfaction as a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences.

2.5 Empirical research work

Reviewing the prior research works done in the HR field, it can be seen that a lot of work has been done that tries to find out the relationship between human resource management (HRM) practices and human resource outcomes. Ogilvie (1986) perceives HRM practices as concrete and tangible programmes that are designed to develop commitment. Wimalasiri (1995) states that selection, placement, development, rewards, and retention practices promote, reinforce, and influence the commitment level of employees. As rightly pointed out by Ulrich (1997), Human resource management practices are considered to be highly effective tools for enhancing organisational commitment levels among employees. Edgar & Geare (2005) also found that a significant relationship exists between HRM practices and employee work-related attitudes which include organizational commitment, job satisfaction, and organizational fairness. Luna-Arocas and Camps (2007) conducted their research in Spain and concluded that strategies related to salary and job enrichment were positively related to job satisfaction leading to a negative effect on turnover intentions. In a study conducted on Southwest airlines, Aric (2008) highlighted that compensation strategy can enhance individual performance by strengthening the strategic and business strategy of the organisation, which in turn will reduce employee turnover. In their study on the relationship between HR practices and job satisfaction, Mir Mohammed et al. (2010) found that HR planning and training and development had a positive impact on job satisfaction. The findings of the study conducted by Rathanweera (2010) also pointed out to the fact that HRM practices are significant predictors of employee commitment, satisfaction and retention. In yet another study undertaken by Juhdi etc., (2011), career

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management, performance appraisal, person-fit (presented in training and development), and compensation practices was found to be positively related to organisational commitment. A study undertaken by Anvari et al (2011) in Iran on 301 non-academic staff in medical science universities revealed that perceived effective organisational commitment could be achieved through strategic compensation practices because of the fulfilment of psychological contract which reduces the turnover intentions of the employees. The study conducted by Imran & Ahmed (2012) concluded that the HR practices of compensation, work life policies, training and development, career opportunities, empowerment, perceived organizational support, organizational climate and communication have a direct and positive impact on organizational commitment. In similar lines, the study conducted by DeCenzo & Robbins (2013) concluded that when the human resource practices in an organisation are highly valid and reliable, the probability of new employees adapting to the organisation will be higher, the turnover will be lower and the organisational commitment will be higher. Focussing their research work on four pharmaceutical companies in Bangladesh, Rahman et.al, (2013) found that recruitment, selection, training and development policies implemented by these companies resulted in employee satisfaction whereas human resource planning, working environment, performance appraisal, compensation and industrial relation policies resulted in dissatisfaction. In similar lines, study conducted by UshaPriya (2013) also concluded with results showing that compensation, social benefits and training and development were positively related to employee satisfaction. While examining the effect of HRM practices on job satisfaction, Oyeniyi et al. (2014) found that promotion, compensation, training and performance evaluation practices had a positive effect on job satisfaction but supervisory role practices had a negative effect on job satisfaction. This study was conducted on the employees of Nigerian banks. In order to examine the impact of comprehensive Human Resource Development practices on Organisational commitment and employee intention to stay, Uraon (2018) collected information from 516 employees of software companies operating in India. His study revealed that Human Resource Development practices had positive impacts on employee commitment and employee intention to stay.

As evident from the literature review, even though there is a lot of research work undertaken to link HR practices with human resource outcomes, very few studies are conducted in Indian context, especially in large scale manufacturing industries. This study thus, tries to fill this void by conducting the research in three prominent large scale manufacturing industries operating in Karnataka State, which is one of the leading States of India in the manufacturing sector.

3. STATEMENT OF THE PROBLEM

A strategic blend of resourcing practices that include human resource planning, recruitment and selection practices no doubt helps an organisation to recruit the right people for the right jobs which in turn help in accomplishing its goals and eventually its success. But research works that demonstrate the impact of strategic resourcing practices on human resource outcomes is an under-researched area especially in the Indian context, more so in large scale manufacturing industries. To fill this gap, this study tries to find out the impact resourcing strategy has on the behavioural and attitudinal outcomes of the employees working in large scale manufacturing industries of Karnataka State, which is industrially a prominent State in India. However, the study takes into account only three human resource outcomes viz., commitment levels, satisfaction levels and reduced turnover intentions.

4. OBJECTIVES AND RESEARCH QUESTIONS

The main objective of this study is to examine the relationship between resourcing strategy and human resource outcomes in the select large scale manufacturing industries. The study makes an attempt to achieve the above research objective by raising the following three research questions and finding answers to them.

Research Question 1: What is the nature of the relationship between resourcing strategy and commitment levels of employees in the select large scale manufacturing industries?

Research Question 2: What is the nature of the relationship between resourcing strategy and reduced turnover intentions of employees in the select large scale manufacturing industries?

Research Question 3: What is the nature of the relationship between resourcing strategy and satisfaction levels of employees in the select large scale manufacturing industries?

5. SCOPE OF THE STUDY

The present study is carried out on large scale manufacturing industries from three prominent sectors viz., Chemicals and Petrochemicals industry, Railway Equipment and Locomotive industry, and Automotive industry operating in Karnataka State.

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6. RESEARCH METHODOLOGY

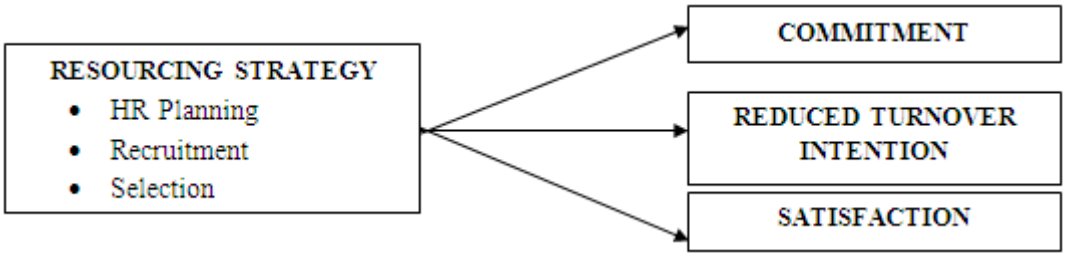
6.1 Sampling Design

The population for this study is made up of large scale manufacturing organisations from chemicals & petrochemicals industry, railway equipment and locomotive industry, and automotive industry. For selecting the respondents, sampling is done in three stages. In the first stage of sampling, the study locale is chosen; in the second stage study companies are chosen and in the third stage of sampling the respondents within the selected companies are chosen. In order to choose the study locality, the official division of Karnataka state was considered wherein the State is divided into four division viz., Bangalore Division, Belgaum Division, Gulbarga Division and Mysore Division. But only Bangalore and Mysore divisions were chosen since they have a high concentration of large scale manufacturing units operating in the selected industries. In order to choose the study companies, a list of companies was prepared by referring the available Indian Industry Directories published at National and State level, and the District Industrial Profile published by Ministry of MSME, Government of India in their official website. From this list, nine companies were selected. In order to choose the respondents from the selected companies, only managerial level employees were considered. In total 720 questionnaires were distributed to the employees out of which 351 responded (response rate of 42.08 per cent which is considered as acceptable in the research circle for industrial surveys) and 303 responses turned out to be usable ones.

6.2 Conceptual Framework of the Study

Based on the literature review, the research model of the study is constructed by taking resourcing strategy comprising of strategic human resource practices related to planning, recruitment and selection as independent variable and human resource outcomes viz., commitment levels, reduction in turnover intentions and satisfaction levels of employees as dependent variables.

Figure-6.1: Proposed model of the study



Source: Developed by the researcher

6.3 Limitations of the Study

The study is confined to the large-scale manufacturing companies of three industries - chemicals & petrochemicals industry, railway equipment and locomotive industry, and automotive industry operating in Karnataka State of India. Therefore prudency and caution should be exercised when generalising the findings of this study.

7. ANALYSIS OF DATA

The data collected from the respondents were analysed using statistical software package 'SPSS version 21.0 for Windows'. The analysis was done by computing Pearson Correlation Coefficient Analysis and Multiple Regression analysis. The results are presented below:

Pearson Correlation Coefficient Analysis: Correlation analysis is a statistical tool which measures the association between two or more variables and the extent and direction of relationships between variables. The results of the correlation analysis between the study variables resourcing strategies and human resource outcomes are given in table no. 7.1.

Table No-7.1: Correlations between Resourcing Strategy and Human Resource Outcomes

		Resourcing Strategy	Commitment	Reduced Turnover Intention	Satisfaction
Resourcing Strategy	Pearson Correlation	1	0.201**	0.260**	0.463**
	Sig. (2-tailed)		0.000	0.000	0.000
Commitment	Pearson Correlation	0.201**	1	0.205**	0.288**
	Sig. (2-tailed)	0.000		0.000	0.000
Reduced	Pearson Correlation	0.260**	0.205**	1	0.291**

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Turnover Intention	Sig. (2-tailed)	0.000	0.000		0.000
Satisfaction	Pearson Correlation	0.463**	0.288**	0.291**	1
	Sig. (2-tailed)	0.000	0.000	0.000	

**. Correlation is significant at 0.01 levels (2-tailed)

At 1% level of significance, the association between resourcing strategy and commitment is 0.201. This points out that there is a low positive correlation between resourcing strategy and commitment. Also, the association between resourcing strategy and reduced turnover intentions is 0.260. This points out that there is a low positive correlation between resourcing strategy and reduced turnover intention as well. But even though the resourcing strategy's influence on commitment and reduced turnover intentions are low, the influence cannot be ignored. The association between resourcing strategy and satisfaction is 0.463 and is significant at 1% level of significance. This shows that there exists a moderate positive correlation between resourcing strategy and satisfaction. The association between commitment and reduced turnover intentions is 0.205 and is significant at 1% level of significance. This indicates that there exists low positive correlation between commitment and reduced turnover intentions. Thus, even though the influence of commitment on reduced turnover intentions of the employees is low, the influence cannot be ignored. The association between commitment and satisfaction is 0.288 and is significant at 1% level of significance. This indicates that there exists low positive correlation between commitment and satisfaction. Thus, even though the influence of commitment on satisfaction levels of the employees is low, the influence cannot be ignored.

Multiple Regression Model: A multiple regression model is built for the sample data to analyse whether there exists a relationship between Resourcing strategy and Human Resource Outcomes. Table 7.2 shows the multiple correlation coefficients 'R' and Coefficient of determination 'R^2' with standard error of the estimate for the sample data. R^2 value of 0.655 indicates that the variation in Human Resource Outcomes is explained to an extent of 65.5% by Resourcing Strategy. The ANOVA table for regression model shows F test statistic value 571.428 with significance value $p < 0.001$. This indicates that the regression coefficient is highly significant at 1% level of significance. Therefore, the regression model is also significant. Since the regression model is significant, Resourcing Strategy can be used to estimate Human Resource Outcomes with reasonable accuracy.

Table-7.2: Model Summary and ANOVA for the Regression Model – Resourcing Strategy and Human Resource Outcomes

Model Summary - Resourcing Strategy and Human Resource Outcomes					
Model		**R**	**R Square**	**Standard Error of the Estimate**	
RES		0.809	0.655	0.320	
ANOVA – Resourcing Strategy and Human Resource Outcomes					
Source of Variation	**Sum of Squares**	**Degrees of freedom**	**Mean Square**	**F**	**Sig.**
Regression	58.394	1	58.394	571.428	0.000
Residual	30.759	301	0.102		
Total	89.154	302			

Source: Author

With the regression model being significant, regression coefficients of independent variables in the model are tested for significance using t-test.

Tabl-7.3: Regression Coefficient,'t' Test Statistic Value and its Significance for Resourcing Strategy and Human Resource Outcomes

Dependent Variable: Human resource outcomes				
Independent Variables	**Unstandardised Coefficients**		**t**	**Sig.**
	B	**Std. Error**		
Constant	2.083	0.082	25.306	0.000
Resourcing strategy (RES)	0.461	0.019	23.905	0.000

*Significant at both 1% and 5% level of significance.

Source: Author

Table 7.3 shows that the constant and the regression coefficient of the independent variable namely Resourcing Strategy is significant at 1% level of significance.

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Equation 7.1: Regression Equation for Resourcing Strategy and Human Resource Outcomes

$$HRO = 2.083 + 0.461\ RES$$

The regression equation 7.1 can be used to predict the human resource outcomes based on the resourcing strategy.

8. FINDINGS AND DISCUSSION

Based on the statistical analysis of the data, this research paper attempts to answer the research objective and the associated research questions.

Objective: To examine the relationships between resourcing strategy and human resource outcomes in the select large scale manufacturing industries

In the light of the results of data analysis, the above research objective is analysed by seeking answers to the research questions 1, 2 and 3 applying correlation and regression analysis to the collected data and is discussed below:

Research Question 1: *What is the nature of the relationship between resourcing strategy and commitment levels of employees in the select large scale manufacturing industries?*

The measure of correlation coefficient between resourcing strategy and commitment is found to be positive but low (0.201) and is significant at 1% level of significance. This indicates that when the employees' perception about resourcing strategy increases favourably, their commitment levels towards the organisation also increase. Moreover, though the data shows a low positive relationship between resourcing strategy and commitment levels, the effect of resourcing strategy on commitment levels of employees cannot be ignored since 4 per cent of the variations that happen in commitment levels are explained by resourcing strategy and is significant at 1% level of significance.

Resourcing strategy is a crucial human resource strategy for an organisation because inadequate or faulty resourcing practices lead to hiring of employees who may be inclined to leave the organisation within a short span of time, without any intention to stay and grow with the organisation. On the contrary when the employees are hired after rigorous recruitment and selection procedures, they realise that the organisation has invested considerable time and effort in hiring them and this realisation brings a belief that the organisation values them and their place in the organisation. This belief will invariably bring a sense of commitment towards the organisation. Further, strategic resourcing practices focus on matching the job applicant with not only the vacant job profile, but also with the organisation's values which will result in person-organisation fit thereby helping the newly recruited employees to inculcate the value systems prevalent in the organisation and accept the organisation's goals which ultimately leads to increased commitment levels. Thus, resourcing strategy makes a low but positive impact on the commitment levels of the employees.

Research Question 2: *What is the nature of the relationship between resourcing strategy and reduced turnover intentions of the employees in the select large scale manufacturing industries?*

The measure of correlation coefficient between resourcing strategy and reduced turnover intention is found to be positive but low (0.260) and is significant at 1% level of significance. This indicates that when the employees' perception about resourcing strategy increases favourably, they show a reduced turnover intention. Moreover, though the data shows a low positive relationship between resourcing strategy and reduced turnover intention, the effect of resourcing strategy on reduced turnover intentions of employees cannot be ignored since 4.2 per cent of the variation that happen in reduced turnover intentions are explained by resourcing strategy and is significant at 1% level of significance.

Even though the employees consider resourcing strategy adopted by their organisations as an important human resource strategy, it does not create a major impact on their decision to stay or leave the organisation. Effective HR planning, recruitment and selection practices will no doubt result in hiring the best employees, but this alone will not ensure that they will stay with the organisation. This is due to the fact that an employee will not base his decision to stay or leave the organisation on the basis of how effectively he and his colleagues are recruited. Thus, resourcing strategy makes a low but positive impact on the reduced turnover intentions of the managerial level employees.

Research Question 3: *What is the nature of the relationship between resourcing strategy and satisfaction levels of the employees in the select large scale manufacturing industries?*

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The measure of correlation coefficient between resourcing strategy and satisfaction is found to be moderately positive (0.463) and is significant at 1% level of significance. This indicates that when the employees' perception about resourcing strategy increases favourably, their satisfaction levels also increase. Moreover, though there is a moderate positive relationship between resourcing strategy and satisfaction levels, resourcing strategy cannot be neglected while measuring satisfaction levels since 8.3 per cent of the variations that happen in the satisfaction levels of the employees are explained by resourcing strategy and is significant at 1% level of significance.

Resourcing strategy includes strategic practices in relation to HR planning, recruitment and selection practices adopted by an organisation. Resourcing strategy when effective will result in the selection of people who best suit the requirements of the organisation. When the organisation provides adequate and relevant information about the job at offer, it receives applications from candidates whose profile match the job description and specification. This will reduce the chances of overqualified candidates applying for the job, reducing the chances of recruiting less satisfied employees at the entry stage. Also, detailed job information which projects the expectations of the organisation for a particular post will inspire talented candidates with high aspirations to apply for the post, thereby creating a pool of prospective satisfied employees from which the company can choose. Again, recruitment for the vacant post can happen internally. When recruitment happens internally employees get a transfer within the organisation which may result in promotions and/or higher pay. Thus when the employees perceive that the human resource planning process in their organisation is conducted systematically, they know that they stand an equal chance of getting a higher post and/or a higher pay which will result in increased satisfaction levels. Therefore a fair and just HR planning, recruitment and selection practice will ensure hiring the right person to the right job. A well-executed resourcing strategy therefore makes a moderate and positive impact on the satisfaction levels of employees.

Thus, it is seen that the resourcing strategy makes a low impact on commitment levels & reduced turnover intentions and a moderate impact on the satisfaction levels of employees. This is further strengthened by the regression analysis conducted by considering resourcing strategy as an independent variable and three human resource outcomes considered as a set of dependent variables. 65.5 per cent of the variations that happen in the human resource outcomes can be attributed to resourcing strategy. The results show that the constant and resourcing strategy are significant at 1% level of significance, hence suggesting that resourcing strategy makes a significant positive impact on human resource outcomes. Thus, multiple regression analysis shows that the resourcing strategy best predicts and is a good explanatory variable of the three human resource outcomes.

9. SUMMARY, CONCLUSION AND RECOMMENDATIONS

This research paper tries to find out the impact of resourcing strategy comprising of strategic human resource practices related to planning, recruitment and selection on human resource outcomes viz., commitment levels, reduction in turnover intentions and satisfaction levels of employees. This impact study is conducted in select large-scale manufacturing industries operating in Karnataka State, India by administering structured questionnaires to a sample of 303 management level employees of selected nine large-scale manufacturing companies. Resourcing strategy was taken as independent variable and human resource outcomes were taken as dependent variables. Collected data was analysed using inferential statistics using SPSS. Results of the study shows that there is a low positive correlation between resourcing strategy and both, commitment and reduced turnover intentions of employees and the correlations are statistically significant at 1% level of significance whereas there is a moderate positive correlation between resourcing strategy and satisfaction levels of employees and the correlation is statistically significant at 1% level of significance. Multiple regression analysis also shows that the resourcing strategy best predicts and is a good explanatory variable of all the three human resource outcomes. Thus, this study supports the fact that organisations can effectively use resourcing strategy to enhance commitment and satisfaction levels among their employees and reduce their turnover intentions. Since the study is not free from limitations, the results of the study cannot be generalised, but can serve as an early step towards developing resourcing strategy thereby affirming the investments made my organisations in such HR practices.

