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Dr. Subodh Kesharwani
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EIS Level the Corporate/Academia Spread and Bridge the Gap with Changing Time

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Message from Editor Desk

EIS Crossing Barriers and Work as a Espousal to Transform

Dear GJEISians,

Someone who buys Yahoo at this instant will get hold of their Asian stakes in Alibaba and Yahoo Japan *(which is in part owned by SoftBank)*. Alibaba and SoftBank are going to be amongst the top 10 (if not top 5) global Internet players in the next 10 years. So many people deleted their Uber accounts in the wake of the '#DeleteUber' movement that the ride-sharing company had to rapidly generate a mechanized way for customers to run off the service. The mass migration began on 27th January shortly after US President Donald Trump signed an executive order as an interim measure so to stop citizens from seven countries from entering the United States. This caused a large remonstration at New York's JFK airport, supported by the New York Taxi Workers Alliance, who went on strike and stopped pickups in the area. Alibaba is going to formulate a gigantic move into the US and it is expected that Amazon and Jeff Bezos in its cross-hairs

Why I am talking about this stake or merger or acquisition I don't make out but there is a little moral of story or background music behind this which according to me is nothing but an espousal to transform. GJIES as a scholarly journal had no doubt initiated in this shift too. GJEIS as an educational or scholarly journal is a periodical publication in which scholarship relating to a particular academic discipline is published and is peer-reviewed/ blind reviewed or refereed. The contents here usually takes the form of articles presenting empirical papers, original research, review articles, ~~and~~ book reviews, View Point, Questionnaire format, doctoral snapshot~~,~~ The good news is that GJEIS had been listed in UGC Recommended Journal list ~~at S. No. 13667.~~ Since 2009, GJEIS has been a trustworthy digital resource for libraries and institutions of higher learning and provides access to the full historical run, digitizing the original print publication from cover to cover. GJEIS also allows access to this expansive collection of global scholarship that was previously only available through institutional affiliations. GJEIS in addition follow the submission becomes subject to review by outside scholars of the editor's choosing who typically remain anonymous. The number of these peer reviewers (or "referees") varies according to each journal's editorial practice — typically, no fewer than two, though sometimes three or more, experts in the subject matter of the article produce reports upon the content, style, and other factors, which inform the editors' publication decisions. Though these reports are generally confidential, GJEIS and its publishers also practice public peer review. The editorial office either chooses to reject the article, ask for a revision and resubmission, or accept the article for publication. Even accepted articles are often subjected to further (every so often considerable) editing by GJEIS editorial staff before they appear in print. GJEIS peer review process can take from several weeks to several months. The Journal is very much transparent in it's functioning and declare all the dates and details in an article itself like *(Manuscript Accepted Date; Originality Check Date; Peer Reviewers Comment date ; Blind Reviewers Comment Date; Author Revert date; Camera-Ready-Copy schedule, etc.),* which not only provide lucidity but offer clarity to viewers and subscribers.

GJEIS is on the verge of completing 10 years of publication in 2018. Since it has started its publication, this journal has addressed issues concerning science, management, engineering and technology in many frontier areas of research, development and its application. Since GJEIS which addressed as an academic journals are not subsidized by universities but backed by KARAM Society which is run by Research and Academic management consortium and professional organizations, who always work as a mentor, and do not exist to make a profit. However, from 2017 we are planning to accept advertising, page and image charges from authors to pay for production costs, but some flexibility and waiver would be given to extra ordinary research articles. On the other hand, GJEIS are produced by commercial publishers who do not make a profit by charging subscriptions to individuals and libraries and offer free articles from their portal http://www.informaticsjournals.com/index.php/gjeis/index. The GJEIS as a scholastic Journal facilitates well-groomed business lead-

ers with its research initiatives and rigours blind and peer review process The journal is right now listed in almost fifty directories in the world, equipped with Digital Object Identifier (DOI) from Cross-ref USA http://www.crossref.org . It also had an average impact factor of 1.68 from the various impact factors rating agencies. The journal with its eight volumes focused on this part and emphasize how changes brings a paradigm shift on the plus side and create tremendous market opportunities in products and services. Mandate of a Journal is to popularize the impression of Enterprise, Information and System in business and outside business. It is designed to enlighten people that synchronization of three words is not just a pecuniary objective, but is more ubiquitous, that is why we have to get transversely what the academics and the peers are doing and saying about technological pitch in creating a niche. We have built a comprehensive squad to make GJEIS sincerity.

We had moved to a new portal from starting of 2017 to http://www.informaticsjournals.com/index.php/gjeis/index with a target to toughen GJEIS more academically and research oriented. We had also now made the open access just to enhance citation as well as reaching to unreached. On the other hand the dedicated page in Facebook created in order to touch with the GJEIS Fraternity https://www.facebook.com/GJEiS. The GJEIS Website has been moving to a new contemporary Google-hosted JavaScript service which follow community-curated online directory, helps in indexing and facilitate in providing s access to peer-reviewed articles. It is also equipped with search engine optimization and web analytics for statistical analysis. I take this chance to thank all the staff of KARAM Society and people from Informatics for their dedication and passion in bringing out this eventful issue. I would also like to thank our office staff at the journal office, for their timely and meticulous work..

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Analysing Asymmetrical Associations using Fuzzy Graph and Discovering Hidden Connections in Facebook

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Abstract

The fuzzy graph theory to analyse the relationship strength in Social Networks has gain significant potential in last few years and has seen applications in areas like Link Prediction, calculating Reciprocity, discovering central nodes etc. In this paper, we propose a framework to analyse and quantify the degree of strength of asymmetric relationships and predict hidden links in social networks using fuzzy logic. Till now, the work in fuzzy social relational networks has been limited to symmetric relationships. However, in this paper, we consider the scenario of asymmetric relations. The proposed approach is for web 2.0 application *Facebook*. Our contribution is three fold. First, the measurement of the strength of asymmetric relationship between nodes on the basis of social interaction using the concept of fuzzy graph. Second, a hybrid approach for prediction of missing links between two nodes on the basis of similarity of attributes of user profiles such as demographic, topology and network transactional data. Third, we perform fuzzy granular computing on attribute 'strength of relationship' and categorise into four granules namely {*socially close friends, socially near friends, socially far friends, socially very far friends*} based on the results of supervised learning conducted over dataset. Similarly, actual outcome for predicted links is categorised into three granules namely *Accept, Not accept* and *May be*. The proposed approach has predicted relationship strength with mean absolute error of 9.26% whereas the proposed approach for Link prediction has provided 64% correct predictions.

Keywords: Asymmetry, Computing With Words, Fuzzy Graphs, Fuzzy Sets, Fuzzy Granular Computing, Link Prediction, Reciprocity, Social Relational Networks, Strength Of Relationship

1. Introduction

A social network is defined as a set of social actors, or nodes, or members that are connected by one or more types of relations[1]. On a Social Networking Sites (SNSs) like Facebook, Twitter etc., Friendship links or connection between two nodes are undirected and weightless i.e. it is formed through mutual agreement of both users. Friendship appears on both profiles and considered to be of equivalent strength for both nodes. It considers that either the connection exists or doesn't exit. Subsequently, strength of relationship can be represented in binary logic of '0' and '1' for existing connection and absence of connection respectively. However, this is rarely the case in real world and so in virtual world. The strength or intensity of the relationship between two nodes in a social network is a significant factor which can be used to determine future links, optimal path for information dissemination, advertisement etc. There are various approaches which are proposed to determine the strength of relationship between the nodes on the basis of similarity of nodes and transactional data exchanged between nodes. Unlike Classical Mathematics which deals with binary logic ('0' and '1') only, Fuzzy logic is a many valued logic and values between '0' and '1' are considered too. Thus, fuzzy logic considers the fact that links of varying strength may exist instead of just presence or absence of links. Therefore, strength of relationship can lie between '0' and '1'. However, the work in domain of fuzzy logic has focussed on symmetric graphs only i.e. undirected graphs where strength of relationship is symmetrical. However, the relationship between two nodes is rarely symmetric. The trust or influence of (x→y) is often not equivalent to trust or influence of (y→x). The rapid increase in connections on social networking sites further enforces this concept. On an average, there are 130 friends per profile on Facebook. Thus the assumption that all 130 friends are equally important to a user is not practical. There has to be difference in strength of relationship between any two nodes. As for evidence to this fact, a study says that median of 'actual' friends on Facebook is 50 only[6].

Our approach for quantifying the strength of relationship between two nodes is based on the 'interaction'. Unlike concept of Similarity which is relatively a static factor, Interaction is a true representative to determine and analyse the dynamic nature

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of relationship between two connected nodes over a period of time. Two nodes is said to be strongly connected if they interact regularly and weakly connected if there is very less or negligible interaction. Here, in context of *Facebook,* the term 'interaction' refers to activities such as comment, tag, like or timeline posts done by a node x on node y's page. In this paper, we incorporate concept of fuzzy logic in asymmetric socio-grams to capture the true strength of relationship which can lie between 0 to 1, thus providing more clear picture about influence and reciprocity from the perspective of (x → y) and (y → x). We categorise the computed 'strength' in four granules based on the supervised learning conducted on the data set collected and performed fuzzy granular computing for the attribute "strength of relationship".

Online Social Networks (OSNs) contributes a formidable share to a user online activity. One such OSN, Facebook was created in the year 2004 by Mark Zuckerberg and fellow students. The average time spent by an user on Facebook per visit is around 18 minutes. 70% of users say that they use Facebook daily including 45% who do so several times a day[1].It is a significant part of daily media practices of its users. According to a latest report, nearly 1 billion user worldwide access Facebook through their mobile phones at least once each month in 2015. Globally Facebook has 1.35 billion users, while daily active users are 864 million[1]. Analysis of Social relational networks has applications in online advertising[2], recommendation and E-commerce system, organization management to study the interaction of employees, covert networks[3], Web applications, Co-authorship networks[4], tracking terrorist organisation and their way of expansion etc. Due to their vast reach and easy connectivity, they have become an important way for social searches in which the motive is to find a person who might be of advantage to them in future or pass on an introduction to a specific people or organization for recommendation and to get connected[5]. "Link Prediction" is the concept which deals with finding "hidden connection" in a social network between nodes. The term 'hidden connection' refers to links which might appear in future between two nodes which are presently not connected. Further extending the concept of strength of relationship between two nodes, we introduce a method for finding the hidden connections in the social network. The link prediction problem can be stated as: Given a snapshot of a social network, can we guess which new interactions among its members are likely to occur in the near future? OSNs like Facebook has well placed algorithms to recommend these hidden links in form of "people you may know" on the home page of users.Friendships between people are not formed arbitrarily. *Homophily* is the principle which states that a contact between similar people occurs at a higher rate than among dissimilar people[6]. It emphasises about the localized flow of cultural, behavioural, genetic and material information in a network. The more similar social characteristics are, the lesser will be the network distance i.e. the number of nodes between them. OSNs also demonstrate this social phenomenon which predicts that occurrence of connection between two similar persons is more likely. People who lived or lives in the same neighbourhood, attended the same school or college or organization, having similar kinds of interests are more likely to become friends[7]. Similarly, Researchers have also validated the tendency for clustering or 'transitivity'[8]. Therefore, having higher number of mutual friends suggests higher possibility of connection in future between x and y. To quantify the degree of similarity between two profiles, we utilise profile attributes that defines the person's cultural and geographical background, education, personality, interests etc. For dealing with the problem of link prediction we incorporate three types of features a) Demographic b) Topological and c) Network transactional features. Demographic feature includes age, relationship status, home town, location, employment status, school college information etc. Topological feature (here) measures the number of shared neighbours in the social network graph. Network transactional features here include the number of groups joined by the individual. For the aggregation of all these similarity features, we use modified version of OWA(ordered weighted aggregation or 'or-and' operator) operator which is introduced by Ronald R. Yager[9]. We predict the link on the basis of value of 'aggregated similarity features' and categorise the actual outcome of predicted links in three granules namely *Accept, Not Accept* and *May be.*

The paper is organised as follows. Section 2 describes previous theoretical advancements and proposed works which is further subdivided in two sections, Section 2.1 – Estimation of strength of relationship and Section 2.2 Link Prediction. Section 3 outlines the definition of fuzzy graphs and how the concept of fuzzy graphs is applied on social relational networks and combined as fuzzy social relational networks. Section 4 is again subdivided into two parts. In Section 4.1, we formulate the strength of relationships for asymmetric relationships in a social network. Section 4.2, the method to predict the hidden links is explained .In Section 5, the idea of granular computing in the strength of ties is explained. In Section 6, we describe our experiment work which is subdivided two section. Firstly, Section 6.1 deals with the data collection for Facebook activities of 75 university students. Second, Section 6.2 explains the experimental work for Link Prediction which is performed on 10 seed nodes for evaluation of obtained results. Finally we state our conclusion and future work in the end.

2. Related Work

The existing literature for estimation of 'strength of relationship' between two nodes and link prediction is elaborated in this section.

2.1 Estimation of 'Strength of Relationship'

Mark Granovetter[10] was first to introduce the "tie strength" problem. Assessment of strength of relationship between the two socially connected people is previously done and has underlying structure based on the exchange of emails, mobile calls, tweets on twitter, instant messaging, *Facebook* activities and so on. Ogatha[11] investigated the strength of social relations between individuals through the email conversation. The relationship is strong if the emails are exchanged frequently, recently and reciprocally. In[12] and[13] the tie strength of mobile phone graphs are investigated. In[14] the affinity based on phone call-detail records and how to quantify the social ties' strength between actors in groups is studied. In[15] the method for calculating the indirect as well as direct relationship strength is introduced. Srba *et al.*[16] focussed on calculation of the relationship strength by means of the interaction data and other "rate factors". Viswanath *et al.*[17] analyzed the relationships between nodes using the *Facebook's* "wall posts". Some of the previous work not only focussed on the strength prediction but also intended to categorise the relationships based on the strength they predict. In[18] the author describes how to categorise the friendship among teenagers based on the SMS, Instant messaging, telephone calls and messages on Social networking sites. In[19] the further progress has been done in categorising the social relationships into four groups based on their strengths. In [14] the social relationships are categorised in the groups based on affinity caused due to phone calls. However the above mentioned authors have considered the social relationships as symmetric. The concept of unequal relationship between two nodes on a social network was firstly introduced by Hangal et al. in[20] for twitter. Ronald R. Yager[21,22] was first to introduce fuzzy logic in the social networks but his contribution is limited to symmetric ties. In this paper we show the existence of biased friendship which is common in real world by showing the existence of varying degree of tie strength that people have on *Facebook*. Our approach takes into account the asymmetric behaviour of ties in the fuzzy social relational networks. We show the asymmetric behaviour by categorising the relationships among four granules i.e. fuzzy subsets using the idea of granular computing.