10. FUTURE RESEARCH DIRECTION

In future, similar studies can be conducted that encompasses other geographical areas in India as well as in other countries. Moreover, other human resource strategies and human resource outcome variables can be studied with a different sample size and in different sectors. Since the study area touches upon behavioural science, longitudinal studies can also be undertaken to find out the effects of human resource strategies on various human resource outcomes.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

SYNTHESIS, SPECTROSCOPIC, ANTIBACTERIAL ACTIVITY AND THERMOGRAVIMETRIC STUDIES OF COPPER (II) AND ZINC (II) COMPLEXES OF SCHIFF BASE LIGAND

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ABSTRACT
Metal complexes were synthesised with 1,10-phenanthroline and the schiff base derived from isatinmonohydrazone and 2-acetylthiophene. The synthesised complexes were characterised by elemental analysis, molar conductance, magnetic moments, TGA, electronic and spectral studies. The presence of functional groups and their metal coordination were analyzed with vibrational spectra and the molecular vibrations of the various functional groups were analyzed and assigned. Further, the biological activities were evaluated in vitro for their antimicrobial susceptibilities against different strains of bacteria and fungi also analysed for DNA cleavage activities. By comparison, the inhibition values in antimicrobial studies are higher for metal coordinated complexes than the ligand. This experiment helped to cleave the DNA in the presence of H_2O_2, thus confirming the participation of hydroxyl radicals in the cleavage process.

Keywords: Schiff base, IR, TGA, XRD, Antibacterial studies

1. INTRODUCTION

Metals are endowed with unique characteristics that include redox activity, variable coordination modes, and reactivity towards organic substrates [1]. The rapid developments of materials science and crystal engineering have considerably promoted the uses of coordination complexes as functional materials such as catalysts, magnetic materials, non-linear optical materials, and porous materials [2–6]. Schiff base metal complexes have been studied extensively because of their attractive chemical and physical properties and their wide range of applications in numerous scientific areas. Schiff base was first reported by Hugo Schiff in 1864 [7]. In continuation of the study, many researches around the globe prepared mixed-ligand metal complexes and studied their biological applications such as binding of DNA through drug-target interactions and to cleave the duplex by its various reactivity [8-14]. Isatin, an endogenous indole and its derivatives have been shown to exhibit a wide range of activities [15-19]. Schiff bases derived from Isatin exhibit antimicrobial, antiviral, anticancer, antimalarial, herbicidal and anti-inflammatory activity [20-26]. They also have anti-HIV, antiprotozoal and antihelminthic activities [27-30]. Some of the Schiff base complexes containing N and O donor atoms are effective as stereospecific catalysts for oxidation, reduction, hydrolysis, biocidal activity, other organic and inorganictransformations [31-35]. Thesevaried applications of this type of Schiff base ligand and its complexes encouraged us for thesynthesis, characterization and biological activity studiesof some mixed ligand transition metal complexes of Schiff bases ligand L1 (derived from Isatin monohydrazone and 2-acetylthiophene) and 1,10-phenanthroline.

2.EXPERIMENTAL

2.1 Chemicals and Reagents

Isatin and hydrazine hydrate were obtained from Himedia. 2-acetyl thiophene, ammonium acetate, and acetic acid were purchased from Merck. 1,10-Phenanthroline, Cu(II), Zn(II) acetates were purchased from Sigma and used without further purification.All other reagents and solvents were purchased from commercial sources and were of analytical grade. Common solvents like chloroform, ethanol, and methanol were purified by standard methods.

2.2. Synthesis of ligands

2.2.1. Synthesis of Schiff Base Ligand (L)

Isatin monohydrazone (5mmol) in methanol (25 mL) was taken in a 100 mL round bottomed flask. A solution of 2-acetylthiophene (5 mmol) in absolute methanol (25 mL) was then added slowly to the flask. Added few drops of acetic acid and were heated at reflux for 8h with vigorous stirring. The volume of the mixture was reduced to half of the initial volume under reduced pressure and an excess of anhydrous ether was added. A reddish precipitate was formed, which was collected by vacuum filtration and washed several times with anhydrous ether and dehydrated in vacuum with anhydrous $CaCl_2$. The purity of the obtained compound was verified by TLC (Thin Layer Chromatography). The yield of the isolated ligand was found to be 65% (Scheme – 1).

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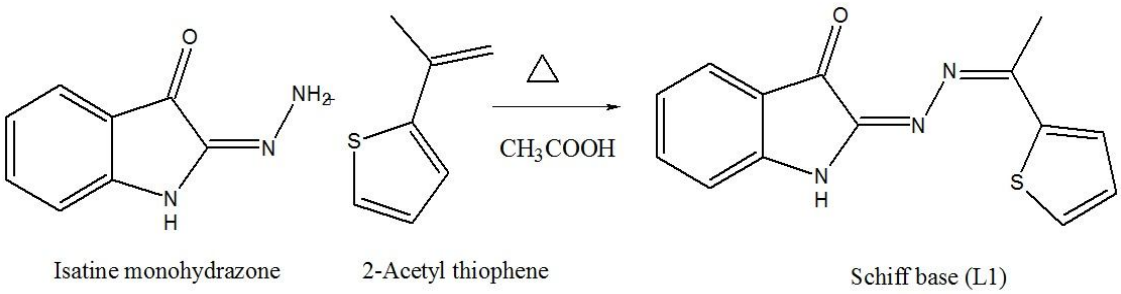
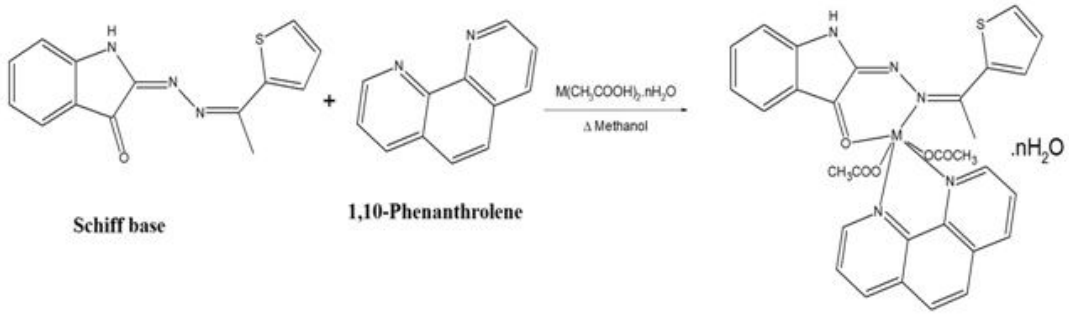


Isatine monohydrazone 2-Acetyl thiophene Schiff base (L1)

Scheme-1: Synthesis of Schiff base ligand

2.2.2. Mixed ligand Metal Complexes with Ligand L1 and 1,10-Phenanthroline {[MLP($CH_3COO)_2$].nH_2O) M = Cu(II) and Zn(II),P = 1,10-Phenanthroline}

The Schiff base L1 (1mmol) in methanol (20mL) was taken in a 100 mL round bottomed flask. A solution of metal(II) acetate (1 mmol) in aqueous methanol (10 mL) and solution of 1,10-phenanthrolene (1 mmol) in aqueous methanol (10 mL) was then added dropwise to the flask and the reaction mixture and refluxed for 4 h on awater bath. Cool the reaction mixture. The volume of the mixture was reduced to half of the initial volume under reduced pressure and an excess of anhydrous ether was added. The precipitate formed was filtered off, washed several times with ether and with little cold ethanol, and then dried in vacuo over anhydrous $CaCl_2$. The yield was found to be 60-65% (Scheme – 2).



Schiff base 1,10-Phenanthrolene

Scheme-2: Synthesis of metal complexes [M = Cu(II) & Zn(II)]

2.3. Instruments and Methods

Elemental analysis of carbon, hydrogen, and nitrogen contents present in the samples were recorded on Perkin Elmer Elemental Analyzer. A Coronation Digital Conductivity Meter was employed to study the molar conductance of the complexes. The infrared spectra of the solid sampleswere recorded on JASCO/FT-IR410 spectrometer in the range 4000 - 400 cm^{-1}. Magnetic susceptibility measurements of the powdered complexes were carried out by employing the Guoy`s method at room temperature. TGA and XRD pattern were recorded on a Perkin-Elmer 7 Series Thermal Analyser and RigakuDmax X-ray Diffractometer. Antibacterial and antifungal properties of the ligand and its complexes were tested in vitro against four bacterial and three fungal species, by the disc diffusion method.A gel electrophoresis experiment wasused to identify the cleaving ability of the ligand and its complexes in the presence and absence of H_2O_2 as an oxidant.

3. RESULTS AND DISCUSSION

3.1 Characterization of Metal Schiff Base Complexes

The analytical and physical characterization of [MLP($CH_3COO)_2$].nH_2O complexes are given in Table1. The analytical data show that the metal, ligand and 1,10-phenanthrolene ratio is 1:1:1 in all the complex systems. The composition of the complexes is [ML($CH_3COO)_2$].nH_2O, where L is the Schiff base ligand, P is 1,10-phenanthrolene, M is Cu(II) and Zn(II)and n is 2 or 3. The metal complexes are soluble in methanol, chloroform, dichloromethane, DMF, DMSO etc.The low molar conductance values (Table 1) of the metal complexes reveal their non-electrolytic nature [36].

Table-1: Analytical and physical data of the Schiff ligand (L) and its complexes

Compound	Empirical formula	Colour	M.W.	Elemental analysis Found (calcd) %				Λc ($Ohm^{-1}C Cm^2mol^{-1}$)	μ_{eff}
				C	H	N	M		
L	$C_{14}H_{11}N_3OS$	Red	269.32	62.86 (62.44)	3.92 (4.12)	16.02 (15.60)	-		-

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[CuLP($CH_3COO)_2$].$2H_2O$	$C_{30}H_{29}N_5O_7SCu$	Reddish brown	667.20	54.93 (54.01)	3.98 (4.38)	9.17 (10.50)	10.84 (9.52)	12	1.82
[ZnLP($CH_3COO)_2$].$3H_2O$	$C_{30}H_{31}N_5O_8SZn$	Reddish Yellow	687.05	52.99 (52.45)	4.87 (4.55)	9.69 (10.19)	10.12 (9.52)	10	Dia

IR SPECTRA

In the mixed ligand Cu(II) complex (Figure –1), the band of azomethine group is shifted to lower frequency at 1613 cm^{-1} in the complex is the indicative of the coordination of the azomethine nitrogen atom to the Cu(II) ion. The stretching bands of the carbonyl group shifted from 1723 cm^{-1} to 1719 cm^{-1} is attributed to the coordination of carbonyl oxygen. The broad band appeared at ~3400 $cm^{-1}$is the indication of the stretching vibration of the coordinated water molecules. A band at ~751 cm^{-1} in the complexes is also assigned to the coordinated water molecule [37]. The spectrum of the Copper(II) complex shows new vibrational wavenumbers at in 663 and 510 cm^{-1} due to the formation of M-O and M-N coordination, respectively[38]

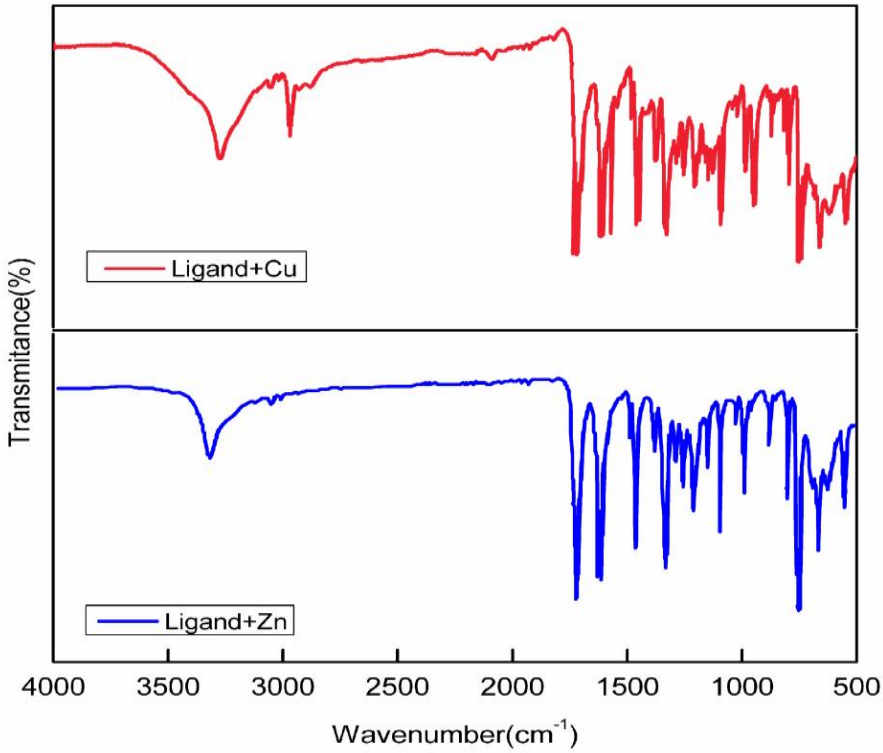

Figure-1: IR spectrum of Cu(II) and Zn(II) complex

In Zinc(II) complex (Figure – 1), the band of azomethine group is shifted from 1614 cm^{-1} to lower frequency at 1611 cm^{-1} in the complex is the indication of the coordination of the azomethine nitrogen atom to the Zn(II) ion. The stretching bands of the carbonyl group shifted from 1723 cm^{-1} to 1719 cm^{-1} is the confirmation of the coordination of carbonyl oxygen. The broad band appeared at ~3400 cm^{-1} can be attributed to the stretching vibration of the coordinated water molecules. A band at ~750 cm^{-1} in the complexes is also assigned to the coordinated water molecule [30]. The spectrum of the Copper(II) complex shows new peaks at 645 and 515 cm^{-1} ascertaining the formation of M-O and M-N coordination, respectively [38].

THERMAL ANALYSIS

The thermal stability of the metal complexes can be viewed through the data presented in Table.2. All the complexes undergo same decomposition mainly in two steps. The first step taking place in the 75–105^{0}C range corresponds to removal of lattice water molecules. The final decomposition step is represented by the complete removal of total organic moiety in the 105 – 660 °C range with the formation of metal oxide as the final product.

The TGA curves of the Cu(II) complex (Figure 3) shows a weight loss 5.10 % (calculated 5.40 %) in the temperature range 90 - 105 °C showing the elimination of two lattice water molecules. The second weight loss 83.15 % (calculated 82.68 %) in the 110 - 600 °C corresponds to the coordinated organic part. Above this temperature, a horizontal curve has been observed due to the formation of a metal oxide.

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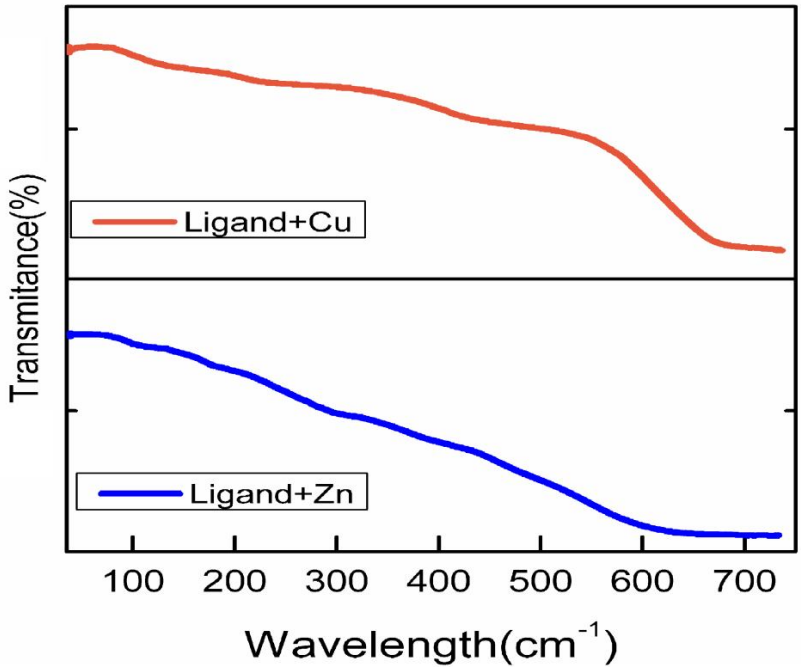

Figure-2: TGA spectrum of Cu(II) and Zn(II) complex

The Zinc (II) complex shows (Figure – 2) a two stage decomposition steps complexes in the TGA study. The first stage taking place in the 70–105°C range is attributed to the expulsion of three lattice water molecules (weight loss 8.3 % (calculated 7.86 %)). The second weight loss 79.50 % (calculated 80.29 %) in the 110-660°C corresponds to the coordinated organic ligand. Above this temperature, a horizontal curve has been observed due to the formation of a metal oxide. The final residue is qualitatively proved to be anhydrous metal oxides.

Table-2: Thermogravimetric (TGA) data of Schiff base metal complexes

Complexes	Temperature range T (°C)	% Weight loss Obs.(calcd)	Process
$[CuLP(CH_3COO)_2].2H_2O$	90-105 110-600 >610	5.10(5.40) 83.15(82.68) 11.75(11.92)	$-2H_2O$ (Lattice) loss of organic moiety CuO
$[ZnLP(CH_3COO)_2].3H_2O$	70-105 110-660 >670	8.3(7.86) 79.50(80.29) 12.20(11.85)	$-3H_2O$ (Lattice) loss of organic moiety ZnO

POWDER XRD

Powder XRD patterns of the Copper(II) and Zinc(II) metal complexes were recorded over 2θ = 0-80 range. From the data it was observed that Copper(II) (Figure–3) complex showed sharp peaks indicating their crystalline nature. Zn(II) complexes did not exhibit well defined crystalline peaks indicating their amorphous nature.