2.2 Link Prediction

Liben-Nowell and Kleinberg[23] proposed one of the earliest approaches of link prediction for social network. Those methods were developed for prediction hinged on measures considering the proximity of nodes in a network. Bliss[24] proposed the dynamic link prediction algorithm in social networks. In[25] the new algorithm was introduced which combines both content based filtering and friends of friends concept to produce new algorithm for recommending friends. In[26] a new weighted content based recommendation technique is proposed. Backstrom et al. [27] involves the idea of homophily to upgrade the link prediction model in Myspace and LiveJournal. Crandall et al. [28] study about the temporal evolution of link structure in which they incorporates both homophily and influence concepts. The aforementioned work is limited to the dilemma of link existence problem using non-fuzzy approach. In[29] a new approach which incorporates the fuzzy model concept for link prediction problem in social networks emerged. Till now, the work is limited to proposing approaches for link prediction or friend recommendation but none of them has done any experimental work to validate the efficacy of their approach. In this paper, we propose an approach for link prediction by incorporating concepts like modified OWA operator and membership functions from fuzzy logic. We categorise the outcome of recommended nodes in three categories, namely accepted, not accepted and may be. Further, we calculate the accuracy of our proposed approach on the basis of comparison between results obtained and data collected from actual users.

3. Prerequisites

To understand the fuzzy relational social networks, it is necessary to review the fuzzy graph, graph theoretic and algebraic concepts.

3.1 Fuzzy Graphs

Fuzzy logic was proposed by L. Zadeh in the year 1965 to address the realistic cases more precisely. Classical Mathematics logic which deals with 0 and 1 is effective for exact systems only and fails to accurately model imprecise system which is the case with the real systems dealing with humans. Fuzzy models the fuzzy relationship concept to represent the weighted graph that can be termed as Fuzzy Graph.

Let S be a set, then a fuzzy subset of S is a mapping $\sigma: S \rightarrow [0,1]$ which assigns to each element $x \in S$ a degree of membership, $0 \leq \sigma(x) \leq 1$. A fuzzy relation on a S is a fuzzy subset $S \times S$, i.e a mapping $\mu: S \times S \rightarrow [0,1]$ which assigns to each ordered pair of elements (x, y) a degree of membership, $0 \leq \mu(x, y) \leq 1$.

In the context of social networks, The fuzzy relations help in modelling the strength of relations between the members. The membership degree $\mu(x, y)$ represents the strength of relationship between x and y , so the membership degree can be defined as

$$\mu(x,y) = \begin{cases} 1 & \text{if } x \text{ has the strongest possible degree of relationship with } y \\ @@\delta \rightarrow]0,1[& \text{if } x \text{ is related to } y \text{ to a certain extent} \\ \ldots @@0 & \text{if } x \text{ i} \end{cases} \quad \text{eq 1}$$

In case of binary or crisp relations, relationship between x and y is either 1 or 0. The researchers commonly described social relationships as binary i.e. nodes x and y can either be friends or not.

a. Following are the main properties of Fuzzy graph.

- Reflexivity: A fuzzy Relation μ *on* σ is reflexive if $\mu(x,x) = \sigma(x)$ for all $x \in S$
- Transitivity: A fuzzy Relation μ *on* σ is transitive if $\mu(x,y) \geq Max_y[\mu(x,y) \wedge \mu(y,z)]$

In this paper, we use socio-gram as directed and weighted graph. Therefore, the property of symmetry of relation between two nodes is not applicable here, i.e. $\mu(x,y) \neq \mu(y,x)$ and $w(x,y) = \mu(x,y)$ respectively. In social networks, the transitivity property deals with the concept of 'friend of a friend can be my friend. We assume the relationship strength with x to x will be the highest always that is 1.

3.2 Distance

Distance $d(x,y)$ between two users x and y in social networks can be defined as the shortest length of the path from x to y. The distance $d(x,y) = 1$ if x and y are directly connected.

3.3 Weighted Average Aggregation Operator (WA)

Ordered Weighted Average is the concept to aggregate the functions depending on the importance/weight of the features. It provides a way to "orand" the different criteria on the basis of their assigned weight. This operator helps in decision making for a problem where there is a requirement to satisfy "all" criteria and "or" at least one of the given criteria. OWA operator becomes WA operator if the two property of OWA is neglected i.e weight association w.r.t ordered positions and symmetric property but the property for "orand" operator still survives. A WA operator g of dimension n is function g: $\mathbb{I}^n \rightarrow \mathbb{I}$ (where I = [0,1])with an associated weighting vector *W*,

$$W=\begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix} \quad (2)$$

such that

1) $W_i \in (0,1)$ (3)

2) $\sum_{i=1}^{n} W_i = 1$ (4)

3) $g(a_1, a_2 \dots\dots\dots, a_n) = W_1 a_1 + W_2 a_2 + \dots\dots\dots\dots + W_n a_n$ (5)

Conveniently $g(a_1, a_2 \dots\dots\dots, a_n)$ is denoted as $g(A)$ where A is associate argument vector. Here it is necessary to highlight the case that the weights, the W_i' s are associated with a particular element i.e. W_i is the weight associated with the th^{i} i thelement of A. For each criterion a_i , $a_i(x) \in [0,1]$

$$g(a_1, a_2 \dots\dots\dots, a_n) = W.A \quad (6)$$

W.A symbolises multiplicative product of *W* and A vectors where $0 \leq g(A) \leq 1$

It should be noted that we eliminate the term "ordered" from ordered weighted average operator because here the condition of symmetry (commutative property) is not required.. Asymmetry condition implies that $g(a_1, a_2) \neq g(a_2, a_1)$ where g is weighted average operator.

4. Proposed Approach

This section is subdivided into two sections. Section 4.1 explains our approach regarding prediction of strength of relationship on the basis of interaction between two nodes in context of asymmetric relationships. Section 4.2, explains link prediction based on the concept of *Homophily* and similarity of three categories of parameters a) demographic features b) topological features and c) the network transactional features.

4.1 Prediction of Strength of asymmetric relationships

4.1.1 Interaction Vector

Granovetter and Mark [10] said "*The 'strength of a tie' are amount of time, the emotional intensity, the intimacy(mutual confiding), and the reciprocal services.*"

Among above mentioned four factors, measurement or analysis of '*emotional intensity' and 'intimacy'* requires access to personal messages exchanged which are generally not publicly available. Further, demands human judgement to label what is emotional and what is not for accurate text analysis. However, '*time*' and '*reciprocal services*' data are comparatively easy to obtain, quantify and analyse. From the above statement, it is clear that similarity cannot be the criterion to determine the strength of relationship between two nodes after the formation of connection. The concept of 'Complementarity in Interaction'30 states the similar idea that in spite of being completely similar in terms of cultural and educational background (like in case of siblings), one cannot say that they will have the strongest relationship in the virtual environment. Thus, instead of relying on Similarity attributes, we consider only interaction based features i.e. Interaction Vector to determine the strength of relationship. This enables us to identify relationship between people with dissimilar profiles. Interaction Vector represents the dynamic concept and comprises of attributes relevant to quantify the strength of an existing relationship. Unlike Similarity vector which is relatively a static factor, Interaction vector is a true representative to

determine and analyse the change in the strength of relationship between two connected nodes over a period of time.

For modelling of interaction vector, we use attributes derived from interaction activities to know how people maintain their social relationships. For example in *Facebook,* there are certain interaction activities like timeline posts, picture tagging, likes and comments that defines the '*closeness*' between node on the basis of efforts made i.e. time or resources spent by the profile owner. According to a survey31,32 44% of Facebook users '*like*' content posted by their '*friends*' while 29% do it several times in a day. Similarly, at least 31% users '*comments*' on other photos on a daily basis and 12% users have '*tagged*' a friend in a month duration. The approach can easily be understood by the fact that each user has a limited amount of resources (i.e. time) to use in the building up and maintaining a relationship, it is more likely that the users would spend these limited resources to those whom they find more important. Thus the formula for the computation of strength of relationship $IV_f(x, a)$ of x *towards* a is the combination of the interaction activities done by x *for* a incorporated with the use of weighted average aggregation operator.

The formula contain features which denote the interaction between two nodes like wall posts, likes, comments and tagging.

$$IV_f(x,a) = \gamma_p \frac{Post(x,a)}{\sum_{y \in V} Post(x,y)} + \gamma_t \frac{tags(x,a)}{\sum_{y \in V} tag(x,y)} + \gamma_l \frac{likes(x,a)}{\sum_{y \in V} likes(x,y)} + \gamma_c \frac{comments(x,a)}{\sum_{y \in V} comments(x,y)} \quad (7)$$

Where $0 \leq IV_f(x) \leq 1$

Reciprocity can be termed as the "*action of returning similar acts*" 14. In social networks, the concept of reciprocity is very important in applications like privacy controls (e.g. detection of spammers, phishing), marketing of a product to a specific set of audience etc. Reciprocity is the factor which distinguishes an asymmetric relationship. In this paper we focus on the reciprocity of interaction activities that takes place in the Facebook *from perspective of both nodes* and mapping it to calculate the strength of relationship *i.e. strength(x → y) is not always equal to strength(y→x).* Suppose in case of Facebook, one person x *likes/comments* every activity done by another person y but y does not reciprocate to x. Thus supposedly node *x* is important for node *y* but not vice versa. Hence, this is a perfect example of asymmetrical relationship. This has been experimentally shown in Section 5.

4.2 Link Prediction

The approaches for Link prediction can be categorized broadly into two groups. First one is based on the link structure of network i.e. shared neighbours between two nodes. Second one is based on the concept of '*homophily*' i.e. similarity of nodes[33]. In our approach we use a hybrid approach by combining both techniques and including one more attribute namely network transactional attribute (i.e. the same groups joined). Every SNS is based on a very different fundamental concept which makes it unique and suitable for a particular requirement. However, profile generation is an overlapping concept whose attributes differ according to the basic principle of the specific SNS. Along with demographic features, the personal interests and mutual friends are also the criteria which represent a profile. Thus, the attributes considered to determine similarity between two profiles of a social network is defined according to the specific OSNs (*Facebook* here). It enables a comparatively accurate prediction results in comparison to the generalized Similarity vectors.

In *Facebook*, all the members create their personal profile page which contains information regarding the views, interests, friends, location, school, college, organization, and home town which can be marked as private or public information. '*Private*' refers to access to restricted audience like friends whereas '*Public*' is information accessible to anyone. The information related to these features is available in a user profile. While recommending nodes, we are considering *distance* $d(x, y)$ to be maximally up to 334. The similarity of user's interests is highest in the direct connections and decreases as the distance between nodes increases. We take into account three features a) Demographic b) Topological features and c) Network Transactional features.

4.2.1 Demographic features

Demographic or background similarity provides the basic similarity between two nodes and refers to factors like age, sex, education, work, nationality, geographical location, extended family etc. According to a recent survey[3], 'High school and University friends' constitute the largest share and 'co-workers and groups' forms the second largest share in the average user's friend list. So, we gather that people from 'work environment (university and school for students)' are more likely to be friends rather than family members or close acquaintances. Consequently, we include aforementioned Demographic features in the prediction of missing link, given in Table 1.

Table 1. Demographic Features

Demographic profile features	
f_1	Age
f_2	High School
f_3	College
f_4	Current city
f_5	Home town
f_6	Employee in an organisation
f_7	Relationship status or extended family

These demographic features can be extracted using the tool "Wolfram Alpha Facebook Report[4]" and the Facebook appli-

cation "Friend list Manager"[5,35]. We have identified 7 features to capture the profile similarity. User similarity of y with x can be represented as vector]T where $s^{(x,y)}$ is a mapping from $\mathbb{I}^n \rightarrow \mathbb{I}$ (where $\mathbb{I} = \{0,1\}$) and $s_i^{(x,y)}$ denotes similarity value for the feature *fi* between x and y. $s_i^{(x,y)}$ can be either 1 or 0.These similarities are described below:

- *Age feature*(f_1)

The people with same age or at an age gap with 1-2 years are more likely to become friends[36]. Therefore the formula to compute age coefficient of user y with x is defined as

$$Age\ coefficient(y,x) = \frac{1}{1 + (age_y - age_x)^2} \quad (8)$$

If value $0.1 < age\ coefficient \leq 1$ then *age similarity* is 1 otherwise it will be 0. The set 'age difference' has the universal space Y= {0,...,100} and the membership function to the age similarity $\mu_{age\ similarity}$ can be represented graphically

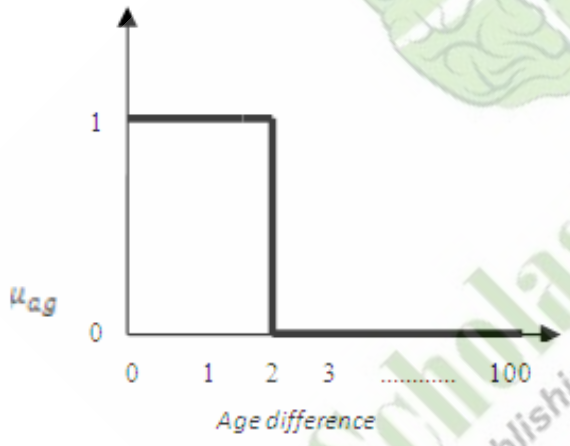

Figure 1. Graphical Representation of Membership Function "Age Similarity".

- *Features* $f_2, f_3, f_4, f_5, f_6, f_7$: If the value of the mentioned features is same or related, then value 1 is set otherwise 0 is assigned as shown in table 2.

Table 2. Demographic profile Similarity

f_2	School	{ same, different }
f_3	College	{same, different}
f_4	Current city	{ same, different}
f_5	Home town	{same, different}
f_6	Employee in an Organization	{unrelated, related}
f_7	Extended family or any relationship	{yes, no }

So the overall demographic profile similarity can be calculated using[37]

$$sim_{db}(x,y) = \frac{\text{EMBED Equation. 3}}{|s^{(x,y)}|} \quad (9)$$

$|s^{(x,y)}|$ is the number of features included in $s^{(x,y)}$ i.e. 7.

4.2.2 Topological features and Network Transactional Features

Topological feature measures the number of mutual friends in the network. It measures the connectivity of the nodes in social network. This information is easily available on the user's profile itself or can be extracted using the tool "Wolfram Alpha *Facebook* Report". *Network Transactional features* help to know the number of overlapping groups joined by the user. This can be obtained using graph search available in Facebook by typing "*groups [person's name] joined*" in the graph search. The common friends are displayed with the group's name. Near about 31% of *Facebook* friends are not classified by *Facebook* users as family, co-workers, neighbours, classmates, or people from voluntary groups. The authors who conducted survey speculate that these remaining ties are predominantly dormant ties and friends-of-friends[5]. As a result we select topological feature and network transactional feature in addition with demographic feature for the computation of similarity vector. From this survey result we roughly estimate the weights associated with the each attribute in similarity vector which is explained below.

In order to calculate derived similarity or topological and network transactional similarity, Cosine Similarity is used. The overall similarity vector is calculated by using *weighted average aggregation operator.*

The overall similarity vector S_V can be calculated as

$$S_V(x,y) = \alpha_g \frac{\|g_x \cap g_y\|}{\|g_x\|_2 . \|g_y\|_2} + \alpha_f \frac{\|f_x \cap f_y\|}{\|f_x\|_2 . \|f_y\|_2} + \alpha_{db} Sim_{db} \quad \text{... eq. (10)}$$

Where

$\|g_x \cap g_y\|$ – *number of common groups between x and y*

$\|g_x\|_2 = \sqrt{g_x}$ *where* g_x – **total number of groups joined by user** x

$\|f_x \cap f_y\|$ – **number of friends common between** x *and* y

Therefore, S_V is the combined Similarity vector and moreover

$$0 \leq S_V(x) \leq 1 \quad (11)$$

Both IV_f *and* S_V are *weighted average aggregation operator.*

5. Granular Computing and Computing with words

Our main motive to involve fuzzy concepts is to extend the concept of social relational network with the network concepts so

that the human beings can visualize social network relationship in such a way that they are explicit to both men and machines. In order to bridge the gap between man and machine conception, two very famous concepts are used namely a) *Granular computing* and b) Zadeh's fuzzy set approach for Computing with Words. Computing with Words (CW) is a technique, proposed by Lotfi A. Zadeh in 1979, in which words are used instead of numbers for computing and reasoning. This methodology allows us to employ human concepts in formal representation of the network properties. Human beings use linguistic terms for communication, logic and understanding the world where as machines are more inclined to use formal symbols. The main advantage of CW is that it maps the system with vagueness and imprecision that fits more into frame of human thinking. The importance of role played by the fuzzy sets and CW in representing the linguistic concepts has been already been evidenced in [21,38].

Granular computing is a concept, dependent on human-based thinking to facilitate high level of cooperation by providing a framework which is compatible to machine and understandable to man. It divides the system into its parts. In crisp granular computing, there are well defined components which are not possible in the real world. Therefore the concept of fuzzy granular computing arises to solve this problem. The above mentioned technology not only links the man and machine but also provides bridge between the network analyst's linguistic definition of social network concept and the formal model of network as shown in Fig.2

In the analysis of weighted social relational networks, we take an attribute "strength of tie" which has certain vocabulary associated with it. In this paper, CW uses fuzzy subsets or granules (*socially close friends, socially near friends, socially far friends*, *socially very far friends*) to formally represent the semantics of linguistic term or fuzzy set "strength of tie". Fuzzy set helps in formalizing the linguistic concepts in such a manner so that machine can compute and understand. "Strength of Relationship" has domain $I = [0, 1]$. Granule *socially close friends* can be represented as the fuzzy subset S of $[0,1]$, such that for any $y \epsilon [0,1]$, value S(y) would indicate the degree to which y satisfies the working definition for the concept *socially close friends*. Similarly the linguistic value of other remaining granules can also be mapped in space I. The granules are defined as follows:

a. Socially close friends: These are the people in our friend list with whom we consider our relationship strongest. Quantifying them by interaction activities, we find that interaction activities and frequency is more to and from socially close friends.

b. Socially near friends: These relationships are not as strong as compared to (a). Sometimes, not always, they do the interaction. We observe intermittent frequency of interaction activities from these people. Mostly the neighbours, distant relatives, general friends, colleagues etc. come under this granule.

c. Socially far friends: These types of friends are weakly connected to each other and the frequency with which they interact is less. We seldom receive any interaction activity to and from them.

d. Socially very far friends: This category of friends belongs to dormant ties in social networks and the people we add due to similar interests or any other reason. Dormant relationship is a relationship between two individuals who have not communicated with each other for a long time. In reality, the dormant relationships are not essentially strong or weak in strength but due to some reasons they are out of touch.

Similarly the results of link prediction can be divided into three granules. These are as follows:

a. Accept (A): this link prediction granule tells that the suggested node(x) has a high similarity to the node to whom the suggestion goes(*y*). Or they have a lot of same kind of interests and they had good face to face communication. There can be senior junior relation between *x* and *y*. In short *y* will accept the friend request if *x* send it.

b. May be (MB): this granule is the outcome when *y* is not sure about accepting or discarding the request. There may be very less similarity but due to same interest or future benefits the *y* might not reject the *x* and in the future *y* can accept the request.

c. Not Accept (NA): this granule will be the outcome if *y* does not like *x* at all. Although there may be a lot of similarity but due to existence of the negative tie between $y \rightarrow x$, *y* will discard the request of link. Or the other reasons may be *y* do not know *x*.

6. Experiments

We analyze and validate our approach on the *actual Facebook* data. We divide the procedure of data collection in two parts.

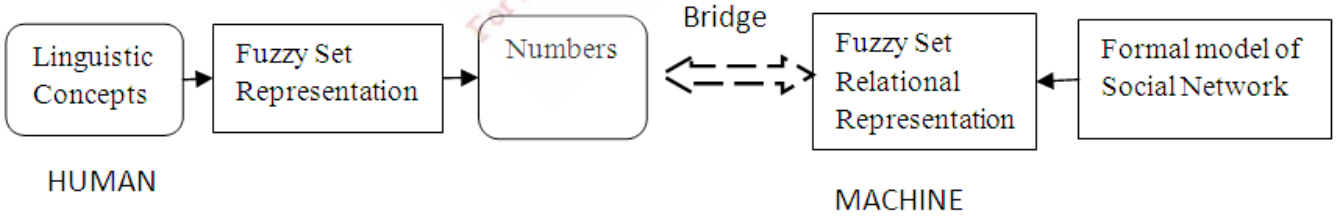

Figure 2. Paradigm for Intelligent Social Network Analysis.

Firstly, we describe data collection for estimating tie strength and extend it to show the effectiveness of interaction vector. Secondly, we repeat the prior procedure for link prediction and subsequently show the method's accuracy in predicting missing links.

6.1 Estimation of 'Strength of Relationship'

6.1.1 Data set collection

According to a survey, 71% of Online Adults (among them 87% are of age 18-29 years old) use Facebook[3]. Therefore, we collect the data from 75 students (aged between18 to 29 years old over a period of 3 months-November, 2014 to January, 2015) who visit Facebook frequently, and engage in interaction activities such as liking, tagging, commenting, sharing the posts etc. We asked them to choose at least 4 friends (75*4=300 nodes) from their friend list such that they can categorise them on Likert scale[4] on the basis of their interaction on Facebook. We define the range for Likert scale from socially close friend → socially near friend → socially far friend → socially very far friend. The participants are advised to choose friends in such a manner so that every friend belong to different categories of Likert scale. In addition, following details were also obtained.

1. The low interaction activities done by them for each friend they selected and we rate their friendship according to table 3. By using Friendship Pages[6] and http://www.facebook.com/Xuser_id?and=Yuser_id(Xuser_id and Yuser_id are Facebook Profile Ids), a user can find out about the timeline posts, tags, likes and comments between any two friends of their own friend list other than the user itself.

2. Interaction activities on Facebook for given friends over the period of 3 months. For knowing the total activity done by the user, he/she can use search for activity log[1] available on the Facebook application.

3. Priority list for the low interaction activities namely "*like, comment, tag and post*" which they tend to use for the close members rather than the far members.

6.1.2 Evaluation and Results

The proposed approach contains 4 interaction activities which contribute to the calculation of strength of connection between two nodes. From the above data, we gather that interaction activities have varying priorities. So, it is not practical to assume that the contribution for every activity is equal. From the data collected for priority of interaction, we made a rough estimation of preferences. The weights are associated with each activity according to their significance and contribution in calculating tie strength.

The weights are assigned in such a way that $\sum \omega_i = 1$ i.e. sum of all weights should be equal to 1. From the data, we obtained that *tag → comment → timeline post → like* is the order assigned in decreasing priority by approximately 95% participants. It is to be noted that sometimes the user do one type of activity only, then the weight associated with that activity becomes 1. For example if the person's activity is liking the comments or images posted by others and no other activity is done by him then the weight associated with liking becomes 1. Similarly, if a user performs only two types of activities on Facebook, then we assign equal weights to both of them.

For estimation of the weights associated with the interaction vector (IV), genetic algorithm (GA) is applied on collected data. After learning the weights, we compute the "strength of connection" and apply fuzzy granular computing for dividing the social network relations into granules based on the attribute "strength of relationship". A genetic algorithm processes on the population of data collected so as to obtain the optimized solution for 'strength of relationship' problem[39,40]. A good set of weights will generate good prediction. In order to solve the problem effectively, supervised learning is performed in which we divide the whole data set into two disjoint sets, training data set (70%) and testing data set (30%). To obtain the good fitness for weights, the fitness score must be as lowest as possible. The fitness score is defined as the average difference between the actual and predicted ratings in the training data set and is given as follows:

$$fitness = \frac{\sum_{j=0}^{n_R} |r_j - pr_j|}{n_R} \quad (11)$$

Where n_R is the training data set cardinality for a given user. r_j is the actual rating done by a user and pr_j is the predicted rating computed through IV_f.

Testing data set are used as hidden ratings so that the interaction vector with the weights that are decoded by the fitness function would try to predict the ratings or fuzzy set for the ties. The mean absolute error(MAE) is used to check the effectiveness of the interaction vector in forecasting the correct fuzzy subset or rating for the friend as mentioned in The MAE(*i*) for the person *i* is given by the below mentioned formula.

$$MAE(i) = \frac{\sum_{j=1}^{n_i} |pr_{i,j} - r_{i,j}|}{n_i} \quad (12)$$

Where n_i is the cardinality of the test data set for person u_i. The effectiveness of interaction vector can be calculated by using the following formula

$$MAE = \frac{\sum_{i=1}^{N_T} MAE(i)}{N_T} \quad (13)$$

Where N_T is 30. Lower the value for MAE, the more accurate predictions are made by the interaction vector about '*which fuzzy subset is associated with which friend for a given user* u_i '.

A small socio-gram for collected data is shown in the figure 3. This figure not only calculates the strength but also give some idea about the different degree or type of relations exist in the social network. This snapshot also gives an idea about the biased friendship that exists in the social relational network (for node '17', node '18' is *socially close friend* but for node '18', node '17' is *socially near friend*).

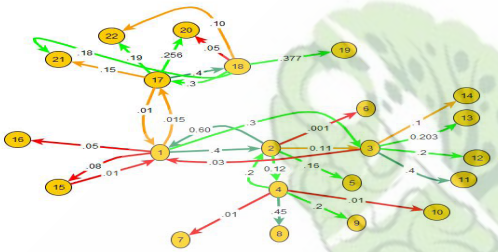

Figure 3. A snapshot of different types of friendship and the biased friendship that exists.

Table 4. Results of tie strength based on data collection

Results for 'Strength of Relationship'	
Total connections	128
True positive(correctly Predicted Strengths)	112
% of True positive	87.5
Mean absolute error	9.26 %

The results is summarized as follows. Fuzzy granular computing with granules formed (refer Section 5) for the attribute "strength of tie" (refer Fig. 4) is obtained with mean absolute error of 9.26% by applying weights $\gamma_t = .4,\ \gamma_p = .2, \gamma_l = .1, \gamma_c = .3$ (which provides maximum fitness) on IV_f. The user model formed is shown in fig 3. The legends for colors are mentioned in Table 3.

Table 3. Color representation and ratings used to denote different granules for attribute "Strength of Relationship"

Color of 'edge'	Type of friendship	Ratings
Dark Green →	Socially close friend	4
Light Green →	Socially near friend	3
Orange →	Socially far friend	2
Red →	Socially very far friend	1

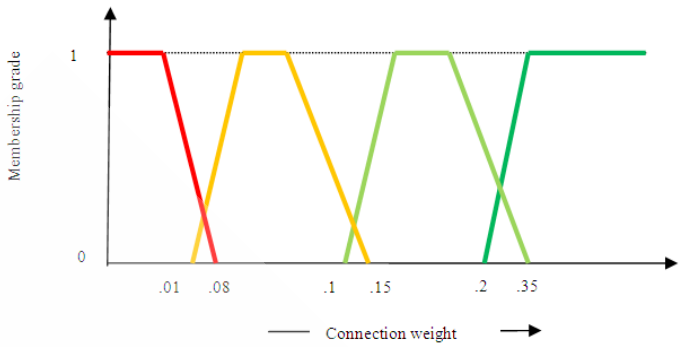

Figure 4. Fuzzy set for attribute "strength of tie".

6.2 Link prediction

6.2.1 Data collection for the link prediction

We use the data, collected for calculating strength of relationship. We identify 10 nodes (participants) and calculate the potential strength between Node '*x*' and potential connected node '*y*' in future using the approach proposed in Section. We suggest maximum 5 nodes and minimum 3 nodes to each participant on the basis of strength lying above threshold value decided experimentally. We ask participant's response whether he/she will {*accept*(A) , *not accept*(NA) or *may (MB) accept}* the recommended node. We recommend cumulatively 33 nodes to the participants. Nodes are suggested based on the concept proposed in section 4.2 and results are shown in table 6 and 7.