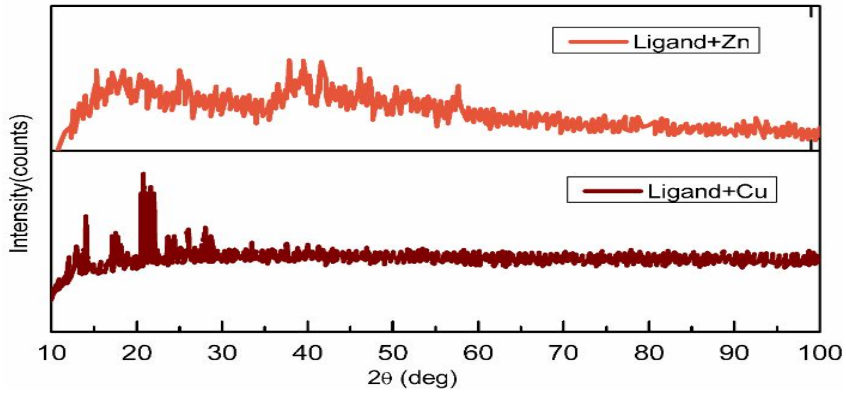

Figure-3: Powder XRD spectrum of Cu(II) and Zn(II) complex

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ANTIMICROBIAL ACTIVITY OF THE MIXED LIGAND METAL COMPLEXES OF SCHIFF BASE LIGAND (L)

The results of the antimicrobial activities of the synthesised compounds are summarized in Table 3.Amikacin was used as positive standards for antibacterial studies. Nystatin was used as a reference for antifungal studies, and DMSO was used as a negative control. These compounds display moderate to strong activity against microbes. Relatively a better activity is found for the bacteria rather than the fungi. These synthesized compounds shows moderate to strong antimicrobial activity. In the antibacterial activity, the Zinc(II) complex shows very good activity against all the bacteria and specially against *E. coli*. And *B. subtilis.*Against E. Coli bacteria, the activity of Zinc(II) complex is better than the negative standard amikacin. Cu(II) complexes also displays moderate activity against the bacteria and also the fungal species.In the case of antifungal activity, Copper(II) complex is more active than the other complexes and the free ligand (L).Here, the Zn(II) complex shows a significant activity against the Gram-negative bacteria such as E. coli. and *B. subtilis* . So the complex reported in this work may possess a possible antitumour effect [39]. The antibacterial activity of complexes are shown in the Figure 4 and 5 and respectively.

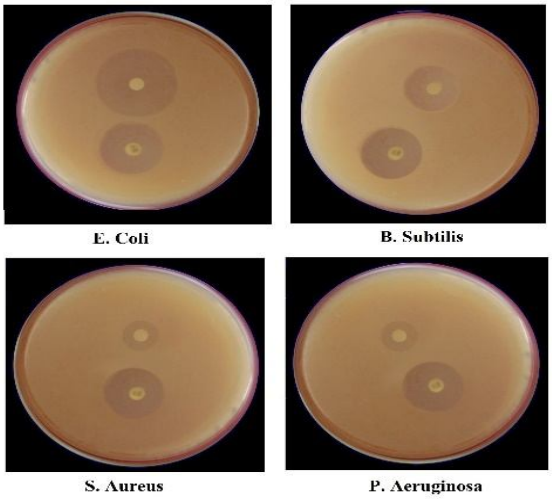

Figure-4: Antibacterial activity of $[ZnLP(CH_3COO)_2].3H_2O$ complex

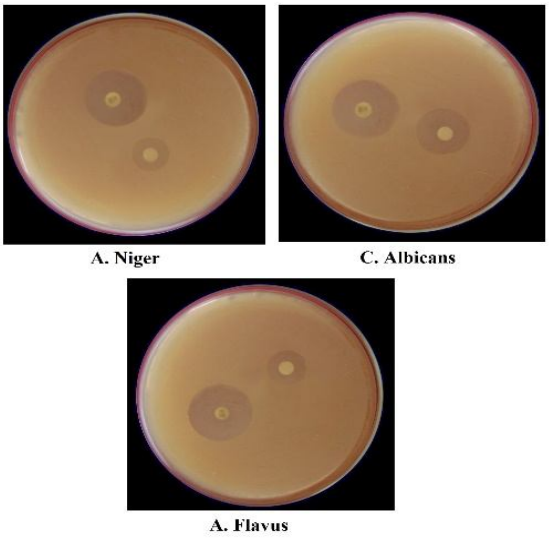

Figure-5: Antifungal activity of $[CuLP(CH_3COO)_2].2H_2O$ complex

Table-3: In vitroantimicrobial activity (MIC, µg/mL) of the mixed ligand (L) complexes

Compound	Bacterial species				Fungal species		
	E. coli	B. subtilis	P. aeruginosa	S. aureus	A. niger	A. flavus	C. albicans
L	24	>100	61	90	48	71	91
$[CuLP(CH_3COO)_2].2H_2O$	08	10	12	18	07	17	07
$[ZnLP(CH_3COO)_2].3H_2O$	03	07	14	22	57	47	11
Amikacin[a]	05	05	04	05	-	-	-
Nystatin[a]	-	-	-	-	06	06	05

[a]Standard

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DNA CLEAVAGE ANALYSIS OF MIXED LIGAND CU(II) AND ZN(II) COMPLEXES OF SCHIFF BASE LIGAND (L)

CT DNA was used to check the DNA cleavage ability of mixed ligand metal complexes. A gel electrophoresis experiment wasused to identify the cleaving ability of the ligand and its complexes in the presence and absence of H_2O_2 as an oxidant. The interaction of ligand and all the metal complexes were take part in the presence of H_2O_2. Here, Zinc(II) and copper(II) complexeswere cleaved the DNA completely. Zinc(II) and Copper(II) complexes seem to catalyze the generation of highly reactive hydroxyl radicals from H_2O_2. These hydroxyl radicals take part in the oxidation process of the deoxyribose moiety, followed by the sugar-phosphate backbone cleavage of the DNA strand. It is observed that most of the cleavages of DNA in the presence of H_2O_2 are due to the metal ions reacting with H_2O_2 to produce diffusible hydroxyl radicals or molecular oxygen, which may damage and cleave the DNA in to fragments through Fenton type chemistry [40]. We have also checked the activity of our synthesised compounds in the absence of the oxidant H_2O_2. This experiment was not helped to cleave the DNA, thus confirming the participation of hydroxyl radicals in the cleavage process.

4. CONCLUSION

Schiff base mixed ligand Copper(II) and Zinc(II) complexes with the 1,10-phenanthroline (co-ligand) were synthesized and studied through different characterization techniques, viz., elemental analysis, vibrational and electronic spectra, magnetic moment, molar conductance, TGA and powder XRD. From the IR data, the coordination of the Schiff base (L) to the metal atom was found to be through the azomethine nitrogen and the carbonyl oxygen. The nitrogen present in 1,10-phenanthrolene also coordinated with the metal ion in this mixed ligand complexes. The geometry of the complexes is assigned as octahedral for Zinc(II) complexes and distorted octahedral geometry for Copper(II) complex. A two-step degradation process is shown in the thermogravimetric analysis result of all the complexes. Powder XRD results show that the Cu(II) complexes have crystallanity. Zn(II) complexes are amorphous in nature.These compounds display moderate to strong activity against microbes. DNA cleavage results reveals that Zinc(II) and Copper(II) complexes seem to catalyze the generation of highly reactive hydroxyl radicals from H_2O_2.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

COMPARATIVE STUDY OF ONLINE AND OFFLINE SHOPPING: A CASE STUDY

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ABSTRACT
The study tries to recognize that, how consumer measure channels for their purchasing. Specifically, it progresses a conceptual model that addresses consumer value perception for using the internet shopping versus the traditional shopping. Earlier study showed that perceptions of price, product quality, service quality and threat strongly impact perceived value and purchase intents in the offline and online network. Observations of online and offline buyers can be evaluated to see how value is constructed in both channels. It is hitherto to recognize what factors influence online and offline shopping choice progression. The objective of this study is to provide an impression of online shopping decision process by comparing the offline and online decision making and identifying the factors that motivate customers to decide whether to do online shopping or go for the offlin e shopping. Consumer's shop when and where they want, where they are comfortable with the products and the choice of shopping..

Keywords: Technology, consumer, online shopping, offline shopping, internet, purchasing behaviour

INTRODUCTION
The increase in technology provides good opportunities to the seller to reach the customer in much faster, easier and in economic way. O nline shopping is emerging very fast in recent years. Now a day the internet holds the attention of retail market. Millions and millions of people shop online. On the other hand the purchasing of product from traditional market is continuing since years. Many customers go for purchasing offline so as to examine the product and hold the possession of the product just after the payment for the product. In this contemporary world customer's loyalty depends upon the consistent ability to deliver quality, value and satisfaction. Some go for offline shopping, some for online a nd many go for both kind of shopping. The focus of the study is on the consumer's choice to shop on internet and at the traditional stores at the information gaining period. However online shopping is easier for the people and less price than the offline shopping. While making any purchase de cision consumer should know the medium to purchase whether online shopping or the offline shopping. Consumer should decide the channel for them which can best suit to their need and wants and which can satisfy them. In this competitive world how consumer c an decide the particular medium for their purchase of goods is very important to understand in a managerial point of view. (Laing and Lai, 2000) said that the internet shopping is the third best and most popular activity over internet after online shopping next comes the e- mail using,instant messaging and web browsing. These are even more important than watching or getting entertain by the internet or getting any information or news, this are the two very common thought which comes to the people's mind when considering the internet users do when they are online. The behaviour of online shopping is also known as online buying behaviour and internet shopping. Buying behaviour means the purchase of good over internet using web browser. Online shopping also cons ist the same five steps which is related to traditional shopping behaviour. (C hiang and Dholskia, 2003; Lynch, Kent, and S rinivasan 2001) they said that in the typical way of online shopping when the consumer need some product or service they go through the internet and browse or search the things they need and their information. But rather than searching actively, many a times potential consumers are attracted by the information about the product they want. They see many products online and choose the best one which suits him/her. Then they purchase that product and finally the transaction takes place and post sales service provided by the online sites. Online shopping attitude and behaviour are related to the consumer.

FACTORS AFFECTING ONLINE SHOPPING
Online shopping becomes relevant in the last decade. The kind of business online retailer are doing is proof enough that they are providing some benefits to customer which offline shopping does not give to the customer. These are the factors affecting online shop ping:

Risk: When customer buy products from online shopping they do not touch or feel the product in a physical sense .Hence we understand that lot of risk is involve while buying an online product whether it will reach us on proper time or not is also a concern and a lso there may arise a risk of product size and colour as it may differ in real view or sense. Sometimes the product ordered is kind of damaged.

Convenience: Online shopping is much more convenient than offline shopping. Instead of taking out your vehicle and visit shop to shop you can just sit at your home and do the shopping. It is convenient to sit at one

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place and shop the product of our choice without moving from place to place. O nce you have decided on what you want to buy the payment process is seamless and the order is delivered to your place. O nline shopping makes things more convenient. We can have a lot of choice over there in any kind of material we want to deal with that too without any fear of dealing with any dealer or distributers. Online s hopping is convenient in its real sense as it do not carry any dealing with issues of asking for wanted items or issues of asking for desired kind of items which helps in avoiding the part of waiting, asking, questioning about the product.

Pricing Policy: O nline retailers gets an inherent advantage in pricing as they don't have to bear expenses like store rent, bills etc. They can pass their price directly to customer and generally offer a lower price to customer than offline market. Even when shipping charges are included than also it is better than the offline shopp ing. Hence, determines the level of online shopping. Lower the price- higher the mood to demand, higher the price – lower the demand. Price of any commodity also influences the purchasing power of any specific buyer. Consumer generally prefer mild or normal price with good quality and do not want to spend or expense lot for any kind of stuff. So buying and selling both are simultaneously affected by the price of product.

Quality: The quality of product at online sites and offline stores vary a lot and then this determines the frequency of online shopping. Q uality also carries good affecting nature over any kind of shopping. As consumer or buyer want to have a good quality of product as they spent their huge sum of money. In general, qualities is a primary need over any kind of purchasing as it somewhat secure or give a good sense of buying or kind of guarantee about the product preferred.

Delivery time: The product ordered by the customer in online shopping takes a minimum of six to seven days to deliver the product to the customer. But in offline shopping the possession of the goods is immediately transferred to the buyer. So this is a major factor which affects the online shopping. People want a good delivery time; they prefer to get a product in a desired time or in short time of duration. Duration is the second major factor affecting the demand o f product.

Variety: The kind of variety that a customer gets online is hard to match any product purchased offline. The online retailer's stock products from the entire major brand and a customer can find any product in their listing no matter how hard to find it is in the offline store. O nline and offline both shopping provide variety of range from various brands. Variety in it itself is the foremost dealing factor which influence the market. Larger the variety of product in shop higher the selling and vice-versa. People generally prefer to move where they get more variety of products.

Offers: Apart from offering products at lower price most online shopping regularly come up with discount offers in association with bank, brand etc. Which entail customer to get additional saving while buying products online? O ffline stores only give offer or discount during stock clearance or when the manufactures gives the discount on the products. O nline shopping always p rovides offers at all the time and day. In every purchase we get some offers even if there is no festival or carnivals. O ffers are a great factor which attract customer to purchase online. O ffer carry a great influence in shopping.

1.3. FACTORS AFFECTING OFFLINE SHOPPING

Offline shopping has existence since the existence of mankind.Offline shopping gives different types of benefits to the customer. There are some factors which affect the shopping offline those are as follow:

Less number of choices: There are limited numbers of choices when it comes to offline shopping. The numbers of varieties are limited. The ranges of products available in the shops are limited. Sometimes, the stocks are old and are up for discount and sale. Basically in offline or any shop we get less numbers of choices as it consists of manual work. We have to choice in that less number of materials due to manual factor.

Time consuming: It takes a lot of time to go shopping to a store. Distance from home or workplace to the sto re is time consuming. It is also time consuming while trying out the outfits in a store or even going through other products. In off- line shopping customer move one place to another and one shop to another in search of their desired product.

Authenticity: O ffline shopping is more authentic than online shopping. While buying the product we can feel the texture of it and know what it's like. We exactly know what we a re buying while buying anything offline. But in online shopping, we don't always know what exactly we are buying. This is because what we see on the websites is not always what we buy when the product reaches us.

Bargaining: In offline store a customer can do physical bargaining to the seller unlike shopping online. In online shopping a customer cannot do bargaining as the price of the product is fixed. Some of the customer

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purchased products depending upon bargaining so they do not go for online shopping as they feel shopping online is more costly than the market.

STATEMENT OF THE PROBLEM

Hyderabad, as we all know, is one of the most backward states in the country where the economic status of the people is not good as compared to the other states. It is important to look into the situation from an academic research point of view so as to question the reasons behind the condition of the shopping in the state of Hyderabad. This research may fill the gap between the choice of online shopping and offline shopping. This study reflect the problems and factors of online and offline shopping. There are certain problems, why people do not do online shopping and go for market to shop things? What are the major reasons behind the online and offline shopping? This study helps the consumer to get an idea about the online shopping. In Hyderabad, there is less number of people who do shopping online as compared to the other states. The study makes the consumer clear about which option should be taken by the consumer to get more benefit out of it.

SIGNIFICANCE OF THE STUDY

The consumers in today's era have not only many stores choice, but they also have a wide variety of channels to choose from. With the start of numerous channels (e.g. Mobile Commerce, E-Commerce) and a continuous increase in the competition among channels, the understanding of what incites consumers to purchase from one channel rather than another becomes progressively important channel design and management.

OBJECTIVES OF THE STUDY

The present study broadly compares the online and offline shopping, specifically the objectives are:

a) To analyse the significant difference between the online and offline consumer groups in terms of demographic, technology use, availability and attitude of the consumer.

b) The factor influencing the consumer to shop solely online and solely offline.

METHODOLOGY OF THE STUDY

This part of study defines all the process of data collection. When it comes to data collection, there are two methods in general used by researcher to collect data, primary and secondary method. Primary method includes observation method, interview/questionnaire method, and case study method. Secondary method is the method in which already collected data. The present study is based on combination of both qualitative and quantitative data. The qualitative data is collected through the sampling from the consumer. Random consumer is selected for the sampling purpose. The sample individual is selected from different age group, different sex and from different location of Hyderabad. The different group of people including student, employee and unemployed, housewives, etc are considered as sample for the study.

a) Sample size : Determining the size of sample that is needed for a particular piece of research. For this research 150 sample size is taken for the interviews. From this sample size the calculation of simple percentages for each variable is done.

REVIEW OF LITERATURE

The extensive literature review has been conducted to gain deeper understanding of research about online and offline customer and their experience. The review clarifies and simplifies the dominant dimension consumer consider when they make any online purchase decision. Following this, the major theoretical gap related to understanding what and why consumers do, and do not purchase using the Internet is explored with respect to the theories of retail change and consumer behaviour theory with particular reference to the buying decision process. More specifically, the study examined the interrelationships among quality, value, satisfaction, and loyalty when consumers choose to shop online.

Chaing and Dholakia (2014) carried out a study in which they examined the purpose the customer to purchase goods online during their shopping. Mainly there are three variable in their study those affects the consumer to purchase online or to go offline. Those are the accessibility features of the shopping sites, the type of the products and their characteristic, and the actual price of the product. The study revealed that the accessibility and the convenience of the shopping sites create the intention in the customer to purchase or not. When there are difficulty faced by a consumer to purchase online then the customer switch to the offline shopping for the purchase behaviour and the consumer face difficulty in offline purchasing then they go to the online purchasing. After relating both the medium of shopping the consumer said that the online shopping is more convenient for them and gives more satisfaction which inspires the consumer to purchase online in the internet.

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Danaher et.al (2003) focused on the loyalty of the 100 brands over the online shopping and offline shopping of 19 product of the grocery. They compared the grocery items of both the shopping with starting model which is a new segmented of Dirichlet model, this model has very dominant features which gives the exact classes for the brand choice and also gives the real model for the purchasing behaviour. The outcome of the study revealed that the reality of the high brands by the high market shares bought the online shopping much greater than the expected. But in case of the small share brand it is just reversed. However in the traditional shopping the expectations and the observations is not at all links to the brand share.

Soopramanien and Robertson (2007) conducted a study in UK on acceptance and practice of online shopping. Their exploration shows that the online consumers choose different course of action based on the apparent beliefs. They found that, how socio demographic variables, attitude and beliefs towards internet shopping effect on the both decision to practice and use of online shopping channels. They categorised online buying behaviour as the one who purchase from online sites and the one who only browse online sites and purchase from the store, and third those who do not buy online. The study do not covered the buyers who choose products in stores and buy online.

Jin and Kato (2004) attempted from that eBay market watch 88% of online graded cards are graded 8 or above. According to Beckett price guide, the value of a card grade 8 often doubles the value of card graded 7. This is collective to the experiment outcomes. It was clear that most graded cards traded online are significantly superior in quality than ungraded cards in both retail and online market.

Selvakumar (2014) concentrated on consumer's perception of the product sold online and the issues considered important to online shopping. This study was conducted among the online shoppers at Coimbatore which is in Tamil Nadu state. It is to analyse the impact of consumer opinion and the attitude. Q uestionnaire was made to collect the data from the population; these questionnaires were given to college going students. The total sample size is 150 respondents. The finding of this study shows that improvement and accessibility influence the customer's intention to shop online.

Suki and Suki (2007) conducted their study in Malaysia. This study is an empirical study. They create a model in which they are identifying the influence of the real value, the real risk and the actual enjoyment of the consumer of online shopping. The consumers who are adopting the online shopping they are in the prominent risk and the prominent indicators. The consumer of Malaysia of online shopping has a perception about the involvement of risk in shopping and their risk is mostly related to the sec urity and the privacy. It includes the security and privacy of the personal information of customer ,transaction of online shopping, the quality of the product and the uncertainty about the product whether the product will reach the consumer or not.