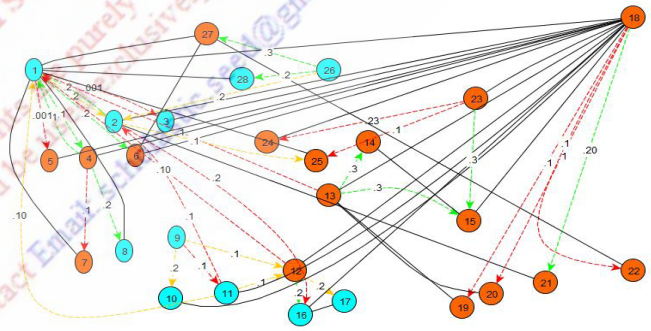

Figure 5. A snapshot for Predicted Links and their outcome.

Table 5. Color representation of prediction of missing links

Color of 'Edge'	Outcome of 'Predicted Link'
- - - - →	Accept(A)
- - - - →	May be(MB)
- - - - →	Not accept (NA)
	Existing Connection

Figure 5 gives the glimpse of the collected data and predicted links where solid lines represent 'existing connection' and dashed line as 'predicted links'(legends are given in Table 5). All the blue nodes are male candidates and the orange nodes are female participants. . Fuzzy granular computing with granules formed (refer Section 5) for the attribute "strength of predicted links" is shown in Fig. 6. The results are summarized in Table 6.

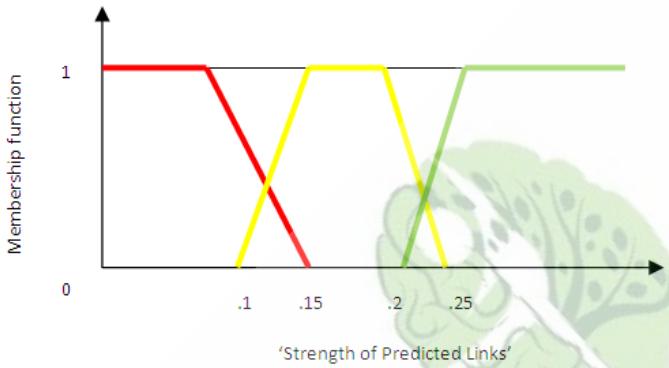

Figure 6. Granular fuzzy computing for link prediction.

From the results and data collected (Table 6), we made following inferences. The recommended links with 'strength' more than 0.1 are unlikely to be rejected (from Fig. 6). However, in given Fig. 5, we observe few '*Not accept*' links having strength higher than 0.1. On investigation about possible reasons, we found that these nodes have 'negative ties' from past. Therefore, the nodes generally won't accept request from nodes whom they don't like or have compatibility issues in past (more supposedly, a negative tie) despite of strong connection. The main reasons for accepting the friend request from the suggested node by a participant are expected '*future benefits*' from the people who are from the same domain, home town and senior junior relationships. The males are more likely to accept request from the opposite sex on the basis of '*attractiveness*'. As per results, male nodes have rejected 29.4 % of the recommended nodes and even in that, recommended male nodes are more prone to rejection as compared to female suggestions. The female nodes are more likely to reject the friend requests from male nodes whom they don't know and from the person whom they never met or have no face to face communication. The result indicates that female nodes have higher rejection rate i.e. 50%. Overall, male participants have shown low rejection ratio in comparison to female participants. The female nodes are clearer in their views about rejecting or accepting a request i.e. 6.25% for "may be" category whereas in case of male participants, 41% of recommended requests are in doubtful state of "may be". It is to be noted that all the suggestions which are made to the nodes are based on the method, proposed in the section 4.2 and the distances between nodes are considered maximally up to 3. The accuracy for the proposed approach for link prediction is about 64% on our data set shown in Table 7.

Table 7. Results for link prediction based on data collected

Results for 'Link Prediction'	
Total recommendation	33
Rejected Recommendation	13
% of Relevant1 Recommendation	64%

Table 6. Data collected from Participant's Response

Nodes(male(M))	Suggested nodes(M/F)	NA/A/MB	Actual results(from participant's response)		
			NA(M/F)	A(M/F)	MB(M/F)
1	5(2/3)	2/2/1	1/1	0/2	1/0
9	3(2/1)	1/0/2	1/0	0	1/1
11	3(2/1)	1/0/2	1/0	0	1/1
26	3(2/1)	0/2/1	0	1/1	1/0
2	3(3/0)	1/1/1	1/0	1/0	1/0
Total	17(11/6)	5/5/7	4/1(=5)	2/3(=5)	5/2(=7)
Nodes(female(F))					
4	3(2/1)	1/2/0	0/1	2/0	0
13	3(1/2)	1/2/0	1/0	0/2	0
12	3(3/0)	1/1/1	1/0	1/0	1/0
18	4(0/4)	3/1/0	0/3	0/1	0
23	3(1/2)	2/1/0	1/1	0/1	0
Total	16(7/9)	8/7/1	3/5(=8)	3/4(=7)	1/0(=1)

Error Percentage	36%

7. Conclusion and Future Work

The aim of the paper was to extend the use of fuzzy logic in asymmetric social relationships and discuss their pivotal role in modelling weighted directed social networks e.g. *Facebook*. Here we represented the investment done by user X→Y and user Y → X in the form of interaction activities which forms the basis for asymmetric strength of tie. By using the idea of CW and fuzzy granular computing, we described the important role played by the fuzzy subsets or granules (*socially close members, socially near members, socially far members* and *socially very far members)* in representation of linguistic concepts for the attribute 'strength of tie' and applied it in defining the asymmetric model of social networks. The proposed approach predicted strength of relationship with mean absolute error of 9.26%. The applications of our proposed approach for estimation of tie strength can be applied for finding the most influential path, improving global social search methodology and in extension of applications of social network database theory. By incorporating the tie strength in social networks, significant improvements can be made for resolving security issues, meaningful visualisation of networks, finding trustworthy nodes etc. We proposed a hybrid approach for link prediction with concepts from *homophily*, network transactional features and Fuzzy logic. The proposed method showed an accuracy of 64% in converting recommended nodes to actual connections. We outlined major factors for acceptance or rejection of a friend request. The proposed approach can be applied in domains of network expansion, recommender system, online advertising targeted towards specific set of audience etc. In future we will expand our concept to other OSNs like LinkedIn, twitter etc. and refine our approach by analysing possible attributes that can be considered.

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Extrinsic and Intrinsic Motivations as Mediator of Big Five Personality and Knowledge Sharing

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Abstract

The purpose of this research is to examine the interrelationships among various interpersonal psychological factors to explain their effect on knowledge sharing behaviors at workplace. A sample of 450 employees was drawn from knowledge based industries. To tap the information regarding performance on knowledge sharing, Big Five personality, and motivation, Knowledge Sharing Behavior (KSB) scale by Yi (2009)62, Big Five personality traits scale by Gosling et. al. (2003)27, extrinsic and intrinsic motivation scale by Lin (2007)40, were used. 'Partial Least Square' technique of 'Structural Equation Modeling' was applied using 'SmartPLS 2.0.M3' to understand the proposed relationships. Findings show the prominence of conscientiousness among 'Big Five personality traits' to explain knowledge sharing behaviors at workplace (Total Effect of 'conscientiousness' on 'knowledge sharing' being 0.5246 significant at $p<0.01$). 'Intrinsic motivation' is found to be a better predictor of 'knowledge sharing' than the 'extrinsic motivation' (Total Effect of 'intrinsic motivation' on 'knowledge sharing' being 0.3195, while that of 'extrinsic motivation' on 'knowledge sharing' being 0.1274, both significant at $p<0.01$). Both 'extrinsic' and 'intrinsic motivation' were found to mediate the relation between certain 'personality traits' and 'knowledge sharing'. Although the paper has certain limitations, nevertheless, this is the first study to consider the relationship between 'personality', 'motivation' and 'knowledge sharing' in a single study and making us understand the interacting and mediating role of 'motivation' to explain 'knowledge sharing'.

Keywords: Knowledge Sharing, Motivation, Mediation, Personality

1. Introduction

Knowledge sharing has been shown to reduce costs in organizations, promote new product developments, improve group dynamics, and increase organizations' competitive abilities. (Cummings, 2004)13.

Nevertheless, promoting knowledge sharing in the organization can be a challenging procedure. At the individual level, it may give rise to a feeling of losing a valuable personal asset (Argote et al., 2001)3. Promoting the conception of new knowledge and its sharing is one of the challenges faced by today's managers (Kogut and Zander, 1992)37. Various interpersonal factors impair the intention and ability of persons to share knowledge, resulting in the failure of even the most advanced knowledge administration frameworks adopted by the organizations meant to promote knowledge sharing (Bock et. al. 2005)5.

Knowledge Sharing can be researched within several contexts including organizational and cultural, interpersonal and group characteristics, or motivational (Wang, S., & Noe, R. A. 2010)58.

Research on knowledge sharing at individual level have been conducted in information sciences (Wasko & Faraj, 2005)60, strategic management (Reagans & McEvily, 2003)51, organizational behavior (Bordia et al. 2006) and psychology (Lin, 2007b, c, d). One of the reasons why the knowledge management systems implemented in the organizations fail is the dearth of concern regarding the interpersonal factors that influence the knowledge sharing in individual or organizational settings (Voelpel, Dous, & Davenport, 2005)57.

Several factors are known to indirectly or directly affect the psychology of knowledge sharing. These factors may include management characteristics and administrative interventions such as incentives or rewards aimed to stimulate knowledge sharing (Cabrera & Cabrera, 2002)6; environmental characteristics (Levin and Cross, 2004)39; and the characteristics of the individuals who are owners of the knowledge such as the strength of association with the organization, interpersonal trust in peers and management, and the sources of motivations, which will ultimately assist them on deciding whether to conceal or share their knowledge (Levin and Cross, 2004).

Various researchers have shown an insight into the psychology of knowledge sharing at individual level. Knowledge sharing

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has been shown to be influenced by interpersonal factors such as personality, emotional intelligence, work engagement, motivational aspects, and interpersonal trust (Obermayer-Kovács et. al. 2015)46.

Only a few researchers have studied the interactions among different interpersonal factors to explain knowledge sharing (Mooradian et. al. 2006). Our study is among the few which explains the psychological process of knowledge sharing through mediation by motivation.

2. Literature Review

2.1 Knowledge Sharing

Knowledge Sharing can be defined as "the provision or receipt of task information, know-how and feedback regarding a product or procedure" (Cummings, 2004), which is an impression of a socially interactive culture comprising the exchange of knowledge, experiences, skills, abilities and values within or between organizations. Knowledge sharing is a "two-way process" involving both the demand and supply of the knowledge created (Ardichvill et al. 2003)2.

Promoting the conception and sharing of new knowledge is vital for the development of any organization (Nonaka and Takeuchi, 1995)44. Knowledge is a vital resource necessary to attain sustainable competitive advantage in a knowledge based organization through a process in which employees would be stimulated to develop new knowledge and apply it in the most productive manner. (Davenport & Prusak, 1998)14.

At individual level, knowledge sharing has its roots in the social exchange theory, where the employees, through a series of social interaction, would bring more efficiency in the behaviors crucial for success at job (Lin, 2007). Knowledge sharing, at organizational level, is about the formulation, coordination and organization, capturing, reusing and relocating the experience-based knowledge, which is present within the organization, to the needful centers within or outside the organization, making the knowledge available to others and generating new knowledge based on the existing one.

Knowledge sharing helps an organization retain the intellectual capital, even after the employee has left the organization, thereby increasing the profitability and productivity of the organization, ultimately leading to value addition and sustainability (Lin, 2007).

2.2 Personality and knowledge sharing

Personality is defined as the "individual differences in characteristic patterns of thinking, feeling and behaving" (APA). Personality, being a cross-situational and highly stable attribute, has been known to explain the variation in a diversity of human actions, choices and behaviors (Landers & Lounsbury, 2006). There are various dimensions of personality which could be explained through several theories. The Five-Factor Model (FFM) best explains the variability in personality traits, making it the most comprehensive and widely used measure of personality (Zhang & Huang, 2001)63. Lewis Goldberg proposed the FFM comprising of five dimensions of personality, nicknamed the "Big Five" comprising of "openness to experience, extraversion, conscientiousness, agreeableness and emotional stability" (Goldberg, 1990)26.

Few empirical researches have been undertaken on studying the relation between personality type and knowledge sharing. Agyemang et. al. (2016)1 found all five traits except conscientiousness to be significantly promoting knowledge sharing among instructors. Chong et. al. (2014)9 found extraversion and conscientiousness to be the predictors of knowledge sharing behaviors in classrooms. Cabrera et al. (2006) found agreeableness, openness, and conscientiousness to significantly explain the 'intention to share knowledge'. Mooradian & Matzler (2006) found agreeableness to effect knowledge sharing by increasing trust among coworkers.

2.3 Extrinsic and Intrinsic Motivation and Knowledge Sharing

Motivation has been defined as " an internal state ...giving rise to a desire or pressure to act" (Westwood, 1992)61. Given the prominence of the interpersonal factors in explaining knowledge sharing, the dearth of intrinsic and extrinsic motivation among employees is found to be related to the failure of the knowledge sharing initiatives taken by the management (Osterloh & Frey, 2000). Osterloh and Frey (2000)48 found extrinsic and intrinsic motivations to be central in promoting knowledge sharing behaviors of employees. From the viewpoint of knowledge sharing, extrinsic motivation focuses on the reasons justifying the achievement of goals in terms of benefits or rewards received from sharing a particular knowledge set (Deci & Ryan, 1985)15, while intrinsic motivation focuses on the inherent gratification and satisfaction derived from sharing a unique knowledge (Deci, 1975)16. Both extrinsic and intrinsic motivations have been known to have a affirmative impact on knowledge sharing on workplace (Chen & Hsieh 2015)8.

2.4 Personality and motivation

Work psychology suggests that individual differences (or personality) influence individual motivation through interaction with organizational and situational factors (Furnham, 2002)21. O'Reilly et al. (1980)45 suggested that employees perceive their jobs in a significantly different manner, even if the tasks required

to be performed at the job, and the job description remain constant, thereby suggesting a possibility of individual variance in the work behaviors, attitudes and motivations. A 'meta-analysis' conducted by Judge and Illies (2002)33 found a strong influence of "Big Five" on different perspectives of motivation: expectancy, goal setting and self-efficacy motivation. Staw et al. (1986)56 contended that the differences in employees' disposition influence their perception about the work environment, making them prioritize their motivations. Furnham (1997)20 suggested that intrinsic motivation factors affect extraverts more than the introverts. Individuals high in openness were found to be more satisfied with jobs which are less monotonous, which allow them to implement innovative skills and produced them the opportunity to learn new techniques (Furnham et al., 2005)23. More recently, Furnham et al. (2009)22 and Guillén & Saris (2013)28 found a strong association between personality and motivation. However, most of the empirical results showing the relation between personality and motivation have been inconsistent (Gellatly, 1996)25.

3. Hypotheses

Based on the theoretical and empirical evidences presented above, we propose the following hypotheses:

3.1 Extrinsic motivation as a mediator

H0a: 'Extrinsic motivation' will not mediate the relation between 'personality traits' and 'knowledge sharing'.

H1: 'Extrinsic motivation' will mediate the relation between 'personality traits' and 'knowledge sharing'.

3.2 Intrinsic motivation as a mediator

H0b: 'Intrinsic Motivation' will not mediate the relation between 'personality traits' and 'knowledge sharing'.

H2: 'Intrinsic Motivation' will mediate the relation between 'personality traits' and 'knowledge sharing'.

4. Research Method

4.1 Sample and data collection

As our research intends to analyze the factors responsible for knowledge sharing, it was only logical to gather data from a population where knowledge sharing among employees is a significant factor for the success of the team performance and hence for the overall success of the organization. For this reason companies from information and communication technology (ICT) based industry and financial institutions located in Delhi and Delhi-NCR regions were chosen for data collection, which are often classified as knowledge-based industries. Data was collected using survey method from middle-to-top level employees from these companies who were part of teams working on projects. Our study involves constructs with reflective models only. Out of 600 questionnaires distributed, 450 valid questionnaires were returned. Entire data collection process took around 180 days. The descriptive profile of data collected is given in Table-1.

Table 1. (Demographic profile)

Demographic Characteristic		No. of responses	Percentage
Gender	Male	264	58.67
	Female	186	41.33
Age	Upto 30 years	261	58
	30-40 years	140	31.11
	Over 40 years	49	10.89
Experience	0-5 years	170	37.78
	5-10 years	207	46
	Over 10 years	73	16.22
Education	Undergraduate	193	42.89
	Post-graduate	257	57.11
Industry	ICT	181	40.22
	Financial	269	59.78

4.2 Instrumentation

In our study, the scales used to measure the variables were adapted from previous studies. All constructs have multiple sub-dimensions. Knowledge sharing and interpersonal trust were measured using 5-point Likert-type scale (ranging from 1 = Never to 5 = Always; and 1 = strongly disagree to 5 = strongly agree respectively). Rest of the constructs were measured using a 7-point Likert-type scale (ranging from 1 = strongly disagree to 7 = strongly agree).

Expected organizational rewards (a sub-construct of extrinsic motivation), defined as the intensity to which employees perceive about attaining extrinsic incentives such as monetary benefits, job security etc. if they share knowledge, was measured using four items scale derived from Davenport and Prusak (1998), which was validated by Lin (2007). Reciprocal benefits (a sub-construct of extrinsic motivation), which is the intensity of employees' believes that they would be reciprocated for sharing knowledge, were measured using four item scale adapted from Kankanhalli et al. (2005)34, which has been validated by Lin (2007). Knowledge self-efficacy (a sub-construct of intrinsic motivation), which assesses the confidence of employees regarding the value of their knowledge to the organization, was measured using four-item scale constructed by Spreitzer (1995)55. Enjoyment in helping

others, which assesses the perception of gratitude obtained by the employee through sharing knowledge, was measured using four items scale derived from Wasko and Faraj (2000)59, which was validated by Lin (2007). Big-5 traits (explained earlier) were measured using Ten-Item Personality Inventory-(TIPI) constructed by Gosling et al. (2003). Trust in management and peers were measured using 6 items "Interpersonal Trust at Work Scale" developed by Cook and Wall (1980)10, which has been validated by Mooradian et al. (2006)42. Finally, knowledge sharing was measured using 28-item knowledge sharing behavior (KSB) scale developed by Yi (2009). The four dimensions of KSB measure written contributions (5-items), organizational communications (8-items), personal interactions (8-items), and communities of practice (7-items).

5. Data Analysis and Results

The relationships between the variables were assessed using structural equation modeling through partial least squares (PLS) approach. All the analyses in our study were conducted using SmartPLS 2.0.M3 (Ringle et al. 2005)52. According to Hulland (1999)30, assessment and interpreted of a PLS model is a two-step process. In the first step, reliability and validity analysis is conducted for the measurement model. In the second step, the predictability and significance of the paths between constructs in the structural model is evaluated.

6. Evaluation of the SEM model requires following steps

Initially the Reflective models is analyzed wherein, internal consistency is calculated first, followed by calculating the reliability of the indicators proposed in the model, followed by testing for the convergent validity (AVE) and lastly testing the discriminant validity.

After the analysis of the reflective mode, we analyze the structural model on the basis relevance and significance of the relations between the variables. First, structural model is analyzed for any issues arising out of collinearity. Then relevance and significance of the relationships proposed in the structural model are analyzed. After this, R2 (or coefficient of determination) and Q2 (or predictive relevance) are calculated, followed by f 2 effect sizes, q2 effect sizes and finally the Importance-Performance Matrix Analysis (IPMA).

Cronbach (1951)[12] devised a statistical method which divided the data in every possible 2 ways and relies on the average of the correlations of all such potential pairs. Such average is called Cronbach's alpha, α, which is considered to be a good measure of the reliability of the scale concerned.

Cronbach's α is:

$$\alpha = \frac{N^2\overline{\mathrm{Cov}}}{\sum s^2_{\mathrm{item}} + \sum \mathrm{Cov}_{\mathrm{item}}}$$

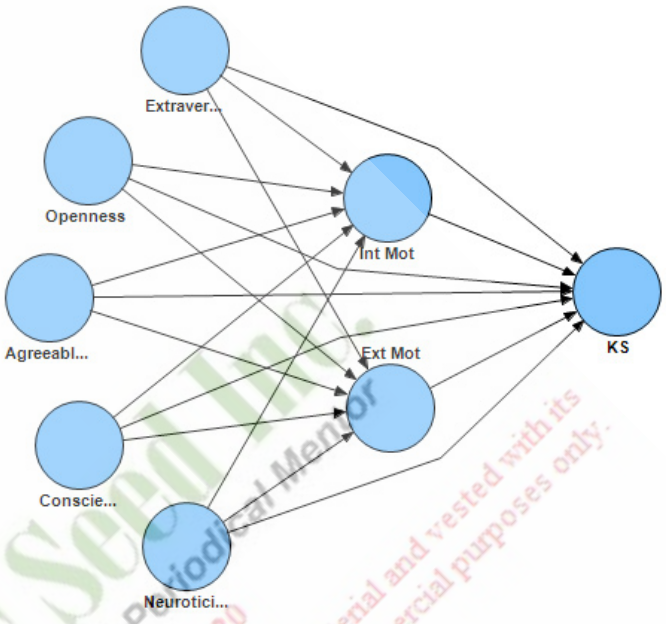

Figure 1. Internal consistency (composite reliability) and indicator reliability.

Following are the results of the Cronbach's α calculated for every scale, and sub-scale wherever applicable.

Both *"Corrected Item-Total Correlation" and "Cronbach's Alpha if Item is Deleted" are a criteria to test indicator reliability.*

The "Corrected Item-Total Correlation" column shows between-item correlation and the aggregate score from the construct. A reliable scale shows good correlation of all the items with the total score. We need to identify the items which do not significantly correlate with the score of overall scale. Hence, if the correlation value of any such items in less than 0.3, then that item is considered to be problematic and needs to be reassessed. Such problematic items may need to be removed. For all our data, the item specific correlation with overall score is greater than 0.3, hence none of the items are considered to be problematic.

The items in the column labeled "Cronbach's Alpha if Item is Deleted" shows the value of overall Cronbach's Alpha if that particular item is not included in the computation. If an item is found to have Cronbach's Alpha value which is substantially larger than overall Cronbach's Alpha may need to be removed as it may impact the reliability of the overall scale. However, no such need was felt.

Finally, the value of Cronbach's α shows the reliability of the overall scale. According to Kline (1999), value of Cronbach's alpha of 0.8 or greater is considered to be acceptable for psy-

Table 2

Scale: Extraversion		
Reliability Statistics		
Cronbach's Alpha	0.941	
Item-Specific Statistics		
	Item-Specific Correlation	**Cronbach's α upon item Removed**
C1	**0.956**	-
C6	**0.956**	-
Scale: Openness		
Reliability Statistics		
Cronbach's Alpha	0.785	
Item-Specific Statistics		
	Item-Specific Correlation	**Cronbach's α upon item Removed**
C5	**0.65**	-
C10	**0.65**	-
Scale: Agreeableness		
Reliability Statistics		
Cronbach's Alpha	0.949	
Item-Specific Statistics		
	Item-Specific Correlation	**Cronbach's α upon item Removed**
C2	**0.951**	-
C7	**0.951**	-
Scale: Conscientiousness		
Reliability Statistics		
Cronbach's Alpha	0.96	
Item-Specific Statistics		
	Item-Specific Correlation	**Cronbach's α upon item Removed**
C3	**0.958**	-
C8	**0.958**	-
Scale: Neuroticism		
Reliability Statistics		
Cronbach's Alpha	0.926	
Item-Specific Statistics		
	Item-Specific Correlation	**Cronbach's α upon item Removed**
C4	**0.936**	-
C9	**0.936**	-
Scale: Self Efficacy		
Reliability Statistics		

Cronbach's Alpha	0.798	
	Item-Specific Statistics	
	Item-Specific Correlation	Cronbach's α upon item Removed
F5	0.699	0.707
F6	0.645	0.73
F7	0.61	0.752
F8	0.523	0.787

Scale: Altruism

Reliability Statistics		
Cronbach's Alpha	0.81	
	Item-Specific Statistics	
	Item-Specific Correlation	Cronbach's α upon item Removed
F9	0.767	0.715
F10	0.675	0.745
F11	0.592	0.782
F12	0.585	0.784

Scale: Expected Organizational rewards

Reliability Statistics		
Cronbach's Alpha	0.744	
	Item-Specific Statistics	
	Item-Specific Correlation	Cronbach's α upon item Removed
F1	0.684	0.593
F2	0.635	0.626
F3	0.399	0.753
F4	0.47	0.723

Scale: Reciprocal benefits

Reliability Statistics		
Cronbach's Alpha	0.809	
	Item-Specific Statistics	
	Item-Specific Correlation	Cronbach's α upon item Removed
F13	0.689	0.728
F14	0.688	0.731
F15	0.484	0.82
F16	0.652	0.747

Scale: Written Communication

Reliability Statistics		
Cronbach's Alpha	0.882	
	Item-Specific Statistics	

	Item-Specific Correlation	Cronbach's α upon item Removed
A1	0.729	0.855
A2	0.761	0.852
A3	0.783	0.841
A4	0.705	0.86
A5	0.643	0.873

Scale: Organizational Communication

Reliability Statistics

Cronbach's Alpha	0.905

Item-Specific Statistics

	Item-Specific Correlation	Cronbach's α upon item Removed
A6	0.724	0.891
A7	0.696	0.893
A8	0.666	0.896
A9	0.762	0.889
A10	0.804	0.884
A11	0.748	0.888
A12	0.664	0.896
A13	0.552	0.905

Scale: Personal Interactions

Reliability Statistics

Cronbach's Alpha	0.913

Item-Specific Statistics

	Item-Specific Correlation	Cronbach's α upon item Removed
A14	0.763	0.898
A15	0.761	0.898
A16	0.627	0.909
A17	0.66	0.906
A18	0.716	0.901
A19	0.735	0.9
A20	0.752	0.898
A21	0.719	0.901

Scale: Communities of Practice

Reliability Statistics

Cronbach's Alpha	0.898

Item-Specific Statistics

	Item-Specific Correlation	Cronbach's α upon item Removed
A22	0.772	0.874
A23	0.762	0.877

A24	**0.681**	**0.885**
A25	**0.71**	**0.882**
A26	**0.664**	**0.887**
A27	**0.758**	**0.878**
A28	**0.593**	**0.894**

chological tests such as Intelligence tests, however in the tests measuring the abilities, the value of greater than 0.7 is acceptable.

7. Convergent validity (average variance extracted)

Convergent validity shows the magnitude to which a measure positively correlates with substitute measures of the same construct. In order to determine the convergent validity for a construct, Average variance extracted (AVE) is used.

The results of AVEs for different constructs and sub-constructs used in our model are presented in Table-3.

Table-3

Variables	AVE
Extraversion	0.9779
Openness	0.8187
Agreeableness	0.9754
Conscientiousness	0.9789
Neuroticism	0.9682
Self-Efficany	0.6238
Altruism	0.6519
Organizational rewards	0.5568
Reciprocal Benefits	0.6358
Written contribution	0.6858
Organizational comm.	0.6075
Personal interaction	0.6231
Communities of practice	0.624

As all of our constructs have AVEs > 0.5, we can say that such constructs and hence entire model meets the convergent validity requirement.

8. Discriminant validity

Discriminant validity shows the uniqueness of a construct in comparison with other constructs on the basis experiential criteria. If discriminant validity for a construct is proven, that would mean that the construct is exclusive in the study concerned and measures the aspects not displayed by other variables in the model. Discriminant validity is widely evaluated using "Fornell-Larcker criterion" (Fornell and Larcker, 1981)[19]. "Fornell-Larcker criterion" relates the square root of each variable's AVE, whereby in order to established discriminant validity, it must be higher when compared to the maximum correlation with any other variable. This would imply that the variable under study would derive more variation with its accompanying indicators than with other variables.

The square roots of the reflective variables' Average Variance Extracted are on the diagonal and the correlations among the variables in the lower left portion. For example, the reflective construct 'KS.' has a value of 0.579 for the square root of its AVE, which needs to be compared with all correlation values in the row as well as the column of 'KS'. Accordingly, all of our constructs meet Fornell-Larcker criterion requirements and discriminant validity is established.