Andrew and Currim (2000) focused on expected differences in choice, behaviour of consumer for two products categories, statistically significant difference are found between consumers attracted to shopping online versus traditional super market with regards to parameters describing the choice process. The study found that correlated to traditional supermarket consumers, online shopping are less price sensitive, prefer larger size to smaller sizes, have stronger size faithfulness. The consumer does more broadcasting choice set effects.

DATA ANALYSIS

This chapter mainly describes the qualitative practice to be used to provide data to examine the issues acknowledged and extend the understanding of consumer value creation in the framework of what and why consumers purchase online. Tentative and descriptive re search can provide the multiple outlooks necessary to obtain multiple approvals of online, offline and channel switching behaviour during the buying decision process. This typically involves sampling the population, surveying them and using inferential sta tistics to analyse the responses. The focus of the analysis is to expect the determining factors influencing, in this case, what and why consumers purchase online and offline as well, why they switch from one way to another. The data gathered during the depth interviews were used to identify common questions concerning consumer behaviour as it relates to the pure online and offline buying process as well as channel switching from one trade channel to another during the buying choice process. Deepness of the interviews and concentration groups provide an efficient means of spreading and emerging theoretical concepts to improve the ultimate research design. And are used in this research to better appreciate what and why consumers use the Internet to shop and in specific why they choose one channel over another in general. Below defines how this qualitative phase of the research is directed and classifies which of the research objectives each activity supports for both the depth interviews.

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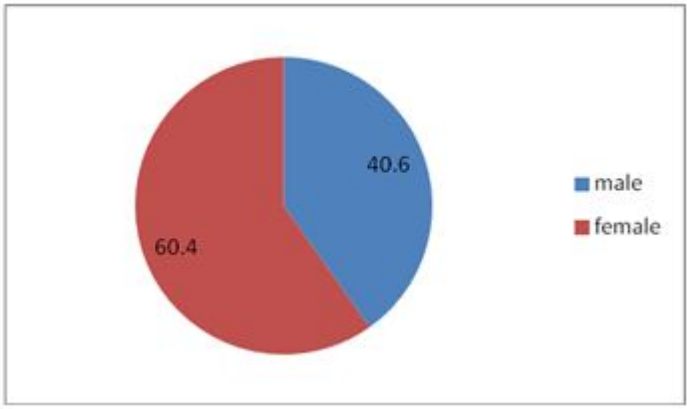
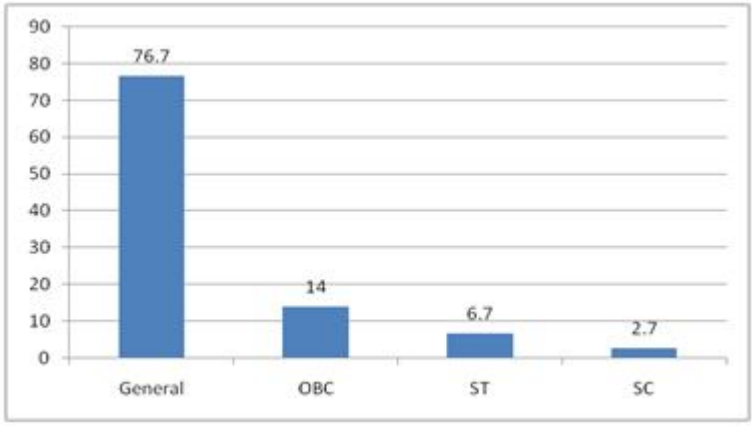
SEX RATIO OF THE RESPONDENT



Source: Survey Data and Author's calculation

150 respondents were taken into consideration for the study. The graph representation shows the percentage of male and female who are doing online and offline shopping. It shows 40.60% of male go for the shopping while 60.40% female do the shopping. This means that more of the female member involved on the shopping. This gives a general idea of the sex ratio who is more involved in shopping.

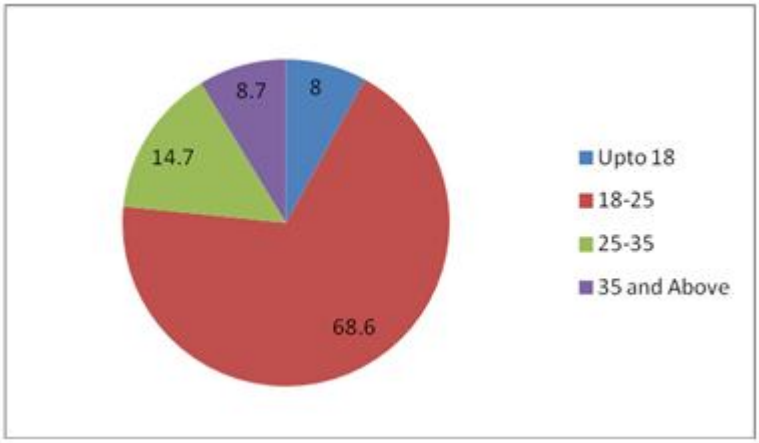
CHART: CASTE OF THE RESPONDENT



Source: Survey Data and Author's calculation

The above graph representation shows the percentage of population category who opt for online shopping. The general caste population are major customers of online shopping covering 76.7 % of the total population. Followed by OBC category comprising 14% of total population. The SC and S T contribute for 2.7% and 6.7% respectively. It was seen that the general population mostly opt for online shopping because of their changing life style. This makes them shop more online where they can save their time and also maintain their status. This online shopping not only fulfils customers need but also saves money and time of their buyers and there it's a win -win situation for all

AGE OF THE RESPONDENT



Source: Survey Data and Author's calculation

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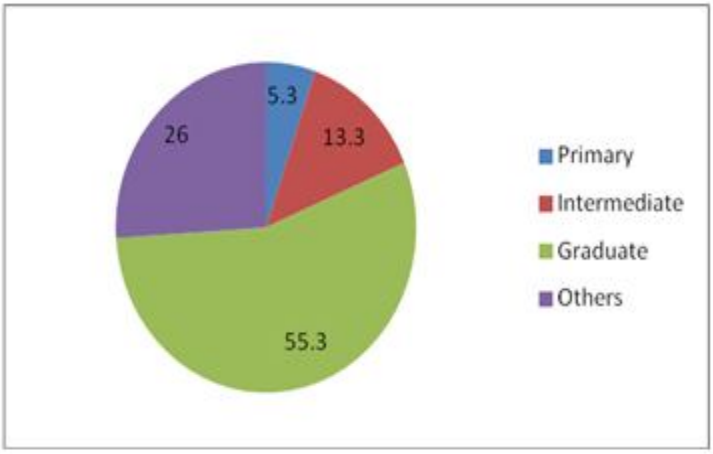
The above graphical representation shows the age category of population who choose online shopping .The major of customers who use online shopping to fulfil their need ranges mostly between 18 to 25 age category comprising of 68.6% of the total consumers and this is mostly seen among them because of the increasing technological revolution among the youth population and they are able to use this technology for their well-being more than other age group category. Next the age group of 25-35 contribute as the second most consumer type using online shopping services of 14.7%. For this age group time is the major factor for using them this stream as way to shop. The rest of the consumers are age group of 35 above and 18 below comprising 8.7% and 8.0% respectively. The percentage of population low because most of the 35 above group have lack of adequate knowledge of technology used. And for 1 8 below money constraint comes into picture.

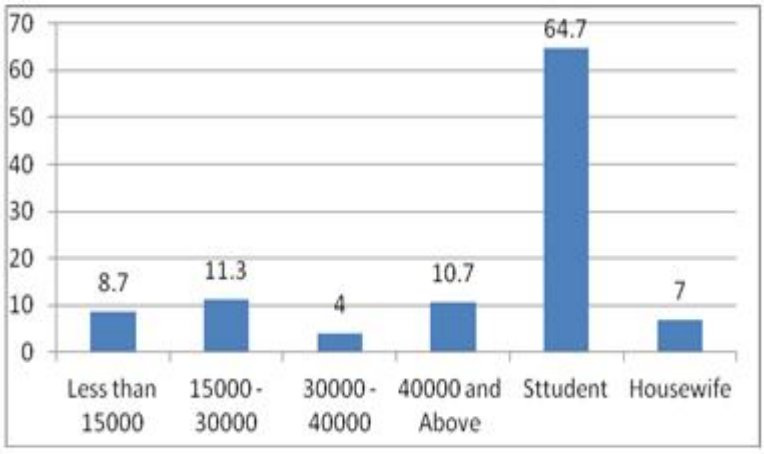
QUALIFICATION OF THE RESPONDENT



Source: Survey Data and Author's calculation

The above pictorial representation shows the qualification of the respondent, and the maximum qualification is others that is graduate people which consist around 55.30%.next is the others which is around 26% they are of P.hd,Masters etc. The intermediate group which consist of 13.30% and the primary group consist of 5.30%.Q ualification is a major factor for online shopping,Unless and until the person is qualified enough to access the internet. They cannot do online shopping

DIFFERENT INCOME GROUP OF THE RESPONDENT(INCOME IN PERCENTAGE



Source: Survey Data and Author's calculation

The above pictorial representation shows the income of the respondent, and the maximum income for the shopping site comes from the student class. These people are not employed rather they study and do shopping online this is because they are updated with the current technology. The representation shows that the 64.7 % of the people are student. Second comes the group of people who is having income of 15000-30000 it takes around 11.3% then followed by the groups of income 40000 and above which is 10.7%, then comes the less than

15000 income group which covered 8.7%,and after that 30000-40000 income group and last comes the housewives which takes 4% and 0.7% respectively. Housewives do not go for the online shopping as they do not get time out of their household work and they are also not technologically updated. The graph gives the clear cut idea about which income group is more into the online shopping.

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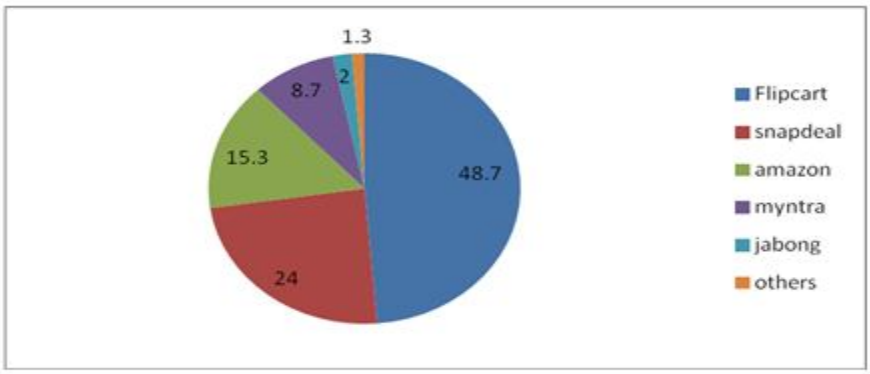
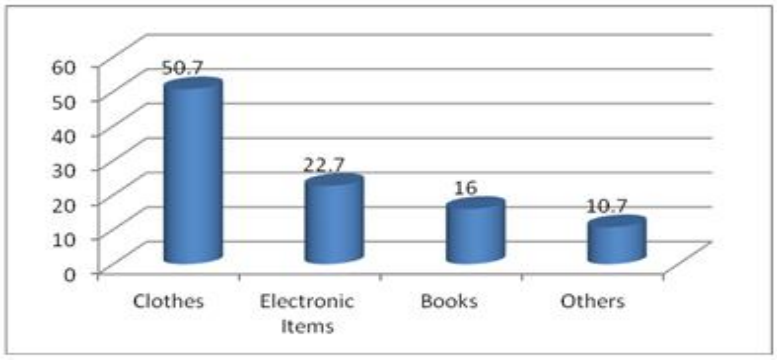
PREFERENCE OF THE DIFFERENT ONLINE SHOPPING SITES



Source: Survey Data and Author's calculation

The most preferred website for online shopping is F lip kart as it was the only site for online shopping in the country for many years later when other sites came into picture its market went down, still it's the most preferred site as its marketing done properly with superior brand quality of products and services over other sites .So, it's still able to retain the market. The next comes the snap deal site where nearly 24% of consumers prefer it. This is because of the recent increasing marketing strategy of the sit e and an assurance to give better service and product. Next comes amazon site which covered 15.3% of the people, it is an online shop giant outside the country still its striving hard to market its brand in the country, and assures a major potential for market in near future. Next online sites preferred are myntra and jabong and the percentage of the people are 8.7%% and 2% respectively. it has come into picture of online shopping because of its fancy offers and benefits it provides. The least number of percentages is 1.3% for other shopping sites like – Yepme, craftvilla.com and other sites.

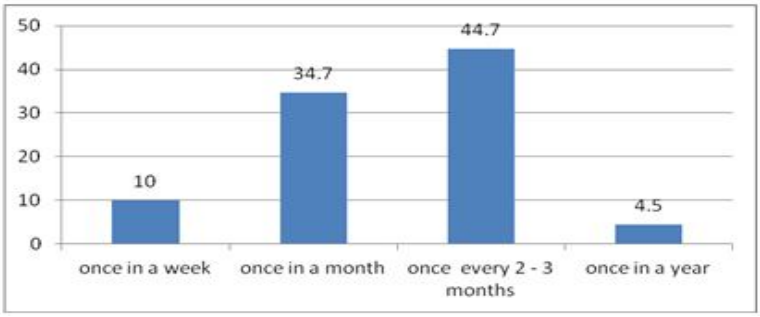
MOSTLY PURCHASED GOODS FROM ONLINE SITES



Source: Survey Data and Author's calculation

The consumers mostly purchase clothes online comprising of 50.7% of the population, The increasing demand of clothes online is because of the variety of options the consumers get to choose and that to at a reasonable price. Moreover the quality provided is also superior. So, there is a demand for clothes in online pages .Next comes the electronic items purchase with 22.7% of the total demand. These sites provide these items at factory output price and also provide a warranty over the items .So, consumers find it reasonable to buy it online. The next demand comes of books comprising of 16% of the demand. The other products purchased online covers for 10.7% of the total items purchased online like – footwear, cosmetics, etc

FREQUENCY OF THE PRODUCT PURCHASED FROM ONLINE SHOPPING SITES BY THE RESPONDENT



Source: Survey Data and Author's calculation

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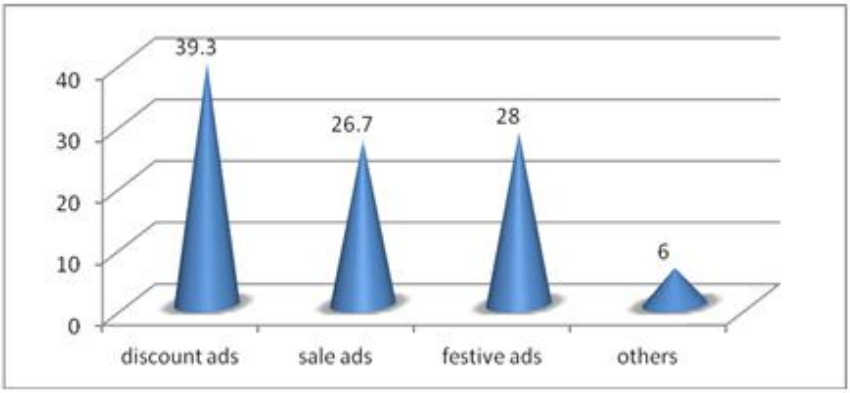
Recent study shows that due to increasing need of society and time constraint has led most of the population switch to online shopping. It is seen that nearly 44.7 % of the regular population do buy the product in every 2-3 months at a regular interval. 34.7% of population do online shopping every month which is because of the availability of income and technology to do shopping. Moreover, 10% of population do online shopping every week. And 4.5% once in a year.

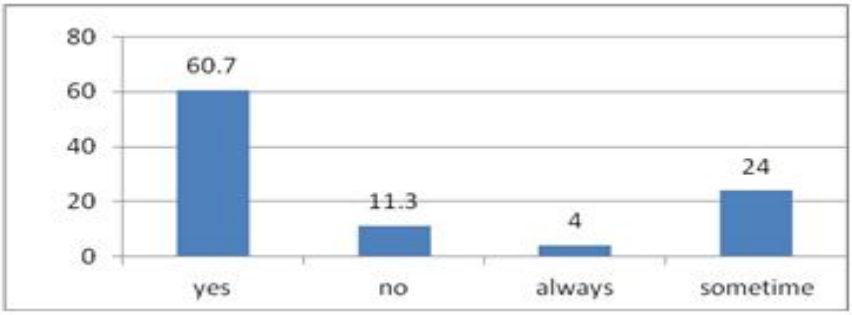
TYPE OF ADVERTISE MENT MOSTLY ATTRACTS TO PURCHASE ONLINE



Source: Survey Data and Author's calculation

Advertisement plays a major role for making a site a brand in the market. Moreover, advertisement attracts its customer towards them to make income. The type of advertise ment that attracts the customer towards them is discount ads which is 39.3%, which give the customer a reason to buy their products at reasonable prices. Also the sales ads bring more customers nearly 26.7% of total customer gets attracted to it. The fest ive season is the time duration during which major of the population do their shopping is 28% and if ads related to it is published then it brings more customer to them.

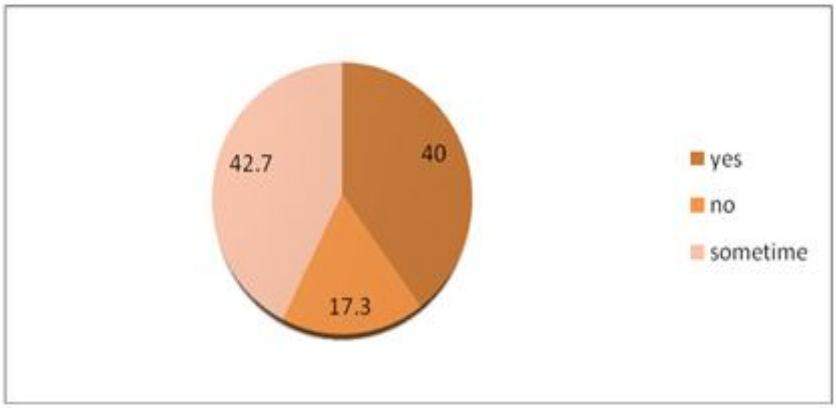
PREFERENCE OF ONLINE SHOPPING WHE N PRICE LOWE R THAN MARKET PRICE



Source: Survey Data and Author's calculation

It is clear from the study that 60.7% of people admit that they would prefer online shopping if they would get price lower than the market price. 24% of people say that they are not sure which option to choose and 11.3% say that they would prefer shop over internet shopping. And 4% people said that they will prefer online shopping instead of purchasing from offline shopping or traditional market.

DOES ONLINE SHOPPING IS AS SECURE AS TRADITIONAL SHOPPING?