9. Assessment of structural model for collinearity issues

If a large correlations are found among different variables studied in a structural model, that would mean that more than one variable is explaining the same phenomenon, hence such high correlation is not desired. "Tolerence" is used in order to compute the "collinearity" among the variables. "Tolerance" basically computes the extent of variance of one variable which is not explained by another variable. "Variance inflation factor or simply VIF is used to calculate the collinearity, which is the inverse of the "tolerance".

The VIF is extracted from the square root of the VIF being the extent to which the "standard error" has been augmented due to the occurrence of collinearity. IBM SPSS Statistics software package. The tolerance and VIF are both provided in the regression analysis output of IBM SPSS Statistics software package. When it comes to the SEM using partial least square technique, a tolerance value of lesser or equal to 0.20 and a VIF value of greater or equal to 5 suggests a collinearity problem (Hair, Ringle, & Sarstedt, 2013). These values would suggest that an 80% or more variance in the indicator of the variable being studied is explained the remainder of the formative indicators related to the same variables.

Table 4. Shows the application of Fornell-Larcker criterion on our model.

Fornell-Larcker Criterion								
	Agree.	**Consc**	**Ext.M**	**Extrav**	**Int.M**	**KS**	**Neuro**	**Openn**
Agree.	0.988							
Consc.	0.026	0.989						
Ext. M.	0.076	0.593	0.629					
Extrav.	0.009	0.003	0.005	0.989				
Int. M.	-0.022	0.701	0.385	0.053	0.710			
KS	0.339	0.541	0.390	0.271	0.512	0.579		
Neuro.	0.009	0.009	-0.028	-0.004	0.037	0.289	0.984	
Openn.	0.037	-0.037	0.024	0.278	-0.02	0.107	0.020	0.905

We treat the values of tolerance which are greater than 0.2 or a VIF value of over 5.00 of a predictor variable to be suggestive of collinearity.If the values of VIF or tolerance suggest any collinearity issues, then the issue is addressed by either removing the problematic variables, or amalgamating the predictors into a single variable.

Table-5

Collinarity Assesment			
First set (to Intrinsic & extrinsic motivation)		**Second set (to KS)**	
Const.	VIF	Const.	VIF
Agree.	1.28	Agree.	1.008
Consc.	1.152	Consc.	1.038
Extrav.	1.086	Extrav.	1.275
Neuro.	1.001	Neuro.	1.204
Openn.	1.09	Openn.	1.09
		Ext. M.	1.206
		Int. M.	1.213

In our model, none of the constructs show collinearity problem.

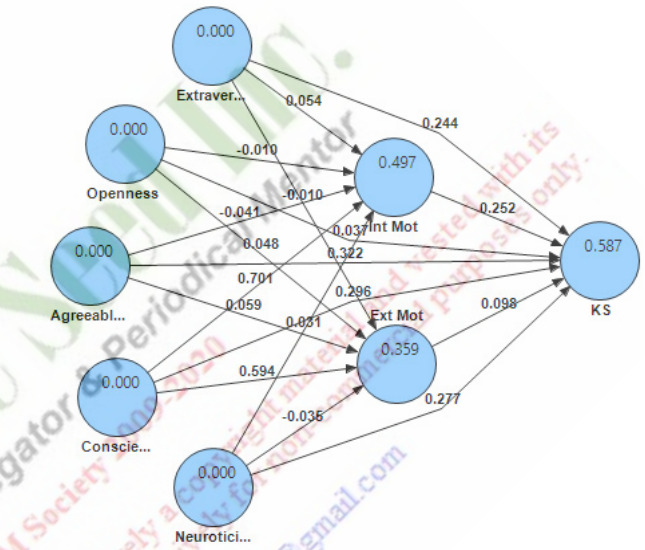

Figure 2.

10. Valuation of the relevance and significance of the SEM relationships

Using partial least square algorithm of SEM, path coefficients, or the approximations are generated for the relationships proposed in the structural model. The values of such path coefficients vary between +1 and -1. As the value approaches closer to +1, it signifies a significantly (most of the times) positive relationships between two variables observed. Vice-versa is true for negative values approaching -1. Weak relationships are usually associated with values closer to zero, which are in almost the cases, non-significant. The actual decision regarding the significance of the path coefficient is contingent upon its standard error which is generated using "bootstrapping". Standard error values obtained using bootstrapping permits evaluating the empirical t value.

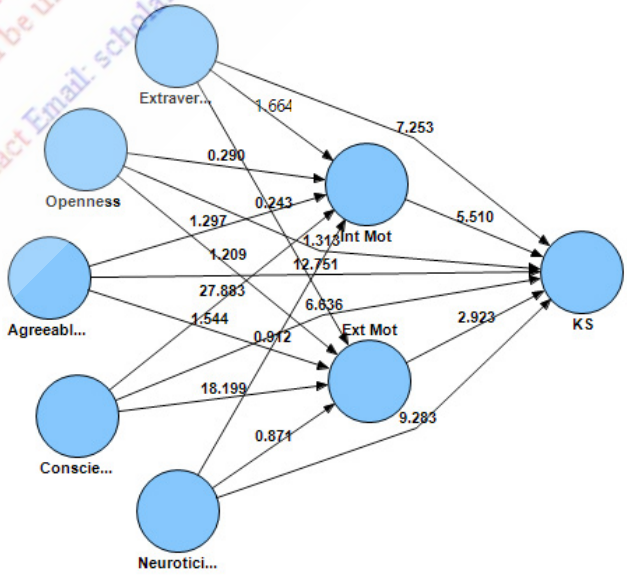

Figure 3

If the t value is greater than the threshold value, we can conclude that at certain probable error, the path coefficient is significant. Generally used threshold values for two tailed tests are 1 .65 which reflects a level of significance at 10%, 1.96 which reflects a level of significance at 5%, and 2.57 which reflects a level of significance at 1%.

Fig- 2 shows the relevance of relationships of structural model, while Fig-3 shows the significance of such relationships by displaying the respective t values.

Table-6

Significance testing results of the structural model path coefficients

	Path Coefficients	t values	Sig. Levels
Agreeableness -> Ext Mot	0.0595	1.6149	*
Agreeableness -> Int Mot	-0.0407	1.3204	NS
Agreeableness -> KS	0.3223	11.7577	***
Conscientiousness -> Ext Mot	0.5942	19.6976	***
Conscientiousness -> Int Mot	0.7013	28.2827	***
Conscientiousness -> KS	0.2959	6.3477	***
Ext Mot -> KS	0.0985	3.048	***
Extraversion -> Ext Mot	-0.0102	0.2587	NS
Extraversion -> Int Mot	0.0542	1.7047	*
Extraversion -> KS	0.2443	6.6938	***
Int Mot -> KS	0.2518	5.4604	***
Neuroticism -> Ext Mot	-0.0355	0.8623	NS
Neuroticism -> Int Mot	0.0306	0.9335	NS
Neuroticism -> KS	0.2773	8.5806	***
Openness -> Ext Mot	0.0476	1.1688	NS
Openness -> Int Mot	-0.0103	0.3056	NS
Openness -> KS	0.0374	1.2752	NS
Agreeableness -> Ext Mot	0.0595	1.5149	NS

Note: NS= not significant
**p<0.05, ***p<0.01

After examining the significance of relationships, it is important to assess the relevance of significant relationships. Many studies do not undertake this important step in their analyses but simply focus on the importance of effects. However, the path coefficients in the structural model may be significant, but their size may be so small that they do not warrant managerial attention.

An examination of the comparative significance of associations is important for understanding the results and deriving conclusions.

Table-7

Path coefficients (relative importance)

	Ext Mot	Int Mot	KS
Agreeableness	0.0595	-0.0407	0.3223
Conscientiousness	0.5942	0.7013	0.2959
Ext Mot			0.0985
Extraversion	-0.0102	0.0542	0.2443
Int Mot			0.2518
Neuroticism	-0.0355	0.0308	0.2773
Openness	0.0456	-0.0103	0.0374

Results displayed in table-7 shows that even though extrinsic motivation is significantly explained by Conscientiousness, weightage of Agreeableness is little enough not to warrant much managerial attention. Intrinsic motivation is significantly explained by conscientiousness and extraversion. Knowledge sharing is significantly explained both extrinsic and intrinsic motivation, however weightage of intrinsic motivation is much higher. All personality facets except openness to experience seem to explain KS significantly.

11. Examining the Total Effects

In a complex structural model like ours, an endogenous construct may be explained by several constructs indirectly. Hence, to get a complete understanding of the structural model, it is important to know the relevance and significance of the relationships between difference exogenous constructs and endogenous constructs, which is explained by the Total Effect of a particular exogenous construct on target endogenous construct. Total Effect is the aggregate of the "direct effect" and all "indirect effects" linking two constructs. PLS uses the bootstrapping methodology (Efron & Tibshirani, 1986)[17] in order to assess the standard errors, which evaluates the significance of the structural coefficients.

Table-8 displays the Total Effects and their significance (at 5% level) for each exogenous construct on each endogenous construct.

Table-8

Significance testing results of the total effects

	Path Coefficients	t values	Sig. Levels
Agreeableness -> Ext Mot	0.060	1.515	NS
Agreeableness -> Int Mot	-0.041	1.274	NS
Agreeableness -> KS	0.168	6.298	***
Conscientiousness -> Ext Mot	0.594	18.900	***
Conscientiousness -> Int Mot	0.701	28.596	***
Conscientiousness -> KS	0.525	21.539	***
EI -> Ext Mot	0.001	0.446	NS
EI -> Int Mot	0.002	0.560	NS
EI -> KS	0.275	7.608	***
Ext Mot -> KS	0.127	4.188	***
Extraversion -> Ext Mot	-0.010	0.248	NS
Extraversion -> Int Mot	0.054	1.632	NS
Extraversion -> KS	0.127	4.692	***
Int Mot -> KS	0.320	8.732	***
Neuroticism -> Ext Mot	-0.035	0.880	NS
Neuroticism -> Int Mot	0.031	0.964	NS
Neuroticism -> KS	0.205	7.164	***
Openness -> Ext Mot	0.047	1.196	NS
Openness -> Int Mot	-0.011	0.309	NS
Openness -> KS	-0.001	0.044	NS

Note: NS= not significant
**p<0.05, ***p<0.01

Table-9

Total effects

	Ext Mot	Int Mot	KS
Agreeableness	0.0595	-0.0406	0.1675
Conscientiousness	0.594	0.7014	0.5246
Ext Mot			0.1274
Extraversion	-0.0099	0.0542	0.1265
Int Mot			0.3195
Neuroticism	-0.0352	0.031	0.2047
Openness	0.047	-0.0109	-0.0011

The results from table-8 and 9 shows that Extrinsic and Intrinsic Motivation are significantly explained by Conscientiousness. Knowledge Sharing is significantly explained by Extrinsic and Intrinsic Motivation, however the weightage of Intrinsic Motivation is much higher. Knowledge Sharing is also indirectly significantly explained by all personality types except Openness to Experience, and the weightage of Conscientiousness is the highest.

Coefficients of determination (R^2) results, representing the "exogenous latent variables'" collective impact on the "endogenous latent variable", are presented in Table-10. $R2$ is a measure which suggests the predictability of the constructs involved in a model. It is calculated as the squared correlation among the definite values and the projected values of a particular endogenous construct.

Table-10

Constructs	R Square
Ext Mot	0.359
Int Mot	0.497
KS	0.587

Predictive Relevance: Q2

Stone-Geisser's Q2 value (Geisser, 1974; Stone, 1974) is an additional tool other than R2 values, which can be used to measure the predictive accuracy of a construct. In other words, when PLS-SEM displays predictive relevance, it precisely foretells the data points of indicators in "reflective measurement models" of endogenous constructs and endogenous constructs. Q2 values which are greater than zero in any structural model, for a particular reflective endogenous latent variable specify the path model's predictive relevance for this specific construct. Blindfolding technique is used in order to calculate Q2 value. Blindfolding technique is a procedure which reuses the sample while eliminating every dth data point in the endogenous construct's indicators and predicts the parameters with the data points which remains (Chin, 1998; Henseler et al., 2009; Tenenhaus et al., 2005). The data points which are removed in this technique, are considered to be missing and dealt with consequently by the SEM algorithm of partial least square (e.g., by means of "mean value replacement"). Omitted data points are then predicted using the subsequent estimates. Q2 measure is calculates using the difference between the true (i.e., omitted) data points and the predicted ones. Blindfolding technique runs the process continuously which repeats till omission of each data point is done and re-estimation of model is done. Q2 values which are greater than zero imply that for a certain endogenous construct, the model has "predictive relevance". Contrarily, the values lesser than or equal to zero represent an absence of "predictive relevance".

All values in table-8 are considerably above 0, thus providing support for our model's predictive relevance regarding endogenous variables.

f^2 effect sizes

Table-11

Results of Q^2 values	
Endogenous latent variables	Q^2
Ext Mot	0.3607
Int Mot	0.4982
KS	0.5999

In order to examine the effect and significance of an exogenous variable on an endogenous variable, variations in the R2 value are analyzed after eliminating the particular exogenous variable. This technique is called f2 effect size. The effect size can be calculated as

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}},$$

In this formula, "R2 included" and "R2 excluded" values represent R2 values of the endogenous construct when the particular exogenous construct is incorporated in or omitted from the model. The variation in the R2 values is examined by assessing the PLS path model twice. Initially the PLS path model is computed with exogenous construct included in the model, which results in R2 included value and after that exogenous construct is removed from the model which results in R2 excluded value. According to Cohen, (1988) a value of f2 of 0.02 reflects a small effect, which a value of 0.15 reflects a medium and a value of 0.35 represents a large effect of the exogenous construct on the endogenous construct under study.

q2 effect size is a technique used to evaluate comparative predictive significance of a predictor variable on an endogenous variable. The evaluation of q2 effect size is similar to the evaluation of Q2. While, Q2 estimates the predictive significance of the SEM model for every endogenous construct, q2 effect size analyses the predictive significance of a certain exogenous variable on an endogenous variable. q2 effect size value of 0.02 reflects a small predictive significance, which a value of 0.15 reflects a medium and a value of 0.35 represents a large predictive significance of the exogenous construct on the endogenous construct under study.

q^2 effect size is calculated using the following formula.

$$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}}.$$

Effect size of variable 'Conscientiousness' on the endogenous construct- Intrinsic Motivation is large. Effect sizes of constructs 'Conscientiousness' and 'Agreeableness' on the endogenous construct- Extrinsic Motivation are small and large respectively. Effect sizes of the variable 'Intrinsic Motivation' on the endogenous construct- Knowledge Sharing is large.

Table-12

Summary of results

Constructs	Path coefficients	f^2 effect size	q^2 effect size
First set (to Intrinsic motivation)			
Agreeableness	NS	0.000	0.005
Conscientiousness	0.715***	0.885	0.883
Extraversion	NS	0.004	0.014
Neuroticism	NS	0.002	0.008
Openness	NS	0.383	0.009
Second set (to extrinsic motivation)			
Agreeableness	0.074*	0.006	0.014
Conscientiousness	0.604***	0.495	0.500
Extraversion	NS	0.000	0.007
Neuroticism	NS	0.001	0.008
Openness	NS	0.003	0.011
Third set (to KS)			
Ext Mot	0.0985***	0.015	0.037
Int Mot	0.2518***	0.224	0.220
Agreeableness	0.3223***	0.124	0.194
Conscientiousness	0.2959***	0.33	0.503
Extraversion	0.2443***	0.037	0.027
Neuroticism	0.2773***	0.049	0.049
Openness	NS	0.001	-0.037

Note: NS= not significant
**p<0.05, ***p<0.01

The predictive relevance of Conscientiousness for the construct Intrinsic Motivation is large. Predictive relevance of Agreeableness and Conscientiousness for the construct Extrinsic Motivation is small and large respectively. The predictive relevance of Extrinsic Motivation for the construct Knowledge Sharing is medium, while that of Intrinsic Motivation is large.

12. Importance-performance matrix analysis

"Importance-performance matrix analysis (IPMA)" is a technique used under PLS-SEM, which, using latent variable scores, compares the "total effects" in a structural model (importance) with the average values of the latent construct scores (performance) for any given dependent variable, thus signifying the aspects which warrant managerial attention (Hair et al. 2013)[29]. Table-13 and Figure-4 shows the result of IPMA analysis.

Table-13

Index values and Total Effects for the IPMA of Knowledge Sharing

	Importance (total effects)	Performance
Agreeableness	0.1675	43.3242
Conscientiousness	0.5246	43.5534
Ext Mot	0.1274	49.8808
Extraversion	0.1265	40.446
Int Mot	0.3195	49.116
Neuroticism	0.2047	39.3773
Openness	-0.0011	16.7301

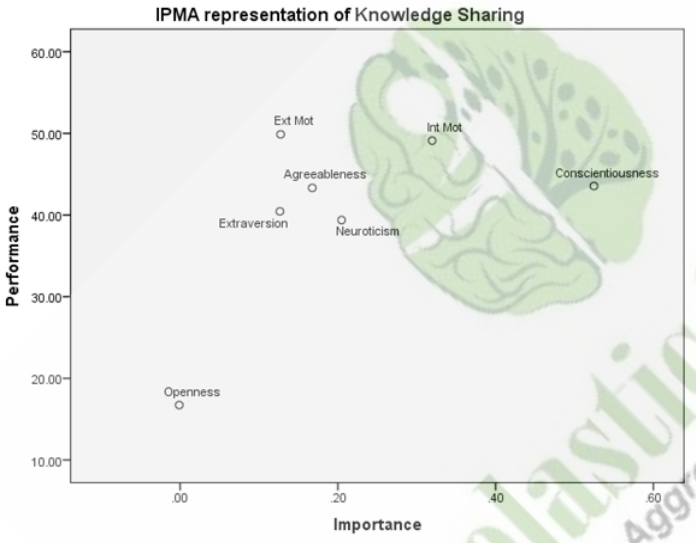

Figure 4. (IPMA analysis).

From the IPMA analysis, it is evident that conscientiousness is the most significant construct to facilitate 'knowledge sharing', while its performance is comparatively lesser than several others'. Construct extrinsic motivation performs best. Construct Trust is one of the least performing construct while it is one of the most significant ones to facilitate 'Knowledge Sharing'.

13. Mediation analysis and Hypotheses Testing

Mediation characterizes a situation where a 'mediator variable', to a certain degree, engrosses the influence of an exogenous variable on an endogenous variable (Baron & Kenny, 1986)[4]. In our study, we restricted all the mediation analysis between three variables at a time depending on our hypotheses, in order to make comprehension easier. Mediation results are presented in Table-14, for those paths for which the condition of significant direct effect (without mediator) has been met. Such condition was not met for the direct effects of openness on knowledge sharing without trust and intrinsic motivation as the mediators. Hence, these paths were removed from the mediation analysis.

15. Extrinsic motivation as a mediator

Extrinsic motivation was found to weakly mediate openness and knowledge sharing (VAF=0.10), and moderately mediate conscientiousness and knowledge sharing (VAF=0.35), partially supporting H1.

16. Intrinsic motivation as a mediator

Intrinsic motivation was found to weakly mediate extraversion and knowledge sharing (VAF=0.08), while a moderate-to-strong mediation was found between conscientiousness and knowledge sharing (VAF=0.63), partially supporting H2.

17. Discussion

Inspired by the necessity to understand the complex relation between prominent interpersonal psychological factors, and their relation with knowledge sharing behaviors of employees, in our study we incorporated Big Five personality traits, intrinsic and extrinsic motivational factors into a structural model, in order to study their indirect and direct effects on knowledge sharing. The results showed the prominence of conscientiousness and emotional stability among Big Five for explaining knowledge sharing behaviors, in lines with Cabrera et al. (2006)7. Kim Shin and Swanger (2009)35 had also found conscientiousness to be one of the most significant personality traits in explaining knowledge sharing. IPMA analysis suggests that even though conscientiousness is the most significant factor in explaining knowledge sharing, its performance is much lower than other interpersonal factors like motivational factors. This has implication for recruitment practices, where the management should attempt to hire more employees rated higher at conscientiousness front, if promotion of knowledge sharing is the aim.

Intrinsic motivation appears to promote more knowledge sharing compared to extrinsic motivation. It is also a stronger mediator for conscientiousness and knowledge sharing. However, it appears that management is a little more focused at extrinsic methods compared to intrinsic methods, to motivate their employees. Management should rather introduce methods such as job enrichment, and value their suggestions (knowledge), which would motivate employees intrinsically, giving them a chance to utilize their unique knowledge set.

Table-14

Mediator: Extrinsic Motivation						
Path	**Path coefficient to Ext Mot**	**Path coefficient of Ext Mot to KS**	**Total effect**	**t value**	**Sig**	**VAF**
Agreeableness> ExtMot>KS	0.10	0.11	0.25	1.84	NS	-
Conscientiousness> ExtMot>KS	0.81	0.11	0.24	4.25	***	0.35
Extraversion> ExtMot>KS	-0.01	0.11	0.25	-0.38	NS	-
Emotional stability> ExtMot>KS	-0.05	0.11	0.24	-1.08	NS	-
Openness> ExtMot>KS	0.14	0.11	0.14	3.22	***	0.10

Mediator: Intrinsic Motivation						
Path	**Path coefficient to Int Mot**	**Path coefficient of Int Mot to KS**	**Total effect**	**t value**	**Sig**	**VAF**
Agreeableness> IntMot>KS	-0.03	0.29	0.24	-0.77	NS	-
Conscientiousness> IntMot>KS	0.96	0.29	0.43	8.47	***	0.63
Extraversion> IntMot>KS	0.07	0.29	0.27	2.01	**	0.08
Emotional stability> IntMot>KS	0.04	0.29	0.25	1.22	NS	-

18. Limitations

In our study, Hierarchical Component Model was used for all constructs except for personality traits. In a Hierarchical Component Model, a construct is explained by two or more underlying dimensions, and as our study comprised a large number of constructs, this made it difficult to see the effect of one sub-dimension of a construct on that of another. Doing so could give a better comprehension of the mechanisms through which different factors interact with one another. Future researchers should concentrate on a fewer factors in order to understand such a mechanism. Results concerning the role of personality in explaining knowledge sharing and other interpersonal factors are not perfectly consistent with older studies. However, studies involving personality are known to bring inconsistent results (Zhao & Seibert 2006)64 In order to keep the questionnaire of a reasonable length, we had adopted a very short scale in order to measure Big Five traits, comprising of only 10-items, as, for even the shortest of other inventories available, number of items exceed over 40 (Facet, B. F. D. Big Five Inventory-BFI). Future researchers may do a more focused study to understand the detailed interactions of personality traits with other interpersonal factors.

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Marital Satisfaction and Spiritual Personality: A Relational Overview

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Abstract

Family is the generator of manpower and an institution for society. Overall growth of society depends on this social institution Marital satisfaction is one of the factors that influence the stability and persistency of family. The aim of this study is to identify relation between marital satisfaction and spirituality. The population under study consists of married couple living in national capital region. 500 questionnaires were circulated to seek response whereas after removing incomplete responses and cleaning of data it results in to sample of 382 individuals consisting of 225 male and 157 female respondents. Marital quality index (Norton, 1983)24 and Daily spiritual scale (Underwood, 2002)31 are used to seek responses. Reliability analysis and exploratory factors analysis is used to check the reliability of the scale in Indian Context. Additionally, a confirmatory factor analysis is performed to validate the scale and develop a model. The study provides an insight that will help in improving marital satisfaction in institution of family.

Keywords: Daily Spiritual Scale, Family, Marital Satisfaction, Marital Quality Index, Spirituality

1. Introduction

Marriage is all about ownership and sense of belonging between the couple. Marriage certainly is not just a task to gain social acceptance, but also aims at companionship for lifetime. The partner is the prime support system. The partner cannot have exactly similar personality traits, but certainly a team can be formed with the partner to live life completely. Marriage is all about attempting to unite with the partner in all life situations. This unification is always mutually beneficial. The fights and arguments are as normal part of any relationship as good times in the relationship. Though the expectation is there in every mind that the partner should always listen and do as expected, but that is not a reality. Most of the times there can be difference of opinions which arise because of different personality traits, childhood experiences, likes and dislikes, aspirations, value systems, perception and beliefs. And those who are not able to accept these differences in thinking and behavior end up creating negative experiences in the marriage.

Marriage in Indian society is believed to be a religious institution. It is understood as relatively permanent unions of two people implying a number of inter locking status and roles. Family is never merely a personal matter, because society is so much affected by the quality of its families. Even the breaking up of a family is not a personal concern alone. Statistically marriages in India have shown a much better survival rate than marriages in other countries (Bharat, 1996 p.8). However, many marriages today are like "house built upon sand". Staying together in a house does not necessarily mean that they are happy. We must acknowledge the fact that today quite a number of marriages fail, some form an uneasy compromise and others end in divorce or in separation. The stability of marriage depends on many factors like adjustment, communication, expectation etc. Some well-known counselors like Fincham and Linfield's (1997))6 are of the opinion that religious belief has a decisive role in minimizing the possibility of dissolution of marriage. Satisfaction in marriage is critical. The relationship a man has with a woman in marriage is perhaps the highest form of relationship, because it involves physical, emotional, spiritual and social aspects of life. Marital satisfaction is an outcome of components like – Affective Communication; Time spent together, Sexual Satisfaction, Problem Solving, Roles, Satisfaction with children and effective child rearing. Marital satisfaction is more intricate than it seems. Two marrying people need to modify themselves according to each other in terms of "sensory, motor, emotional and intellectual capacities". Moreover, one of the dimensions affecting marriage quality can be spouses' value and belief systems and similarities and differences between beliefs and values within this marital discipline. Many researchers have emphasized on religiousness and marital satisfaction (Hunler & Gencoz, 2005)16.

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Definitions of marital satisfaction appear to be as individualized as the study being conducted, and at times as simplistic as asking a single item response as to degree of self-reported satisfaction. Religiosity has been operationally defined by several researchers as religious beliefs and behaviors that are part of an individual's behavioral patterns. There are plentiful indications signifying the impact of 'spirituality' on 'marital relationship', it is hence significant to analyse the spirituality dimension midst married couples. Some authors have made efforts to define spirituality in more rigid sense when it comes to interpersonal relations. Davis et al., (2009)4,5 termed it as "relational spirituality", while Giblin; (1997)9 called it "marital spirituality". This practice of finding a specific definition Spirituality for couples shows that it is a different phenomenon for couples juxtaposed with personal spirituality. What is to be noted is that there is a certain degree of similarity for the characteristics among the different definition of marital spirituality provided by different researchers (Giblin; 1997). Such characteristics are "love for each other", "love for the Transcendent or Divine" and "obedience to His teachings or laws", and the "sharing of the love to others and the community". There are a lot of factors which are important for a healthy marriage, and spirituality is one of them. Even the professions such as counselling and therapy have accepted spirituality to be considered in therapies etc, due to growing significance of spirituality among married couples. Several researchers have also proven the importance of spirituality for mental health (Giblin; 2004)20. Spiritualism is the most integrated and most comprehensive psychological worldview which is ingrained in the minds of the people. Spirituality infers that even if individuals are by nature "restless, unstable, greedy, selfish, and impulsive" and so on, they may still be inclined to "self-transformation" by attaining higher abilities which are spiritual in nature (Roland, 1988) which they can attain through refinement of an " observer" (drashta) in their mind. The observer permits them to assimilate numerous actions and emotions, increase consciousness, obtain purity in belief and deed and excel it similar instincts to convert entirely liberated of all those concerns, which restrain self-transformation.