Source: Survey Data and Author's calculation

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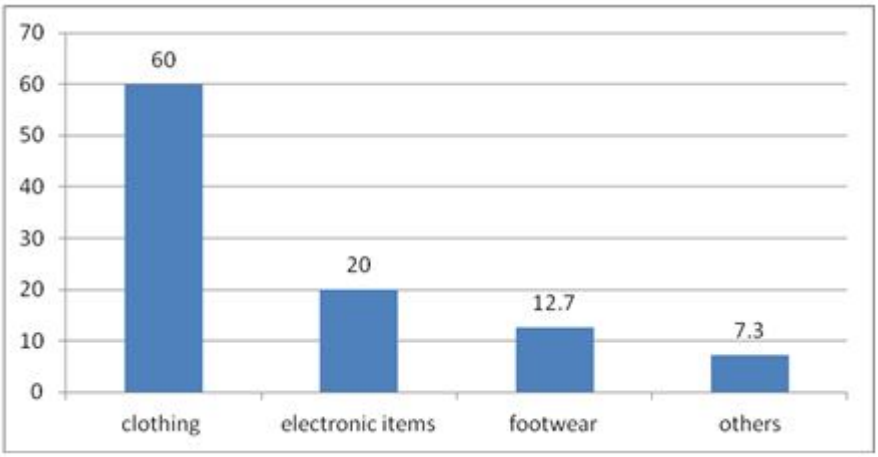
The Graph clearly shows what customers think about online shopping, with 42.70% sometime think its secure sometime it is not as compared to traditional shopping.40% customer think online shopping is as secure as traditional shopping, while 17.30 % believe it is not secure.

CHART



Source: Survey Data and Author's calculation

The clothing is the commodity which is mostly preferred for offline shopping i.e. about 60%, customer like to feel the fabric of clothes, try it and like to see/try different types of clothing that is why they purchase it from offline market/traditional shopping. The second commodity which is most preferred for offline shopping is electronic items 20%, everyone wants to have their hand on items which are in working good condition, the best way to do check the proper functioning of electronic goods is to shop offline where you can use the gadget for trial and make sure that you don't purchase malfunctioned items. Even footwear 12.70% is among the list of the most preferred offline shopping items, sizes vary from customer to customer, so people prefer to buy those footwear which fits them and they are comfortable with. Rest 7.30% are miscellaneous goods which people go for offline shopping such as groceries, vegetables, consumer products etc.

Table 1: Reason for doing online shopping according to the age group

Age of the respondent	Time saving	Door to door service	No issue of going to shop	Availability of product	Total no. of respondent
Up to 18 years	2	4	3	3	12
18-25 years	29	23	19	32	103
25-35 years	6	3	5	8	22
35 and above	3	3	2	5	13

Source: Survey Data and Author's calculation

The survey conducted on 150 customers of different age group about the factors that attracts them to prefer online shopping. Out of 12 customers up to age 18 years of age, 2 said its time saving, 4 gave the reason as door to door service, 3 said they don't need to go outside to the shop for the purchase of goods and 3 think products are easily available online. The 103 customer aging between 18 and 25, 29 said its time saving, 23 gave the reason as door to door service, 19 said they don't need to go outside to the shop for the purchase of goods and 32 think products are easily available online. The 22 customer aging between 25 and 35, 6 said its time saving, 3 gave the reason as doosr to door service, 5 said they don't need to go outside to the shop for the purchase of goods and 8 think products are easily available online. The 13 customer aging above 35, 3 said its time saving, 3 gave the reason as door to door service, 2 said they don't need to go outside to the shop for the purchase of goods and 5 think tha t the products which they are getting is easily available at online.

Table 2: Preference of the age group about the ite m they never purchased from the online sites

Age of the respondent	Clothes	Electronic items	Books	Footwear	Total no. of the respondent
Up to 18 years	1	7	3	1	12
18-25 years	19	37	33	14	103
25-35 years	8	6	6	2	22
35 and above	5	6	2	0	13

Source: Survey Data and Author's calculation

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Out of 12 customers up to age 18 years of age, 1 said its C lothes, 7 said Electronic items, 3 said books and 1 said its footwear. The 103 customer aging between 18 and 25, 19 said its Clothes, 37 said Electronic items, 33 said books and 14 said its footwear. The 22 customer aging between 25 and 35, 8 said its C lothes, 6 said Electronic items, 6 said books and 2 said its footwear. The 13 customer aging above 35, 5 said its C lothes, 6 said Electronic items, 2 said books and none said its footwear.

Table-3: Preference of the respondent for the shopping sites according to the delivery of the time

Shopping sites	yes	no	Total
Flipkart	61	12	73
Snap deal	32	4	36
Amazon	22	1	23
Myntra	9	4	13
Jabong	3	0	3
Others	2	0	2

Source: Survey Data and Author's calculation

On asking Customers which e-commerce website they prefer to purchase stuffs and do they deliver goods on time73 customers said they shop from F lipkart with 61 saying that goods are delivered on time while 12 denying this fact.36 customers said they shop from Snapdeal with 32 saying that goods are delivered on time while 4 said that goods are not delivered on time.

23 customers said they shop from Amazon with 22 saying that goods are delivered on time while only 1 said that goods are not delivered on time. Out of 13 people shopping from Myntra 9 said yes goods are delivered on time and 4 said no. All the 3 customers who shop from Jabong said that goods are delivered on time. While 2 customers shopped from other websites and are satisfied with the proper delivery on time.

Table-4: Preference of the payment process according to the age of the respondent

Age of the respondent	Cash on delivery	Net banking	Debit card	Others	Totals
Up to 18 years	10	0	1	1	12
18-25 years	81	14	6	2	103
25-35 years	13	6	1	2	22
35 and above	10	3	0	0	13

Source: Survey Data

Out of 12 customers up to age 18 years of age, 10 said its Cash on delivery, none preferred Net banking, 1 preferred Debit card and 1 preferred other modes of payment (credit card etc.).The 103 customer aging between 18 and 25, 81 said it is Cash on delivery, 14 preferred Net banking, 6 preferred Debit card and 2 preferred other modes of payment (credit card etc.).The 22 customer aging between 25 and 35, 13 said it is Cash on delivery, 6 preferred Net banking, 1 preferred Debit card and 2 preferred other modes of payment (credit card etc.). The 13 customer aging above 35, 10 said its Cash on delivery, 3 preferred Net banking, none preferred Debit card and other modes of payment.

Table-7: Preference of the respondent to see products while shopping offline

Age of the respondent	Many	few	Very few	Too many	Total
Up to 18	5	7	0	0	12
18-25 years	52	42	5	4	103
25-35 years	12	9	0	1	22
35 and above	6	7	0	0	13

Source: Survey Data and Author's calculation

Out of 12 customers up to age 18 years of age, 5 looked for ma ny products, 7 looked for few, and none looked for very few or too many products. The 103 customer aging between 18 and 25, 52 looked for many products, 42 looked for few,5 looked for very few and 4 too many products. The 22 customer aging between 25 and 35, 12 looked for many products, 9 looked for few, and none looked for very few and just 1 looked too many products. The 13 customer aging above 35, 6 looked for many products, 7 looked for few, and none looked for very few or too many products.

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CONCLUSION

The study reveals that the male are less doing the online shopping than female. The female are more into online shopping because they enjoy doing shopping whether it is traditional shopping or e-shopping. The young generation are more often purchasing from online sites because of the revolution in the technology among the youth population and they are able to use this technology for their well-being more than other age group category. Flipkart is the shopping site which is more preferable by the youngster. There are increasing demand of online shopping because the variety of options for the consumers to choose and that to at a reasonable price and sometime even less price than the market. Electronic items were less demanded from the e-shopping but clothes are much more demanded by the consumers. There are several products which are not delivered by the shopping sites in the preferable area, it is seen that with the advancement of the technology the preference of the online shopping increases. Earlier people more uses the traditional shopping. Now also people who are not aware of the several shopping sites and not that technically advanced are less into internet for shopping.

This study advanced an ideal that uses consumer value perceptions to increase our thoughtful of channel choice. Earlier work verified the key effect of perceived value has on purchase intentions, but merely concentrated on product or store value insights. This paper extends the studies while asking the questions from the consumer who are into online shopping as well as traditional shopping to rate both the channels in the terms of performance, products, time of delivery, quality and other related aspects of online and offline shopping. By accepting this approach, investigators and experts can gain valuable insights into the motivations to adopt a definite channel for shopping area.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

NEW WORLD ORDER, PEACE AND PROSPERITY: A BUDDHIST PERSPECTIVE

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ABSTRACT
Buddha was born in India 2500 years ago. He is rightly regarded as the greatest rationalist and humanist in the history of mankind. Buddha also established democracy as a way of life for the first time in the world and paved the way for the empowerment of women and weaker sections who were marginalized by the Hindutva forces. Buddha also emphasized equality, liberty, fraternity and collective welfare as the real foundations of democracy. The French Revolution was also organized on the democratic principles of Buddha which liberated the mankind from the fascism. In the new millennium, the world is experiencing the worst kind of imperialism and terrorism under the leadership of neo-colonial forces led by America. The marginalized sections have become the worst victims of globalization. The world is also marching towards another war which means total destruction. Under the changed disturbing circumstances, the world has to understand the essence of Buddhism which practically means humanism and collective welfare regardless of gender, religion, region, color, caste and creed. The world has to choose either war or Buddha. Hence, Buddhism assumes great significance from the point of view of creating a new world order for peace and prosperity of the mankind.

PREAMBLE
Buddha can be regarded as an apostle of liberation of mankind from all kinds of diseases, disorders and deprivations. He fought non-violently against all oppressive Brahmanical forces. The indigenous people of India had built a great Indus Valley Civilization and ruled India for about 1000 years by following the law of natural justice. The invasion of Aryans had dealt a death blow to the Indian civilization and heralded a new era of marginalization of indigenous people in the name of Verna system which was based on myths and inhuman practices. The four Vedas have primarily dealt with the man-nature relationship rather than the man-god relationship. Buddha discarded the theory of Varna, existence of god and prevalence of inequity in all walks of life. Buddha provided alternatives for the old social, political, economic and cultural orders and established democracy on the basis of rationality and humanity. He called upon his followers to verify his thoughts and deeds and make use of them if they were found realistic and appropriate. He was totally against hero worship and worship of false gods and goddesses manufactured by the Brahmanical order. Buddha, by spreading knowledge and the spirit of truth fought against all kinds of exploitation and made India the land of 'enlightened citizens'.

Today, human values are threatened by the dominant powers all over the world. The market forces are powerful and almost absolute, aided by globalization of the capitalist order. In the new millennium, the world civilization is at the cross roads. The people are fed up with the materialistic culture manufactured by the champions of globalization and promoted by the media owned, managed and controlled by the market forces. There is also guerilla communication which has polluted the minds and lives of people across the globe. The world will simply disappear in the event of any third world war. Buddhism is not confined to any particular religion but it is a universal path to salvation from all kinds of miseries which are manmade. The mankind should realise that the marrow of civilized society is ethical and not metaphysical. This is indeed the essence of Buddhism which can save the world from destruction in the name of development. This article emphasizes the relevance of Buddhism in the age of globalization on the basis of an extensive review of literature.

EMERGENCE OF THE BUDDHA
The Buddha was born on a full moon day of May in 623 B.C. He was the son of Suddhodhana and Mahamaya who ruled over the land of the Sakyas at Kapilavatthu, near Himalayas. He was named as Siddhattha Gautama since he belonged to the Gotama family of the Kshatriya varna. In ancient India, the monarchial states were known as Janapada and the non-monarchial states as Sangh or Gana. The Sakyas had their own historical legacy.

Ambedkar (1957:01) had referred to the meeting between great sage Asita and King Suddhodana in his work. Ambedkar has stated that Asita had told the King that the child was endowed with the 32 marks of a great man and adorned with the eighty minor marks, his body surpassing that of Sakra, Brahma and his aura surpassing them a hundred thousand fold. Asita had predicted that Gautama would become an enlightened Buddha and will

ISSN 2394 - 7780

turn the supreme wheel of the Doctrine that has not been turned before him by any other being in the world (Ambedkar, 1957:02).

Siddharth Gautama lost his mother Mahamaya after the naming ceremony which was celebrated on the 5th day after the birth of the child according to traditions of Sakyas by Suddhodana and Mahamaya at Kapilavatsu, the capital of Sakyas. The child was named as Siddharth Gautama. Siddharth grew in the company of his father and several cousins. He started his education at the age of eight under the guidance of learned teachers including Sabbamitta. He mastered all the philosophic systems and meditation under the guidance of Bharadwaj. He opposed the killing of animals in the name of hunting and concentrated more on learning and meditation. He cultivated supreme sense of compassion in the childhood. Buddha received the best education and comforts of life. He developed a strong inclination for spirituality in the early stage of life since he wanted to liberate the mankind from all kinds of sufferings based on ignorance.

Siddharth Gautama married Yeshodhara when he was 16 years old much against the wishes of Dandapani, his father in law. They had a son who was named Rahula. Resisting persuasion from his father and the prime minister, Gautama continued in the spiritual pursuit of truth, affirming that attachment to materiality would lead to the destruction of human values. Gautama had practically overcome all misconceptions created by the vested interests. He was initiated into the Sakya Sangh when he was twenty years old. There was a conflict of interest between the Sakyas and Koliyas over the distribution of water resources of river Rohini. He strictly opposed any war on the Koliyas since a war would lead to another war. He opted for a non-violent resolution of the water crisis and voluntarily opted for becoming Parivrajaka which was a kind of an exile voluntarily accepted by Gautama as a true means of liberation from worldly pleasures and compulsions. He left Kapilavatsu when he was 29 years old and became Sakya Muni. He travelled from Kapilavatsu to Rajagraha, capital of the kingdom of Magadha by foot.

King Bimbisara also tried to persuade Gautama to give up his mission but failed to convince Gautama. He visited the rishi Brighu's Ashram and studied Sankhya Philosophy. He was also trained in Samadhi Marga which ensured concentration of the mind. He gained mastery over Dhyana Marga in the country of the Kosalas to achieve concentration by stopping breathing. Gautama continued these exercises for about 6 years and realizing their futility over a period of time ended consciously the trial of asceticism.

Gautama realized that all paths were not good enough for the happiness and progress of the mankind. He sat under the Banyan tree and resolved firmly to accept death in a royal spiritual battle rather than getting defeated in life. He continued his meditation and concentrated on the problem of finding an answer to the question which had troubled him (Ambedkar, 1957:03). Gautama attained Samma Bodhi (Real Enlightenment) after an arduous quest for becoming a Bodhisatta.

CRITIQUING BRAHMANICAL THEOLOGY

Buddha found no merit in the Vedas that he considered as worthless as a desert and discarded the mantras which failed to enlighten people. He firmly rejected the philosophy of the Vedic Rishis as useless (Ambedkar, 1957:04). He attained enlightenment on the basis of firm will and determined efforts. Buddha advocated that there was no logical or factual basis for the presumption that God exists or that he created the universe (Ambedkar, 1957:05).

Buddha vehemently rejected the four theses on which the Brahmanic theology rested in India. He opposed the Chaturvarna philosophy which perpetuated the social inequality among the four castes – Brahmins, Vaishyas, Kshatriyas and Shudras. The Brahmins had gained monopoly over knowledge. The Vaishyas had controlled the national economy. The Kshatriyas had ruled the country on the basis of caste power. The Shudras had become the slaves of the system and were denied the right to education, employment, economic resources and political power. Buddha had also opposed the Doctrine of Karma which was created and endorsed by Brahmanical Philosophy.

The Buddha was strongly opposed to the first tenet of Brahmanism. He repudiated their thesis that the Vedas are infallible and their authority could never be questioned. He argued that everything must be open to re-examination and reconsideration by the people. He condemned the sacrifice of animals in the name of rituals. He observed that the philosophical foundations on which the social order was reared by Brahmanism were wrong if not selfish. The Shudras and women – the two classes whose humanity was most mutilated by Brahmanism had no power to rebel against them. He could find no proof in support of the thesis that Brahmana was a reality and rejected the thesis of the Upanishads (Ambedkar, 1957:06). The people were made to believe that 'Brahm' was an ontological entity and Brahmins were created by Brahma to always remain on top of the social order even though they did not deserve such honor by virtue of deeds.

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Buddha had come across about 62 different schools of darsana which were opposed to the Brahmanic theology. He identified Akriyavada (Purana Kassappa), Niyativada (Makali Ghosal), Ucchedavada (Ajit Kesakambal), Annyonyavad (Pakudha Kacchyana), Vikshepavada (Sanjaya Belaputta) and Chaturyamsamvarvad (Nigantha Nathaputta) as prominent anti-Brahminical schools of thought. He also rejected the philosophies of his contemporaries on the ground that they did not liberate mankind from exploitation. He also decided to seek an alternative path to salvation. Buddha rejected the belief in Chaturvarna as the ideal for social organisations and accepted the natural law of cause and effect with its corollaries.

CONVERSION TO BUDDHISM

Buddha remarked: "The Tathagata has not ceased from effort and reverted to a life of luxury and abundance. The Tathagata is a supremely Enlightened One. Give ear, monks, the Deathless has been attained. I shall instruct you. I shall teach you the Dhamma". This has been quoted in the writings of Piyadassi which primarily dealt with the spectrum of Buddhism (Piyadassi, 1991:15). Buddha chose the middle path in 589 B.C. in order to avoid the extremes based on Eightfold Path such as – right understanding, right thoughts, right speech, right action, right livelihood, right effort, right mindfulness and right concentration. He also emphasized the Four Noble Truths like – the noble truth of suffering, the noble truth of the arising of suffering, the noble truth of cessation of suffering and the noble truth of the way leading to the cessation of suffering. Buddha also achieved the unshakable deliverance of mind which led to the ultimate realisation of no rebirth. Buddha discarded the doctrine of soul and transmigration and emphasized the supreme power of nature.

Buddha undertook the long campaign of conversion after he was persuaded by Brahma Sahampati, a staunch follower of Siddharth Gautama in the kingdom of Magadh. He firmly believed that Buddha would bring comfort to the weary and sorrow-laden mankind ((Ambedkar, 1957:07). Buddha came over to Sarnath and delivered the First Sermon on the basis of middle path which is neither the path of pleasure nor the path of self mortification. He taught the right beliefs, behavior and endeavours in order to provide the path of virtue to the people. The Parivrajakas realised that Buddha was born to free the mankind from supernatural and superhuman forces.

Buddha converted the Yashas, Kassyapas, Sariputta, Moggallana, Bimbisara, Anathapindika Pasenjit, Jeevaka, Ratthapala and other kings who accepted Buddha as the real protector and preserver of mankind. He was invited by his father Suddhodana who was deeply moved by the spiritual accomplishments of his son. Buddha also met his wife Yeshodhara and son Rahula and convinced them that his spiritual treasure was the real path of righteousness which liberated mankind from the system failures and human miseries. He was given a rousing reception by the Sakyas who had rejected him few years ago. They were extremely happy to join the Blessed One. Buddha strongly refused to return home as a man of the world and succeeded in winning over the adversaries on the basis of self realization and self actualisation.

Buddha also converted the common people who were victims of manmade disorders. Upali, the barber, Sunita, the sweeper, Sopaka and Suppiya, the untouchables, Sumangala, a backward woman, Suprabuddha, the Leper and other marginalised persons were inducted into the ranks of the New Order, created by Buddha. He was also successful in converting the vagabond, robber, criminals and others who had strayed onto deviant paths. Buddha did not claim any place for himself in the New Order – Dhamma. He claimed himself as the path finder rather than giver of salvation. He discarded divinity for himself. He claimed 'The Dhamma must be its own successor' (Ambedkar, 1957:08).

Buddha was wholeheartedly supported by King Bimbisara who constructed a the Veluvana garden for the Bhikkus and Upasakas. Buddha also received Jetavana from Anathapindika for the rest and relaxation. He accepted the Ambavana and the Vihara built by Jeevaka. Ambrapali, Vishakha and others also donated gifts to Buddha. Many prominent people like Dhananjanani, Visaka, Mallika and Pasendi greatly influenced by the Buddha's ideals and became his ardent followers.

Dhananjanani, a Brahmin lady had become a devotee of Buddha and made her husband a devotee too. Visakha was another ardent follower of Buddha. Mallika also became a Buddhist. Pasendi, the King of Kosala accepted Buddha as his mentor. There were some adversaries who vehemently opposed the humanism of Buddha. He had the courage and conviction to defeat them truthfully and non-violently. He also effectively handled the criticisms of his adversaries. He replied to his critics in unambiguous manner: "What I have consistently preached both in the past and today is the existence of ill and the ending of ill" (Ambedkar, 1957:09).

Buddha visited several places on foot and earned great admirers and followers across the country. He addressed the gatherings regularly and resolved their doubts and pains. He had also met Sariputta who had nursed hidden enmity against him. Sariputta had practically surrendered before Buddha along with his clan and followers. He

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bid a farewell to Vesali and proceeded to Nalanda along with Ananda and other Bhikkus. He proceeded to Kushinara and relaxed in the river Kakuttha. Thereafter Buddha visited the Sala grove of the Mallas, the Upavana of Kushinara for rest. Buddha had realised the ultimate occurrence of death and assured Ananda that Dhamma would lead them after his demise. Buddha breathed his last in the midnight in 483 B.C on Vaishaka Paurnima. The last rites were performed by the Mallas of Kushinara with utmost reverence in the Shrine of the Mallas, called Makuta Bandhana in the presence of several people. The mortal remains of Buddha were equally divided into 8 parts and distributed to his followers.

BUDDHA AND HIS DHAMMA

Buddhism is more a system of philosophy and practical ethics than a religion. The most striking feature of Buddhism is that it eschews all hypotheses regarding the unknown, and concerns itself wholly with the facts of life in the present work-a-day world. It does not constrain the rational human mind to dwell upon insoluble problems. Rationality and sanity are in evidence in all points of Buddhism which discarded animism, dogmatism, sensuality, asceticism, self denial and self-consecration. The spirit of Buddhism is essentially socialistic, that is to say, it teaches concerted action for social ends. It alone teaches that there is hope for man only in man (Narasu, 1907:14).

Buddha proclaimed that nothing would give real happiness as Nibbana (salvation of the soul). The Buddha's conception of Nibbana is quite different from that of his predecessors. The Middle Way is taught by the Noble Eightfold Path of right outlook, right aims, right speech, right action, right means of livelihood, right effort, right mindfulness and right concentration. He states: "There is no greater benefit than health and there is nothing more valuable than the spirit of contentment". Buddha taught that the Law of Kamma has to do only with the question of general moral order. It has nothing to do with the fortunes or misfortunes of an individual (Ambedkar, 1957:10).

Buddha's philosophy gave a new dimension to the concept of Dhamma. He did not consider certain things such as – belief in the supernatural, belief in Ishwara (God), union with Brahma, belief in soul, belief in sacrifices, belief in speculation, religious reading of books and belief in the infallibility of religious books as the real Dhamma. Arguing that these practices impeded the salvation and progress of the mankind, he called upon the people to uproot these doctrines which were the most potent sources of superstition. He coined a new term called 'Saddhamma' which cleanses the mind of its impurities, makes learning open to all, encourages people to pull down all social barriers, highlights worth rather than birth, promotes equality and creates a new order (educational, social, political and economic). Buddha pointed out that inequality is the official doctrine of Brahminism which hindered the collective welfare in the country.

The religion of the Buddha is perfect justice springing from a man's own meritorious disposition. Dhamma is righteousness, which means right relations between man and man in all spheres of life. Morality comes in only wherein man comes in relation to man. Morality is the essence of Dhamma. It must be sacred and universal. Ambedkar's political values reflected the essence of Buddhism.

Buddha was an annihilationist since he firmly believed in the non-existence of the soul. Buddha knew well that the body dies but the four elements of existence such as Prithvi, Apa, Tej and Vayu live forever. This aspect of rebirth was believed in by Buddha. The Buddhist Law of Karma rejects the concept of soul and applied only to Karma and its effect on present life. He nullified the perception that Past Karma has an effect on Future Life. Buddhism is built upon certain truths, human values and best practices which benefit the mankind. He rightly considered non-violence as the essence of human life. Buddha created a non-violent army of Bhikkus (monks) who made Buddhism as a universal religion and way of life. Prevention of craving and lust is indeed the Buddhist way of life.

Buddha's sermons practically covered all spheres of human life and provided the wisest solutions to the problems of mankind. He offered practically viable sermons to the householders, husband and wife, man and society, man and nature and man and religion to ensure the state of happiness and purity. He upheld the need for righteousness which enables the people to earn good reputation on the basis of noble thoughts and deeds.

Buddha had realized the importance of democracy and established democracy as a way of life for the first time in the history of mankind. He gave importance to the people who constitute the ultimate power in the society. He established the Sangh culture and organised people under the banner of humanism regardless of gender, caste, region and other factors. He formulated certain good conduct rules for the creation of healthy and progressive social, economic, political and cultural order. He referred to the Sangh as a spiritual organisation which consists of Bhikku and Upasaka. The Bhikku is bound to celibacy but the Upasaka can marry according to Buddhist tradition. Buddha wanted people to convert on the basis of consciousness rather than compulsion.

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There exists a path which is for me the most sacred place in India. This path was one day travelled over by the Prince Siddhartha after he had gotten rid of all his worldly possessions in order to go through the world and proclaim the annunciation of love (Venkataraman, 1942:17). In the present geopolitical scenario, as the nations of the East have regained their political independence, their citizens led by their intellectual vanguard have searched long and deeply into their own ancient cultural heritage for ideas and values to stabilise their sense of newly discovered national identity and to sustain them in the contemporary world. There they have discovered much that is still valid and that holds relevance not only to themselves, but to all who are seeking clear understanding on the nature and destiny of humanity. For the insights and values proposed by these ancient systems claim to apply to human beings by virtue of their human nature as such independently of any transient and limiting cultural circumstances (Bodhi, 1991:12).

BUDDHISM AND FUTURE OF THE WORLD

The similarity between Buddhism and democracy is perceived in the teachings of the Buddha. He introduced revolutionary concepts and intellectual innovations which were all democratic in content and intent (Buultjens, 1990:13). Buddha produced great visionaries, missionaries and rulers like Asoka the Great, Kaniska, Harsha and others. Buddha ensured the supreme freedom and security from the bondage of fundamentalism and taught humanity which can save the world from all disorders and diseases.

In the new millennium, the world has witnessed a mad rush for gaining nuclear supremacy. Nuclear power can be used for peace and progress if it is in the hands of humanists who are wedded to peace, tranquility and welfare. The material values have gained an upper hand over the human and spiritual values taught by Buddha and other champions of world peace and progress. It is obvious that without a certain degree of material and economic progress no moral and spiritual progress can be achieved.

The influence of Buddhism on Chinese life and thought has been manifold and tremendous. It was the characteristic of Buddhism and receptivity of the Chinese mind that very soon Buddhism got intermingled and integrated with the rich and ancient cultural traditions of China and became a part and parcel of the Chinese modes of thinking and ways of living. Its influence has far exceeded the scope of religion, and it permeates into Chinese philosophy, art, literature, language, dance, music, architecture, medicine and even family and social life. In 21st century, Buddhism has tremendous potential and attracting power to have its sway all over the world with its noble ideas and ideals (Bhat, 2002:11). China's material and political progress stands as an example which reveals that Buddhism can usher in a new era of development and benefit the mankind in the age of globalization. India and China with their shared ancestry and culture of Buddhism can work together on spiritual paradigms for a new world order, providing alternative to the hegemonic capitalist and neo imperialist models.

World leaders have also appreciated the ideals of Buddha and emphasized their contemporary relevance in their writings and speeches. Albert Einstein observed that he is not the follower of any religion but he would embrace Buddhism if there was any need for religion. Swamy Vivekananda also stated with pride that Buddha was his role model and India needs to emulate Buddha to achieve the goal of self sufficiency in modern times. Rabindranath Tagore also noted that with the entry of Buddha, the world civilization was enriched in terms of great thoughts and deeds. Mahatma Gandhi pointed out that Hinduism should be grateful to Buddha for identification of certain myths, superstitions and other anti-people practices. Jawaharlal Nehru stressed the importance of Buddhism from the points of view of good governance and corporate social responsibility. Baba Saheb Ambedkar also incorporated the ideals of Buddha under the Preamble and Directive Principles of State Policy in the Constitution of India.

It is appropriate to recall what Buddha had said long ago:

"The victor creates enmity

The defeated live in distress,

The peaceful live happily,

Giving up both victory and defeat".

The preamble to the UNESCO charter states: "It is in the minds of men that the defense of peace must be constructed". It was Buddha who said that mind matters and people should achieve balance between the material and spiritual values.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

SMART VEHICLE WITH KYO "AN IOT APPLICATION"

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ABSTRACT
Vehicle stealing is the leading problem in the society where the vehicle is taken without owner's consent (TWOC). These problem can be resolved with an IOT application where the vehicle have the feature of KYO i.e. "Know your operator" . It can be achieved by implementing a biometric sensor through a small device besides the key panel which can scan the thumb impression of the operator, if it matches with the result set then the operator is allowed to use keys and drive the vehicle. If it senses an unauthorized data then an alert is sent to the owner's mobile which reports unauthorized taking of a motor vehicle (UTMV). SMS is sent to the phone numbers .It automatically sends data over a network. Vehicle security is a major problem which can resolved by Short Message Service based intruder detection system

Keywords: Working of Biometric, KYO, Stages of data processing, Association Rule

I. INTRODUCTION

There are automobiles with built in sensors but this is a kind of automated alert system based on intrusion detection system which not only sense unauthorized operator but also warn the authorized operator about TWOC within an existing internet infrastructure.. Taken without owner's consent (TWOC), also referred to as unauthorized taking of a motor vehicle. There are 2, 13,765 vehicles were stolen in the country in 2016. It's a 6.5 percentage hike in 2017.

Looking to this scenario in this paper I have proposed an IOT application where the vehicle has the feature of KYO i.e. "Know your operator". Automobile companies should take imitative to design a vehicle with biometric reading device besides key panel which can read the users finger print and the allowed the user to drive. A biometric system is essentially a pattern recognition system, which makes a personal identification by determining the authenticity of a specific physiological characteristic possessed by the user. It is an application of IOT with association algorithm support can function in effective manner.

Individual 9 out of 10 are using android phone which can help in getting an alert in case of unauthorized access. The device should be attached to the two wheeler, which have sensors to send notification to phones or email id. Internet connectivity is the base of its functioning. If the devices are internet enable then only it can send alert to registered mobile number. Today smart phones have different applications which can be used for controlling devices and getting alerts without any further development or enhancement. It only requires installation fro detection of Intrusions.

IOT

Anything which has its existence is termed as Object. When objects are connected with each other through power of net it is termed as IOT. Internet is the base of getting things/object connected with each other. Connectivity is the base of IOT which allow objects to connect and share date. They will operate as per instruction and programmed application. IOT provides user controlled devices irrespective of time and place ensuring more ways of improving security and safety of human civilization and ecosystem. IOT application areas include tracking devices, automated home connection, and traffic sensors, biometrics readings, alert to mobiles, Green IT e.t.c. In present market IOT is scattered everywhere. In 2020 IOT will cover 30 billion objects in global market as per experts. The proposed system is the implementation of IOT which helps in connecting a vehicle security to the mobile in the form of alert.

II. SOFTWARE IMPLEMENTATION

The software designed of this type of system can be done in any language for designing the app which receives sms in case of intrusions. Program must be written for the device to implement the desire KYO system. The proposed system can use GSM technology for mobile communication, which will generate a message, every time an intruder tries to get unauthorized access to the vehicle It is a unique way to work with GSM because it is used worldwide, implemented and followed standards.

III. WORKING OF VEHICLE BIOMETRIC

A. Sensor: For fingerprint detection optical sensors are used for scanning the fingerprint and convert it into electrical readings. The live scan of the image (fingerprint) is digitally processed. Original Fingerprint is enrolled in the system as template storing the personal identification of the system.

ISSN 2394 - 7780

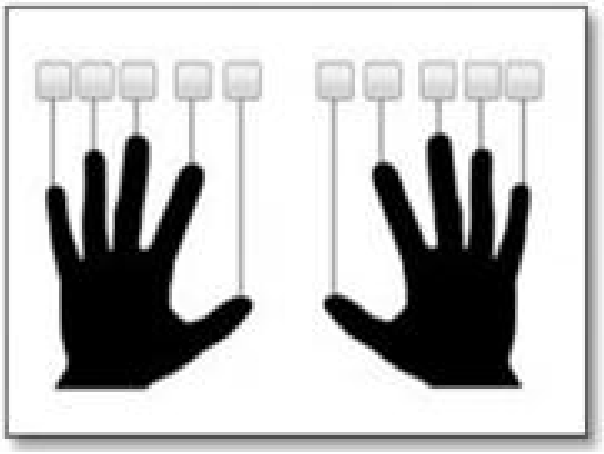

Figure-1: Enrollment

B. Programmed

Logic: An algorithm is used to match digitally processed data with the original preexisting data on the system's database. The readings are matched to crosscheck identity of the user. The algorithm acts as a matcher, which compares the new data with normalized data set to deliver the scores as well as sends notification in case of incorrect entry.

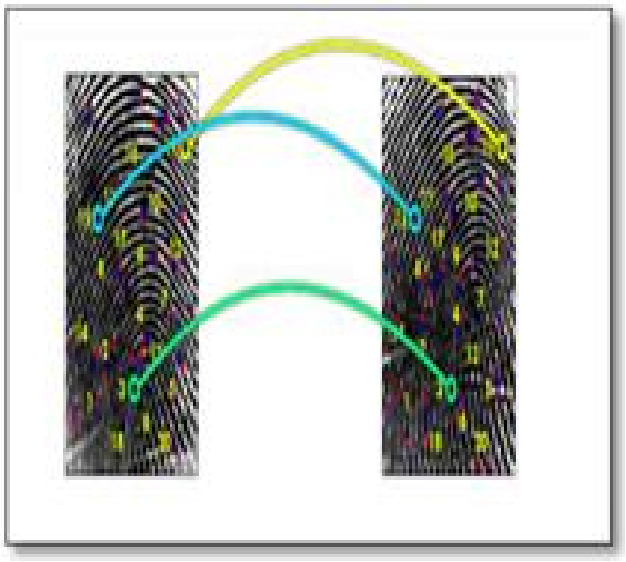

Figure-2: Matching

C. Associative Memory: It is a unique single memory used for searching a value. It helps in linking the output pattern with the input pattern. It matches one bit at any moment with the stored predefined data set. After matching the output of the result is read and stored immediately by the data bus.

IV. STAGES OF DATA PROCESSING

A. Enrollment: original fingerprint saved in the system database is referred as enrollment. Original data set or item set must be enrolled in the system for pattern matching.

B. Reading: When user puts his/her finger for scanning is known as Reading. It reads the real time live images provided to the device based on enrollment.

C. Matching: Comparison of new data with old data set is termed as Matching. It depends on algorithm for its functioning. It uses a Closed frequent Item set mining technique for matching patterns and getting results.

D. Identification: It is a stage after matching the result set with true data for recognizing the identity of the user and comes with an outcome to detect intruder.

E. Notification: The device is programmed in such a way that it can sends notification/alert through android app to the mobile for TWOC. With the help of the GSM network, a mobile can be used to implement an app for getting alerts on unauthorized access to vehicle. .

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The system works as per the diagram

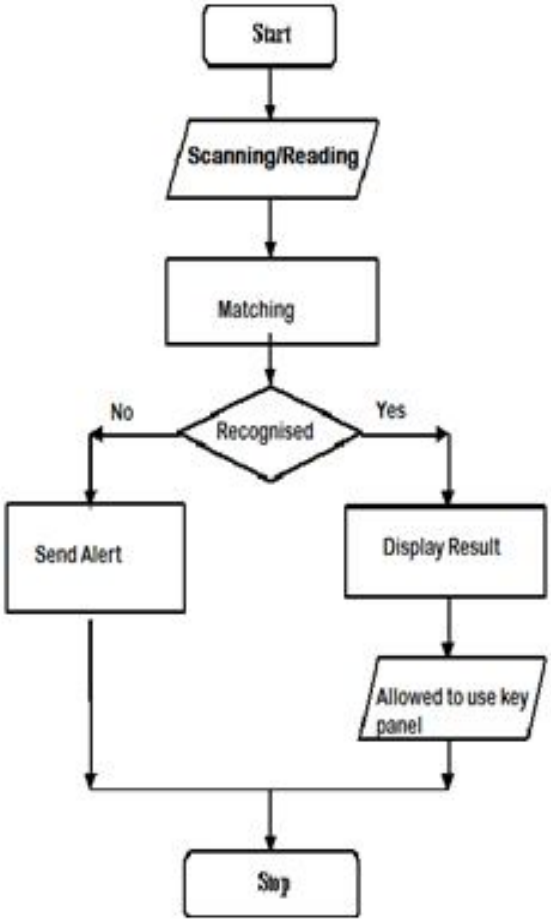

Figure-3: Flowchart for data processing

V. KNOW YOUR OPERATOR(KYO)

A typical good-quality fingerprint image contains about 20-70 minutiae points. The device is programmed in such a way that if the minutia points location matches, then only the key panel is open for use to operator if it doesn't it sends an alert. It sends alert if it detects error with unauthorized data entry. Every finger has some prints with some pattern. Each pattern has some minutia in a fixed location which is transformed into binary values in the form of zero and one. There are some applications also which can convert fingerprint into binary values also. The same value is stored in the database. When user uses the vehicle it matches the binary values to provided data set, if it matches then vehicle is ready to use. The success rate must be pre decided. Suppose it is 70%, when user provide fingerprint and it detects the success rate to be more than 70% then only the vehicle owner is allowed to use it

Equation: 1

$$\text{Success Rate: } \frac{\text{Number of correct data set}}{\text{Total number of data set}} * 100$$

Suppose the total number of minutia point is 32 and the result analysis provides 22 after scanning fingerprint then the success rate is 68.75%.

Figure-4: Diagramatic Representation of KYO concpet

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VI. ASSOCIATION RULE

Matching of thumb impression or fingerprint matching is the traditional technique in practice which is effective till date. Fingerprint consists of patterns which need to be recognized for correct result. Pattern recognition and matching technique is used to identify similar patterns, which look for various match in the output pattern for its pre existing input or enrolled pattern. It returns a score as a result.

It uses a Closed frequent Itemset mining technique. Closed frequent itemset is defined as "an item set X is a closed frequent item set in set S if X is both closed and frequent in set S.

Pattern recognition uses association rules created by analyzing data for frequent if/then patterns and it support two criteria to identify the most important relationships.

Support: Support finds out the frequency of matching patterns.

Confidence: Confidence finds out the veracious of the rule.

So ,

if frequency of matching patterns is more than 70%.

Then key holder is allowed for use.

Association rule mining can be applied to discover matching pattern of the vehicle owner. These patterns are viewed by designers to help in the generation process of finger print specification to be uploading in the main data for matching. Fingerprint knowledge extraction is done from structured and textual data. It allows faster responses towards changes incorrect matching. It should be used actively by companies where customers benefit from the implementation of the system

VII. COST ESTIMATION

A simple vehicle in average cost around 60000 to 70000.

A biometric cost around 4000 – 5000 in average.

Average vehicle cost 65000

Additional part(Biometric) cost 4000

Installation charges 1500

Total Estimated cost 72000 (approx).

It is affordable if a vehicle comes in the market with the power of KYO to every common man.

VIII. CONCLUSION

It is an IOT application related to vehicle protection which aims to identify patterns related to threats. It is a good prevention tool and technique which can control vehicle stealing up to a great extent. The proposed system is very beneficial for two wheeler owner who wants to safe guard their Vehicles. This system is very economical and can be operated smoothly, so that persons of any class can use and safeguard their property.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

SYNTHESIS AND CHARACTERIZATION OF Zn (II), Cd (II) AND Hg (II) COMPLEXES OF *N*-[(1*E*)-2-IMINO-1, 2-DIPHENYLETHYLIDENE] THIOCARBONOHYDRAZIDE

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ABSTRACT
α-Benzilmonoximethiocarbahydrazide (HBMOTCH) and its Zn(II), Cd(II), Hg(II) complexes had been synthesized and characterized by elemental analysis, electrical properties, magnetic susceptibility measurements, FT(IR), PMR and electronic spectral data. Complexes were found to be of non – electrolyte in nature. The analysis of FT(IR) spectral data of all prepared metal complexes suggested that HBMOTCH is bonded to metal (II) ions through the nitrogen atoms only. The magnetic susceptibility and electronic spectral data were supportive of tetrahedral geometry for all prepared metal complexes.

Keywords: Coordination chemistry, Thiocarbahydrazide, Benzilmonoxime, Zn(II), Cd(II), Hg(II)

INTRODUCTION

Schiff bases share a big research area and essentially contains 'azomethine' as the functional group which comprises a carbon – nitrogen double bond (>C=N-), nitrogen being attached to an alkyl group, but not to hydrogen. These compounds are named after Hugo Schiff. A general route to prepare a Schiff bases is reaction between an amine and a carbonyl compound. Schiff bases may contain donor atoms such as O, N, S etc. and can be used as a versatile chelating agent in the arena of complexes.

Schiff bases and their metal complexes find applications in manifold branches of chemistry viz. polymers, dyes, medicine, agriculture and industry. Schiff bases and their metal complexes show evidences of antibacterial, antifungal, antitumor, antiviral activities and also work as therapeutic agents against biological disorders like cancer, inflammation and allergy.

Easy synthesis and various properties of complexes always kept researchers adhered to it. Since, we found these Schiff bases and their metal complexes, an ever-growing branch of coordination compounds, full of promises. In view of these, we wish to propose a Schiff base derived α-Benzilmonoximethiocarbohydrazide ligand (IUPAC name: *N*''-[(1*E*)-2-imino-1,2-diphenylethylidene]thiocarbonohydrazide) and its Zn(II), Cd(II), Hg(II) complexes were synthesized and characterized by using customary methods like; conductivity measurements, elemental analysis, magnetic measurements, UV-visible spectra, FT(IR), NMR spectra.

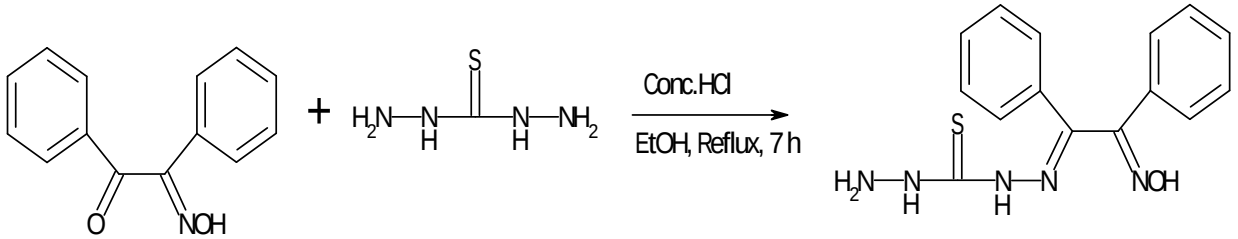
EXPERIMENTAL

All chemical used were of analytical reagent grade. Distilled water used were obtained from a glass distillation unit. Conductivity measurements were made on EQ-660 laboratory conductivity meter using Nitrobenzene as solvent. UV-Visible spectra of the ligand and its metal complexes were recorded on JASCO V-650 spectrophotometer, methanol. 0.1N NaOH was used as solvents to record UV spectrum of the ligand, while Chloroform was used as solvent to record the spectra of the complexes in the UV-Visible region. FTIR spectra in KBr discs were recorded on Perkin–Elmer spectrum 100 model.

PREPARATION OF LIGAND

α-Benzilmonoxime and Thiocarbohydrazide were prepared by literature method. HMOTCH was prepared by mixing hot aqueous solution of thiocarbohydrazide (20.000 g, 0.188 mol) with ethanolic solution of α-benzilmonoxime (10.000 g, 0.044 mol) in presence of sodium acetate (20.000 g), the mixture was refluxed for seven hours on a water bath and kept overnight at room temperature, a colorless solid was obtained. Solid was filtered and washed with hot water and dried at 100 ºC. [The yield of a product was 10.165 g, 73.80% of the theoretical. Melting point was 168 ºC].

Scheme 1



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PREPARATION OF METAL COMPLEXES

Metal complexes were prepared by mixing 2 mmol of ligand in ethanol and aqueous solution of 1 mmol of metal chloride and resulting mixture was refluxed for three hours on boiling water bath. Solution was cooled down at room temperature and complexe was precipitated using 0.5 N NaOH solution. Metal complexes were purified by crystallization.

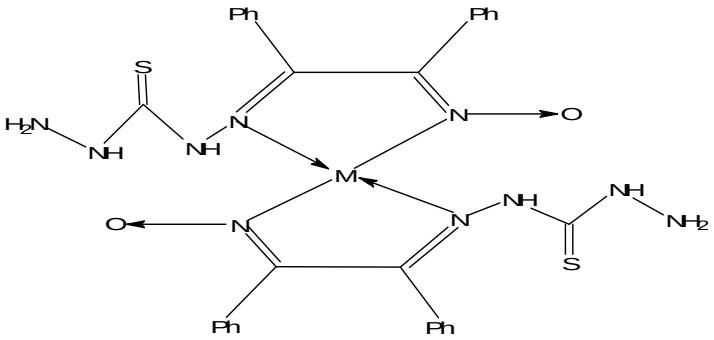
RESULTS AND DISCUSSION

The complexes were intensely colored, thermally stable at room temperature, non-hygroscopic, insoluble in water and show solubility in common organic solvents like $CHCl_3$, CCl_4, DMSO, Acetonitrile, Nitrobenzene etc. The analytical data for ligand (Table-1) and its complexes were found to be consistent with the proposed structure. The molar conductance values of 10^{-3}M solution in nitrobenzene were 2.9-3.5 $\Omega^{-1}cm^2mol^{-1}$ indicating their non-electrolyte nature.

Table-1: Analytical and physical data for HBMOH and its Zn(II), Cd(II), Hg(II) metal complexes

Compound	Color (M.P. in °C)	% Yield	Percentage Expected(Found) C	H	N	O	S	M	Conductance Ω^{-1}
HBMOTCH	Colorless	73.80	57.51	4.89	22.36	5.11	10.22	-	-
	(168)		(57.11)	(4.42)	(22.48)	(5.29)	(10.00)		
$Zn(BMOTCH)_2$	Colorless	80.12	52.21	4.06	20.32	4.64	9.28	9.49	3.5
	(190)		(52.52)	(3.81)	(20.29)	(5.01)	(19.21)	(9.32)	
$Cd(BMOTCH)_2$	Colorless	79.63	48.88	3.80	19.01	4.35	8.69	15.26	2.9
	(195)		(48.82)	(4.00)	(19.03)	(4.28)	(8.62)	(15.00)	
$Hg(BMOTCH)_2$	Yellow	79.99	43.66	3.39	16.98	3.88	7.76	24.33	3.3
	(198)		(43.11)	(3.32)	(16.90)	(3.18)	(7.70)	(24.01)	

A plausible structure for the complexes from the spectral data could be drawn as given below:



Where M = Zn, Cd, Hg

Magnetic susceptibility measurements

The $Zn(BMOTCH)_2$, $Cd(BMOTCH)_2$ and $Hg(BMOTCH)_2$ show diamagnetic nature, which may be due to their tetrahedral geometry.

UV-Visible spectral properties

A methanolic solution spectrum of HBMOTCH in the UV region showed a prominent peak at 239nm (ε = 11800). This may be ascribed to the π□electron system arising from significant conjugation in the ligand. It seems that owing perhaps, to a higher degree of conjugation in HBMOTCH the two types of $\pi \rightarrow \pi^*$ transitions expected, are overlapping with each other. The UV spectrum of HBMOTCH in 0.1N NaOH solution revealed a band at 222 nm (ε = 12000) and a suppressed, bathchromically shifted broad band around 290nm (ε = 10017). It is suggested therefore that the band at 290nm in the UV spectrum of HBMOTCH may be due to the oximino function while the band at 222nm may be due to the thiocarbonohydrazido function.

The electronic spectrum of $Zn(BMOTCH)_2$, $Hg(BMOTCH)_2$ and $Cd(BMOTCH)_2$ in chloroform solution (Table-2) explained charge transfer transition in the region 330-400 nm (ε = 650-1015).

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Table-2: Electronic spectral data for HBMOTCH and its metal complexes in λ_{nm} transition type compound

Compound	Intra ligand charge transfer in nm		Ligand to metal charge transfer
	$\pi \rightarrow \pi^*$		$n \rightarrow \pi^*$
HBMOTCH	239	290	----
$Zn(BMOTCH)_2$	---	---	330
$Cd(BMOTCH)_2$	---	---	379
$Hg(BMOTCH)_2$	---	---	400

PMR SPECTRA

PMR spectrum of HBMOTCH in (d_6) DMSO solvent revealed the oximino proton at 12.53 ppm being acidic in nature. This peak was absent in PMR spectra of Zn(II), Cd(II) and Hg(II) complexes, supporting the deprotonation of the hydroxyl group of the ligand. A broad peak corresponding to two protons is observed at 8.00 ppm. The intensity of the peak suggested the presence of terminal-NH_2 group in the ligand and slightly changed region 7.8 – 7.9 δ, in its metal complexes, suggested that the – NH_2 group is not coordinating. The one proton signal of the >NH group apperaring as a broad band between 8-9 ppm. A broad multiplet between 7.44 to 7.95 ppm was due to aromatic protons of the ligand and this was consistent in all prepared metal complexes, indicates non involvement of this group in the complex formation. The signal at 8.67 ppm then could be assigned to either the NH or SH moiety, such an assignment is favored by the thione- thiol tautomerism possible in the ligand (Table-3).

Table-3: PMR data of HBMOTCH and its metal complexes in ppm

Compounds	-OH	$-NH_2$	N-H	Phenyl ring
HBMOTCH	12.53	8.00	8.67	7.44-7.95
$Zn(BMOTCH)_2$	-	7.80	8.66	7.45-7.90
$Cd(BMOTCH)_2$	-	7.85	8.60	7.44-7.95
$Hg(BMOTCH)_2$	-	7.90	8.68	7.40-7.90

INFRARED SPECTRUM

The FT(IR) spectrum of HBMOTCH in KBr disc were performed in the region 4000-400 cm^{-1}. A significant feature of the IR spectrum of HBMOTCH was the absence of a strong band due to ν(C=O) seen at 1715 cm^{-1} in α-Benzilmonoxime, indicating a successful replacement of the carbonyl group by the thiocarbohydrazide group, during Schiff base formation. The spectrum of HBMOTCH showed two sharp peaks at 3300 cm^{-1}, which may be assigned to the asymmetrical and symmetrical vibrations of the -NH_2 group present in the ligand. In all metal complexes, the band observed in the region 3250 to 3200 cm^{-1} can be attributed to ν(N-H) vibrations (**Table-4**). Apart from these bands, the complexes also showed a weak intensity peak around 1589 cm^{-1}, due to ν(N-H) vibrations. The appearance of the symmetrical and asymmetrical N-H vibrations in HBMOTCH at frequencies lower than the expected may be due to strong inter and/or intra molecular hydrogen bonding in the ligand. This was further supported by the observed absorption due to the ν(O-H) of the oximino group at 3288 cm^{-1}, which is absent in metal complexes, revealing the deprotonation of the hydroxyl group of the oxime in the process of formation of the complexes. The band at 1600 cm^{-1} due to υ(C = N – O) of the oximino group in ligand was shifted to higher frequencies at in the region 1655 - 1678 cm^{-1} in its complexes implying the coordination of oximino group with the metal ion. Also the band at 1693 cm^{-1} which was assigned the azomethine (C = N – N) group of ligand was shifted to higher energy at in the region 1725 – 1745cm^{-1} in the metal complexes, indicating the participation of the azomethine group in the coordination. In the metal complexes with the ligand in which an oxime group coordinates through its nitrogen atom, the formation of N → O linkages are essential feature. The facts were further supported by the appearance of new bands in the regions 582, 533, 515, 490, 492, 458 cm^{-1} in the Zn(II), Cd(II), Hg(II) complexes which were assigned to the Zn-N, Cd-N, Hg-N, stretching vibrations respectively. The band observed at 1000 cm^{-1} assigned to ν(N-O) stretching vibrations and was shifted to 1028-1032 cm^{-1}, describing the formation of N → O linkages. The characteristic absorption of the ligand in the range of 1290 cm^{-1} can be assigned to ν(C=S) combination band with C=C, it is affected by various factors including adjacent group. A medium intense band at 1549 cm^{-1} may comprise C-S-H linkage, which was a shown at 1531 cm^{-1} in parent compound thiocarbohydrazide. Also the weak band at 1262 cm^{-1} ascribed to -C(S)-N< linkage, which same as in parent compound thiocarbohydrazide. A weak band at 2345 cm^{-1} may be due to the single bond C-S vibration with thione-thiol tautomerism, which was shown at around 2346 cm^{-1} in thiocarbohydrazide.

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Table- 4: FT (IR) spectral data for HBMOH and its metal complexes in cm^{-1}

Compound	υ(O-H)	υ(N-H)	ν(C-S-H)	C=NO	C=NN	υ(N-H)	N-O/ N→O	N-N	M-N
HBMOTCH	3288	3300	2345	1600	1693	1589	1000	1072	----
$Zn(BMOTCH)_2$	-	3218	2355	1660	1725	1583	1028	1093	582, 533
$Cd(BMOTCH)_2$	-	3250	2325	1655	1745	1588	1030	1099	515, 490
$Hg(BMOTCH)_2$	-	3200	2333	1678	1740	1591	1032	1100	492, 458

CONCLUSION

Novel complexes with divalent metal cations were synthesized in good yield using metal and ligand in 1:2 ratio. Complexes were studied and characterized to explain proposed structure of the mentioned coordination compounds. Synthesized complexes were non- electrolytic, diamagnetic and proposed to have tetrahedral structure.

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International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

STUDY OF AQUATIC MACROPHYTES DIVERSITY FROM KHARAKADA LAKE KURKHEDA, DISTRICT GADCHIROLI, MAHARASHTRA, INDIA

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ABSTRACT
Kharkada Lake is one of the large perennial fresh water lake which cover 72 hectares of total catchment area situated 10 km west from Kurkheda town. A detail survey of aquatic macrophytes in Kharkada Lake was carried out during the period of one year from June 2015 to May 2016. Among aquatic plants a total 34 species belonging to 21 different families and 31 different genera under 03 classes were identified in which 32 species under the class Angiosperm, 01 species under the class Pteridophyte and 01 species belonging to Algae was recorded from this lake ecosystem.

Further the aquatic macrophytes of lake were classified into different Life forms such as rooted floating (03), free submerged (04), Rooted submerged (03) and emergent anchored which are most dominating life forms in that lake (24).

Keywords: Aquatic Macrophytes, Eco-system, Fresh water, Kharakada lake, Life forms

1. INTRODUCTION

It is very difficult to define aquatic plants exactly because aquatic habitats cannot be sharply distinguished from terrestrial ones [(12)]. According to Muenschar [(10)] hydrophytes are those species which normally stand in water and must grow for at least a part of their life cycle in water, either completely submerged or immersed. The aquatic plant community comprises a diverse group of macrophytic organisms including angiosperms, ferns, mosses, liverworts and some fresh water macro algae that occur in seasonally or permanently in wet environment [(9)]. Aquatic macrophytes are considering as important component of aquatic ecosystem not only as food sources for aquatic invertebrates but also act as an efficient accumulator of heavy metals [(1, 4)].

Aquatic plants play a vital role in Lake Eco-system. It provide directly or indirectly food, shelter to large numbers of fishes, birds and other aquatic animals. Aquatic plants also enrich the lake by adding Oxygen through photosynthesis. Aquatic plants play a key role in maintaining the faunal diversity in Lake Ecosystem.

Studies on aquatic and wetland vascular plants of India were done by several workers in different freshwater bodies of India [(2,3,5,8,13)]. Aquatic macrophytes of Maharashtra especially Vidarbha region were done by Tijare , Rohankar et.al, Harney, Dhore & Lachure[(14,11,7,6)]. and others. As there are no previous reported studies on macrophytes of Kharakada reservoir in Kurkheda tehsil of Gadchiroli district in Maharashtra, an attempt has been made to study physical, chemical and macrophytes diversity of Lake.

2. MATERIALS AND METHODS

2.1 Study Site

Fig-01: Map of Maharashtra state
Showing Gadchiroli

Fig-02: Map of Gadchiroli district
Showing Kurkheda

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(1) (2)
Fig-03: (1) Summer and (2) Winter view of Kharkada Lake

Kurkheda is Town and Tehsil in Gadchiroli District in Indian State of Maharashtra. This area has thick forests locally known as Zadipatti area. It has total forest cover of 39827.72 Sq. km with total of 128 villages. It is located on the 20.370 North 80.120 Eastern side of the State, covering an area of 68230.64sq.km. It has average elevation of 240 meters (790 ft) from sea level. Kurkheda is bounded by Desaiganj (Wadsa) Tehsil towards west, Armori Tehsil towards west, Korachi taluka towards East, Arjuni Morgaon (Dist-Gondia) Tehsil towards North and Dhanora Tehsil towards South. Average relative humidity is 62 percent. The average annual rainfall in this area is 1063 mm.

Credit of lake construction goes to Mrs Kamunabai Nakade before one and half century. The lake located 1 km from Village ($20^0$37.513'N, $80^0$12.294'E). Kharkada Lake is one of the large perennial lake in kurkheda tehsil which cover 73 hectare area and receive water from rain. Lake bounded by Forest at East, South and North sides while agriculture fields towards West side. Lake exploited for fishing and irrigation practices. Anthropogenic activities like Grazing, washing of clothes, bathing of domesticated animals were done in some extent. Fish culture practices also taken place near the lake by making small tanks. This Lake is also provides a breeding place for several Dragonflies and Birds.

Aquatic macrophytes diversity was recorded through survey of study area for one year (June 2015 to May 2016). Survey was done by dividing the total lake into three different sampling sites I, II and III. During the survey regular excursion were made to record the physicochemical data, collection of plant samples and photographs the plants. After collection, the specimens were thoroughly washed, excess water soaked with filter paper, kept in polythene bags lined with filter paper and brought to the laboratory and preserved in 10% formalin and observed. The collected plants were identified with the help of available literature of Subramanyam [(13)], C D K Cook [(5)] and relevant published literature.

3. RESULT AND DISCUSSION

Results of the present investigation were divided into Physicochemical and Floral diversity of the selected lake. The physico-chemical parameters of Kharkada lake is presented in table 1.

Table-1: Range of physico-chemical properties of Kharkada lake

Sr. No.	Parameters	Range
1	Water Temperature(^{0}C)	22 to 30
2	pH	7.5 to 7.8
3	Dissolved Oxygen(mg/L)	6.5 to 8.5

The temperature of lake water varied from minimum 22^0C to maximum 30^0C. The pH of lake is alkaline in nature while amount of dissolve oxygen varied from 6.5 to 8.5 mg/L.

Macrophytes diversity and Life forms of aquatic plants of all three selected sites of Kharkada Lake is shown in the Table no. 2 with their Botanical name, Family name and life forms

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Table-2: Diversity and Life forms of Aquatic macrophytes recorded from Kharkada lake

Sr. No.	Botanical name	Family	LF	Site I	Site II	Site III
1	*Altenenthera sessilis* (L.) R. Br. Ex Dc	Amaranthaceae	EA	+	+	+
2	*Butomopsis latifolia* (D Don) Knuth	Limnocharitaceae	EA	+	-	-
3	*Ceratophyllum demersum* L.	Ceratophyllaceae	FS	+	+	-
4	*Chara globularis* Thuill	Characeae	FS	+	+	-
5	*Coix aquatica* Roxburgh	Poaceae	EA	-	-	+
6	*Commelina benghalensis* L.	Commelinaceae	EA	+	+	+
7	*Crinum viviparum*(Lamarck) R. Ansari et V.J. Nair	Apiaceae	EA	+	-	+
8	*Cyanotis axillaris*(L.) Sweet	Commelinaceae	EA	+	+	+
9	*Cyperus pangorei* Rottboll	Cyperaceae	EA	-	-	+
10	*Cyperus rotundus* L.	Cyperaceae	EA	+	+	+
11	*Dopatrium junceum* (Roxburgh) F. Hamilton ex Benthem	Scrophulariaceae	EA	-	-	+
12	*Eleocharis dulcis* (N.L.Burman) Trinius ex Henschel	Cyperaceae	EA	+	+	+
13	*Grangea maderaspatana* (L.) Poir	Asteraceae	EA	+	+	+
14	*Hydrilla verticillata* (L. f.) Royle	Hydrocharitaceae	FS	+	+	-
15	*Hygrophila schulli* (F. Hamilton) M.R. et S M Almeida	Acanthaceae	EA	-	+	+
16	*Ipomea fistulosa* Martius ex Choisy	Convolvulaceae	EA	-	+	-
17	*Limnophila indica* (L) Druce	Scrophulariaceae	EA	+	-	-
18	*Lindernia anagalis* (N. L.Burman)Pennell	Scrophulariaceae	EA	+	+	-
19	*Lobelia alsonoides* Lamark	Campanulaceae	EA	-	-	+
20	*Marsilea quadrifolia* L.	Marsileaceae	EA	-	-	+
21	*Najas marina* L.	Najadaceae	RS	+	+	-
22	*Nechamandra alternifolia* (Roxburgh ex Wight) Thwaites	Hydrocharitaceae	FS	+	-	-
23	*Nymphaea nouchali* N L Burman	Nymphaeaceae	RF	+	+	+
24	*Nymphoides hydrophylla* (Loureiro) O Kuntze	Menyanthaceae	RF	+	+	-
25	*Nymphoides indica* (L.) O Kuntze	Menyanthaceae	RF	+	+	-
26	*Oldenlandia corymbosa* L.	Rubiaceae	EA	+	+	-
27	*Ottelia alismoides*(L.)) Persoon	Hydrocharitaceae	RS	-	-	+
28	*Polygonum plebeium* R. Brown	Polygonaceae	EA	+	+	+
29	*Rotala indica* (Willdenow) Koehne	Lythraceae	EA	+	+	+
30	*Rotala verticillaris* L.	Lythraceae	EA	+	+	+
31	*Sphaeranthus indicus* L.	Asteraceae	EA	+	+	+
32	*Spilanthes calva* A. P. de Candole	Asteraceae	EA	+	+	+
33	*Vallisneria spiralis* L.	Hydrocharitaceae	RS	+	+	+
34	*Vetiveria zizanoides* (L) Nash	Poaceae	EA	-	+	+

(+) – Present, (-) – Absent, LF- Life Forms, EA- Emergent anchored, RF- Rooted floating, RS- Rooted Submerged,

FS- Free submerged

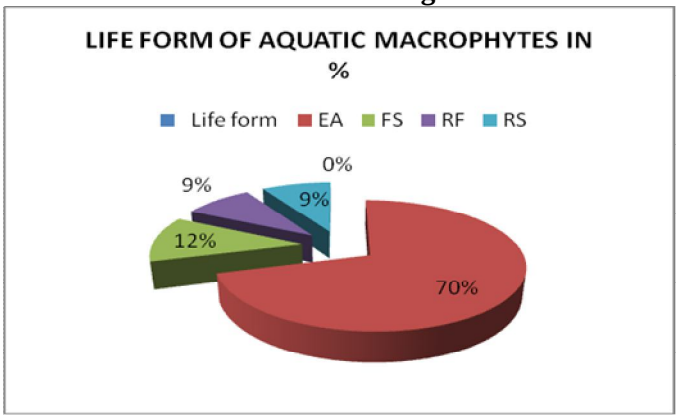

Fig-04: Chart showing Life forms of aquatic macrophytes diversity of Kharkada Lake

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A total 34 Plant species belonging to 21 families and 31 genera. A total 32 Macrophytes were recorded belong to Angiospermic families, 01 plant species under the Pteridophytes and 01 belong to Algae. Further aquatic macrophytes are classified into different life forms; these are Emergent anchored, rooted floating, free submerged and rooted submerged. The lake is dominated by Emergent anchored represented by 24 species, followed by free submerged represented by 04 species, rooted submerged and rooted floating represented by 03 species each.

Among the angiosperic families, Hydrocharitaceae are dominant family represented by 04 spacies. This is followed by families Asteraceae(03), Scrophulariaceae(03),Cyperaceae (03) while families Commelinaceae ,Lythraceae, Menyanthaceae and Poaceae represented by 02 species each and families Acanthaceae, Amaranthaceae, Limnocharitaceae, Ceratophyllaceae, Apiaceae, Convolvulaceae, Campunalaceae, Marsileaceae, Najadaceae, Nymphaeaceae, Rubiaceae, Polygonaceae are represented by 01 species each.

The most dominant members among aquatic macrophytes in lake are *Eleocharis dulcie* localy known as Gad found to be present in all the three sites of lake which are most dominant in marginal shallow water followed by *Hydrilla verticillata, Vallisneria spiralis, Rotala verticillaris, Rotala indica, Alternenthera sessalis, Commelina benghalensis, Cyanotis axillaris, Cyperus rotundus, Grangea maderaspatna, Polygonum plebium, Spheranthus indicus, Spilanthus calva* and *Vetiveria zizanoides* occurs in all sites throughout the year. While *Marsilea quadrifolia, Cyperus pangorei, Crinum viviparum, Butomopsis latifolia, Coix aquatica, , Dopatrium junceum, Limnophila indica, Ottelia alismoides, Lobelia alsonoides, Nechamandra alternifolia* were found to be occur at only one site. *Ipomea fistulosa* are one of the problematic aquatic weed found only at one site in small numbers. *Najas minor* are now introduced in lake before two to three years and show their appearance at two different sites. A very little seasonal variation occurs in species richness of lake. Monsoon and winter verities of lake are succeeded by summer verities as water logged area are reduces.

A phytosociological association found to be observed in lake as *Hydrilla verticillata, Eleocharis dulcie, Najas minor, Vallisneria spiralis* was found to be associated with each other in shallow marginal water. Random patches of *Hy*drilla species was observed in lake which get flowering in summer season. There were partial succession occur in macrophyte community as *Nechamandra alternifolia, Butomopsis latifolia, Limnophila indica, Ottelia alismoide*s were present in winter but in summer they were found to be absent in this lake.

4. CONCLUSION

Kharkada reservoir is one of the large perennial lake in Kurkheda tehsil. The lake supports a wide range of aquatic macrophyte diversity. It also provides breeding place for large number of dragonflies, water insects, birds etc. But due to anthropogenic activities like washing of clothes, construction of bricks on marginal area of lake, Introduction of agricultural waste water in the lake in rainy season increases nutrients richness of lake which make it suitable for unchecked growth of some aquatic weeds like *Eleocharis dulcie, Ipomea fistul*osa that may result into complete disappearance of some aquatic macrophyte species from this lake in feature. It is urgent need to conserve the Kharkada lake ecosystem by total ban or reducing anthropogenic activities which are going to degrade the lake ecosystem for betterment of aquatic plant health and wealth.

ACKNOWLEDGEMENT

Authors are thankful to Dr. R. G. Munghate, Principal, SGM Arts and Science College Kurkheda for their valuable guidance and help.

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Butomopsis latifolia

Limnophila indica

Nyphaea nouchli

Nymphoides hydrophylla

Nechamandra alternifolia

Vallisneria spiralis

International Journal of Advance and Innovative Research
Volume 5, Issue 3 (II): July - September, 2018
ISSN 2394 - 7780

A COMPARATIVE STUDY OF M.N.ROY AND B.R. AMBEDKAR ON GENDER EQUALITY AND WOMEN EMPOWERMENT THROUGH EDUCATION IN INDIAN CONTEXT

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I propose to present in this paper an overall review of gender equality and women empowerment through education according to M.N. Roy and B.R.Ambedkar.This paper is an attempt to show that education was assigned a revolutionary role in both M. N. Roy and Ambedkar's conception of social progress and in their vision of a just and equal society. Education was considered as a key instrument of liberation from oppressive structures of Hindu caste-patriarchy as well as of reconstruction of a new social order etc. Women were integral to this visionary egalitarianism and were consciously mobilized as political actors in the dalit emancipation movement led by them in the early decades of the twentieth century. So, this paper argues that an emancipatory discourse on gender was an important component of both Roy and Ambedkar's philosophy of social democratic liberalism. They permitted women an authentic identification with its underlying principles with a view to achieving a full and enlightened citizenship. In short, according to Roy and Ambedkar, the arena of formal education was a significant focus of women's political involvement, and they played foundational roles as political educators and educational activists. For them, Dalit women redefined ideals of both womanhood and educational purpose in terms of counter-hegemonic reconstructions of nation, society and community, and articulated new subject positions grounded in them.

It would not be an exaggeration if we claim that M. N. Roy developed a new type of humanism in Indian history of socio-political philosophy in the last decade of the 19th century and first decade of the 20th century which is widely known as Radical Humanism. There is a great stress upon rationalism, freedom, ethics and morality in Roy's humanism. Besides, he made all round reforms in Hindu society and introduced compulsory training among the men and women for social and humanitarian works. Both Roy and Ambedkar were greatly influenced with the principles of freedom, equality and fraternity. What they wanted to give all citizens the right to equal opportunity. But our culture has been marked by vices like hatred, jealousy, angry, power, misuse, bias, inequality etc., requires human values like feel affection for, love, kindness, impartiality, freedom, fraternity, justice, happiness and so on for all men and women in every sphere of life. In fact a number of social evils like crime and sin are committed in the name of gender. As a result, it becomes serious obstacles not only in the political stability but also social solidarity. That is why women education or education for women in necessary for all round development of the state according to Roy and Ambedkar. For Roy, 'humanist politics'[i] is a real condition of democracy. Equally, Ambedkar also advocated true democracy where there is liberty, freedom and equality.

Both Roy and Ambedkar are famous for their humanism. Ambedkar's very concept of humanism stands for liberty, equality and fraternity[ii] for all. Ambedkar stood for a social relation based on right relations between man and man in all sphere life. His humanism alternatively known as social justice is directly associated with his concept of religion and morality as his religion did not approve any type of hypocrisy, injustice and exploitation of man by man in the name of religion. He stood for a religion which is based on universal principle of morality and ensures the trio principles of justice, such as, liberty, equality and fraternity. He considered the Brahmin theory of women as the greatest evil of Hindu religion or the root cause of inequality. Ambedkar said, "Under the Brahmin theory women … were not eligible for knowledge …"[iii] He emphasized more on the liberation of the women and the depressed classes. He wanted the women and the depressed classes to educate, organize, and agitate to elevate their position as respectable citizens of the country. Ambedkar accepted that education gives birth to the reason, the feeling of unity, brotherhood and love of country. According to Roy, education is the supreme right of the people. Man without proper education is fool. Thus, they finds human values in education. Education which does not create liberty, equality and morality is not education. Education must appear as the safeguard of humanity. In a sense they were champion of freedom, socialism where there is no distinction between men and women.

Roy's contribution for the betterment of the society and its members and Ambedkar's contribution for the betterment and progress of women is distinctive. Ambedkar not only wanted to "ensure social equality between man and man but also equal status and dignity between man and women."[iv] For Ambedkar, women do not enjoy freedom of the will in Hinduism, but in allowing women to become Bhikkunis (nuns) the Buddha not only opened for them the way to liberty, he also allowed them to acquire dignity, independent of sex. Thus, the effort of the Lord Buddha was the beginning of the revolution and liberation of women in India. On one occasion the Buddha speaking of the value of a women to the world said, "woman is the commodity supreme because she is

ISSN 2394 - 7780

indispensible utility or because through her Bodhi Sttvas and world rulers take birth."[v] According to Ambedkar, Manu was responsible for the downfall of the women. In the opinion of Manu, women are not to be free under any circumstances. Day and night women must be kept in dependence by the males and if they attach themselves to sensual enjoyments they must be kept under ones control. These are a few among many instances cited by Manu through which women were degraded. Thus, Ambedkar rejects the ideas of Manu.

If we look back, attempts had been made by many social reformists, namely, Raja Ram Mohan Roy, Mahatma Gandhi, and others to strengthen women. Raja Ram Mohan Roy was the founder of the ***brahma samaj*** functioned as a pioneering spirit in social reforms and 'adopted Islamic idolatry'[vi]. It made both man and women conscious of education and other social evils. Even Plato in his book *Republic* was vocal about women's emancipation. Having said this, we think that Ambedkar's vision and mission about women's emancipation is unique in nature. As a true humanist, Ambedkar was one of the reformers who championed the cause of women including the issues of Scheduled Castes and Scheduled Tribes. He was a great believer of women's organizations. For Ambedkar, women should learn to be clean and keep themselves away from all vices. The sense of inferiority complex should be eliminated from their mind and heart. After the adoption of the constitution, Ambedkar was entrusted with a new responsibility, the Hindu code bill. The Hindu code bill introduced only four new things in the then existing law, which were, abolition of the doctrine of the rights by birth, right over property to women, share to daughters from the parents property, provisions for divorce. It also insisted upon the consent of the wife to the adoption of a son by the husband. While explaining the bill, Ambedkar spoke 'that it would be wrong to describe the Hindu code bill as either radical or revolutionary. He said that the new ways of progress did not oppose the orthodox practices'[vii]. The Hindu was a right step towards a civil code. Unfortunately, some other members strongly opposed the Hindu bill and within an excitement Nehru asked Ambedkar to drop the bill. The bill was let down in a tragic manner and in the word of Ambedkar it was killed and buried unwept and unsung after four clauses were passed. As disappointment Ambedkar resigned his seat from the cabinet on 27th September, 1951. In his resignation speech, Ambedkar clarified that the Hindu code was the greatest social reform measure ever undertaken by the legislature in the country. Equally, Roy wipes out a number of shortcomings of the Hindus. In short, we have democratic revolution after Roy.

Thus, owing to the effort and layout of Roy and Ambedkar, the Hindu society was subsequently enacted. Ambedkar who publicly burnt the *Manusmriti* in 1972, was himself the chief instrument in giving to the Hindu community with requirements and needs of modern times. Ambedkar accorded equal status to women and men in every sphere and also warned the women against the misuse of their rights. Therefore, we think that it would be appropriate to regard Ambedkar as a humanist and as one of the saviors of the Indian women. Like Ambedkar, Roy's movement was also an expression of the urge for social progress as he wrote that "India is not only struggling to free herself …, but she moving ahead on the path of human progress …"[viii] Thus, in a nutshell, it can be said that a practical solution to the social evils committed in the name of gender is education or right to education for all.

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