2. Literature Review

Marriage is a "social system" where a man and a woman are driven closer to one another and begin to reside with each other. Harmonious marriage relations are important not only for mental health of the individuals involved, but also for their children, and for the society in general. However, if the relation is indecisive and demanding it results in emotional turbulences and disturbances in marital relation. This section examines the studies which analyses elements associated with marriage quality. The investigation in the area of marital relationship examines the factors such as "marital satisfaction, marital success , consensus, companionship, or some such synonym reflective of quality of married life". According to Houseknecht and Spanier (1980)14, quality of marriage if the most commonly studied factor in the field which studies marriage relationship psychology. It has been realized that marital quality is a multidimensional concept. However, a difference has been established among "marital satisfaction" and "marital quality". Marital satisfaction encompasses "*intrapersonal" occurrence and the second was both a measure of an "interpersonal" and also an "intra-personal" phenomenon. "Marital satisfaction" is a subjective understanding of a marriage. Marital quality is a broader concept which encompasses sub-concepts such as 'satisfaction', 'communication', 'integration' and 'happiness' with the relationship. Johnson et al. (1986) in his research stated five main mechanisms of 'marital quality' as "marital instability disagreements happiness, problems and interaction". Hughes et al. (1992)*15 found 'marital disagreement' and 'companionship' as elements of marital quality. Zuo (1992)33, incorporated two scopes of 'marital quality' ('marital happiness' and 'marital adjustment') as distinct ideas and inspected the shared relation among 'marital happiness' and 'marital interaction'. A "marital interaction" contains of the subsequent constituents: regularity that spouses shared the resulting actions collectively: "eating, going shopping, visiting friends, doing household projects, and going out". The constituents of "marital happiness" are: 'the extent of acceptance derived from the other spouse, the contentment with the spouse's company, the contentment of the extent of love and regard derived from the spouse, and the strength of love for the spouse'. According to Johnson and Talitman (1997) marital quality is a "stable phenomenon".

2.1 Marital Satisfaction and Spirituality

'Spiritual values' and 'religion' play a significant part in people's live around the world. There are a numerous reasons and motivations for why people chose to be religious. For numerous individuals religion is a base on which they can rely their lives, their faith and their actions. Nevertheless, religion is complex concept which is extremely tough to describe. According to Swenson (1996), the relationship between relation and family relations has been only marginally studied. The philosophy of materialism assumes that matter is the only reality in the world, which forms all the matter and its constituents. Such philosophers believe that it is only the physical variations in the human body and our brain which results in all mental processes. They defend this argument by indicating that a person can realize only what he "see, hear, smell, or touch". They out rightly refute the presence of 'soul or mind' and claim that judgements, thoughts, sensations and determination do not exist separately from the brain. Mahoney et al. (1999)22 performed a research on 97 couples to understand the impact of 'spirituality' on 'marital relationship'. The participants did a survey, in which they had to answer about their involvement

in religious actions and their insights concerning the commitment of marriage, including the spiritual and religious aspects of the marriage. Juxtaposed with 'individual religiousness' and 'religious homogony' these religious factors straightforwardly present an assimilation of marriage and religion and they were related to larger worldwide marital adjustment, more apparent paybacks in marriage, fewer marital struggle, more oral partnership, and, fewer oral hostility and lesser differences among couples. Poloma (1993) conducted a study in which it was found that playing regularly was related to greater satisfaction with life and happiness among married couples. Swenson (1996)29 also found a strong association among religion and family relations. In his research Weber's (1978)'s32 study was considered to shape up a theoretical relation amongst "personal religious worldviews, personal religious experiences and religious social action" that are projected to impact marriage. While analysing the association among marriage and religiosity, Lacy (1998)19 found a strong association between marital satisfaction and religious beliefs.

The results of the study conducted by Hashemi (2004), Hatami et al (2009), and Haditabar et al (2011), who shows that the components of spiritual intelligence have positive influences on marital satisfaction. Amram (2005)1 believes that SQ includes meaning and duties in life, holy feeling of life, balanced understanding of materials and beliefs about the better world . Family is the biggest generator of manpower and the pathway of other social institutions such that normality or abnormality is mainly dependent on the general conditions of family and none of the social harms could occur without the influence of family (Hamidi et al., 2009). There are many studies which have proved that marital satisfaction is one of the influential factors in the stability and persistency of family and also relating to mental hygiene of couples and children (Hatami et al., 2009)12. The relationship of marriage has been the major source of social support for many individuals and acts as a protective factor against mental diseases as well as destructive consequences of negative measures and trials of life (Perrone-Mc Govern et al, 2012)25. In a study conducted by Booth and Hawkins it was revealed that individuals who are not satisfied with their married life get significantly distress assessments of higher grades and lower grades in life satisfaction assessments compared with individuals who are happy and satisfied with their married life. If the married life is unstable it puts individuals' mental and physical health completely in danger. Therefore, identifying the factors which may decelerate the decline in marital satisfaction is of particular importance (Murray et al. 2011)23. Rostami & Gol (2014)28 predicts marital satisfaction based on spiritual intelligence.

Even though preceding studies substantiate the presence of an association among 'marital satisfaction' and 'spirituality', comparatively lesser is known regarding the association between several dimensions of the two factors. Even though a lot of research has been conducted studying different dimensions of marital satisfaction, there is a paucity of such studies in Indian context. Our research inspects the association among spiritual personality of Indian couples and their marital quality.

2.2 Objectives of Study

1. To identify the constructs that defines marital satisfaction and spiritual personality through review of literature.
2. To validate the identified factors that defines marital satisfaction and spiritual personality.

3. Data and Methodology

3.1Research Design

In order to collect data, a questionnaire with structured form was prepared. 'Exploratory study' was conducted in order to point out various factors on the basis of literature and 'face validity' was used in order to test the validity of the questionnaire. Eighteen variables were selected for the survey through literature review. Questions involved were measured on a 5-point likert scale which ranged from '1-strongly disagree' to '5-strongly agree'. The final questionnaire was pretested on 35 married people.

3.2 Data Collection

Primary data have been collected for the purpose of present study. The primary data has been collected with the help of a questionnaire and have been filled by the people living in Delhi and NCR in the age group of 18-48 years. The questionnaire was self-administered by the respondents in Delhi NCR and was sent through emails and social networking sites. Five hundred questionnaires were distributed but Three hundred ninety two questionnaires were elucidated and used for the final analysis after eliminating those that were partially completed. After data cleaning Three hundred eighty two questionnaires were used for final analysis comprising of 225 males and 157 female respondents.

3.3 Statistical Tools

"Factor analysis" is a "multivariate" analytical process which determines fundamental dimensions among calculated factors and latent factors, thus permitting the building and improvement of the concept. It delivers validity of the construct of "self-reporting questionnaires". The "Exploratory Factor Analysis" (EFA) and "Confirmatory Factor Analysis" (CFA) are considered as the two major modules of factor analysis. "Exploratory Factor Analysis" is a technique for examining if various factors of importance are

linearly associated to a lesser number of 'unobservable factors' whereas, in CFA testing of an anticipated theory, or model is permissible. CFA also has assumptions grounded on 'priori theory' concerning the number of variables which propose the best 'fit' for the model.

4. Analysis and Interpretations of Results

"Exploratory Factor Analysis" was used to cultivate an instrument for measuring the effect of spiritual personality and marital satisfaction using SPSS V 21. For this pool of 18 items comprising of "I feel God's presence" (SP1), "During worship, or at other times when connecting with God. I feel joy which lifts me out of my daily concerns" (SP2), "I feel strength in my religion or spirituality" (SP3), "I ask for God's help in the midst of daily activities" (SP4), "I feel guided by God in the midst of daily activities" (SP5), "I feel God's love for me, directly" (SP6), "I am spiritually touched by the beauty of creation" (SP7), "I feel thankful for my blessings" (SP8), "I desire to be closer to God or in union with the divine" (SP9), "I experience a connection to all of life" (SP10), "I feel God's love for me, through others" (SP11), "I feel a selfless caring for others" (SP12), "I accept others ever when they

Table 1. Rotated Component Matrix

Factor Labels	Items	Factor Loading	Cronbach alpha
Direct Relationship with God (DRG)	SP2('During worship, or at other times when connecting with God. I feel joy which lifts me out of my daily concerns")	0.850	0.929
	SP8("I feel thankful for my blessings")	0.841	
	SP6("I feel God's love for me, directly")	0.830	
	SP5 ("I ask for God's help in the midst of daily activities")	0.800	
	SP4 ("I ask for God's help in the midst of daily activities")	0.786	
	SP3 ("I feel strength in my religion or spirituality")	0.785	
	SP9 ("I desire to be closer to God or in union with the divine")	0.782	
	SP1 ("I feel God's presence")	0.712	
Relationship with God Through Others (RGO)	SP7("I am spiritually touched by the beauty of creation")	0.679	0.937
	SP13 ("I accept others ever when they do things I think are wrong")	0.898	
	SP12 ("I feel a selfless caring for others")	0.893	
	SP11 ("I feel God's love for me, through others")	0.859	
	SP10 ("I experience a connection to all of life")	0.824	
Marital Satisfaction (MS)	MS4 ("My relationship with my partner makes me happy")	0.782	0.842
	MS3 ("Our marriage is strong")	0.771	
	MS2 ("My relationship with my partner is very stable")	0.766	
	MS1("We have a good marriage")	0.761	
	MS5 ("I really feel like part of a team with my partner")	0.661	

do things I think are wrong" (SP13), "We have a good marriage" (MS1), "My relationship with my partner is very stable" (MS2), "Our marriage is strong" (MS3), "My relationship with my partner makes me happy" (MS4), "I really feel like part of a team with my partner" (MS5) were designated on the basis of literature review as mentioned above. The data for the questions was gathered on a 5-point scale. "Principal Component Analysis" was used with 'varimax rotation'. The correlations amongst different variables and the various questions articulated using 'factorial loads' were significant. The "Kaiser- Meyer-Olkin" technique of 'sampling adequacy' came out to be 0.878 with chi- square value of "Bartlett's Test of Sphericity" being significant (chi sq= 5179.421, p = .000). This implies that the 'factor analysis' was acceptable. The 'factor analysis' produced three constituents with eigenvalues above 1 with 68.62% total variance explained. The factor loadings along with Cronbach alpha and factor labels are shown in Table 1.

On the basis of exploratory factor analysis a diagram depicting the preliminary measurement model was designed. The model displayed ten measured indicator variables and three latent variables which were subjected to CFA with AMOS V21.

The latent variables were identified as

1. Direct Relationship with God (DRG) consisting of SP2 ("During worship, or at other times when connecting with God. I feel joy which lifts me out of my daily concerns), SP8(I feel thankful for my blessings"), SP6("I feel God's love for me, directly"), SP5 ("I ask for God's help in the midst of daily activities"), SP4 ("I ask for God's help in the midst of daily activities"), SP3 ("I feel strength in my religion or spirituality"), SP9 ("I desire to be closer to God or in union with the divine"), SP1 ("I feel God's presence"), SP7("I am spiritually touched by the beauty of creation").
2. Relationship with God through Others (RGO) consisting of SP13 ("I accept others ever when they do things I think are wrong"), SP12 ("I feel a selfless caring for others"), SP11 ("I feel God's love for me, through others"), SP10 ("I experience a connection to all of life").
3. Marital Satisfaction (MS) consisting of MS4 ("My relationship with my partner makes me happy"), MS3 ("Our marriage is strong"), MS2 ("My relationship with my partner is very stable"), MS1("We have a good marriage"), MS5 ("I really feel like part of a team with my partner").

The major task in Confirmatory model is to conclude the "goodness of fit" among the hypothesized model and model determined by the sample data. The adequacy of model was evaluated using the 'Chi square' statistic, "Confirmatory Fit Index" (CFI) and "Root Mean Square Error of Approximation" (RMSEA). Preliminary model did not provide a good fit for the data (Figure 1), with value of CFI being 0.884 (Chi square value =727.8, p=0.00). Hence the preliminary model was amended to improve the model fit. Modification indices and standardized residuals calculated through AMOS V 21 were used to modify the model resulting in the final model (Figure 2).

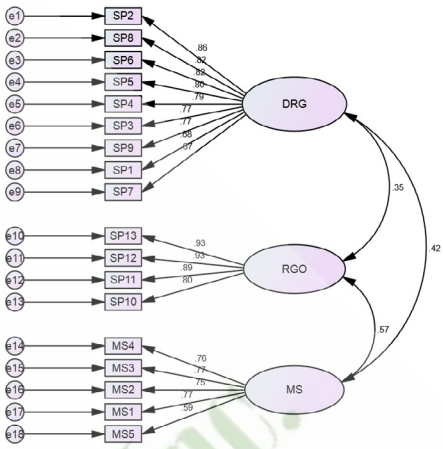

Figure 1. Preliminary Model.

The final model as shown in figure 2 was significantly better fit in comparison to the preliminary model with Chi Square value = 274.706, p=0.000. The CFI for the final model was 0.971, representing that the model provided a good fit. Other indices CMIN=2.163, AGFI (Adjusted Goodness of Fit =0.902, RMSEA=0.055, NFI=0.948 and PCLOSE=0.162 are also meeting the threshold limits. Hence all the parameters are good and we are able to achieve the model Fit. All the indicators had moderate to strong standardized factor loadings ranging from 0.59 for MS5 to 0.93 for SP12 & 13. Squared multiple correlations provided information about the extent of variance of observed variables the factor can account for. The R2 statistics was found highest at 0.8836 for SP12 &13, 0.7921 for SP2 and 0.5929 for MS1 and MS3 corresponding to all the three latent variables identified in the final model. Table 2 shows that critical ratio (CR) for all the three constructs DRO, RGO and MS are greater than 0.7, 'average variance extracted' (AVE) of all the three constructs DRO, RGO and MS are greater than 0.5, 'mean shared variance' (MSV) < 'average variance extracted' (AVE) for all the three constructs DRO, RGO and MS. Thus all the three constructs has discriminant validity, convergent validity and reliability.

5. Summary and Conclusion

Marriage is not only a legal contract but also a social one among two persons who ties their lives emotionally, economically and lawfully. Marriage is all about ownership and sense of belonging between the couple. Marriage certainly is not just a task to gain social acceptance, but also aims at companionship for lifetime. Marriage is an ongoing entity that needs to be kept healthy as similar to the concept of health of the body. One needs to take

care of the emotional and physical well-being of the body so as to keep the body disease free. Statistically marriages in India has shown a much better survival rate than marriages in other countries. Satisfaction in marriage is critical. The relationship a man has with a woman in marriage is perhaps the highest form of relationship, because it involves physical, emotional, spiritual and social aspects of life. Marital satisfaction is an outcome of components like – Affective Communication; Time spent together, Sexual Satisfaction, Problem Solving, Roles, Satisfaction with children and effective child rearing. Marital satisfaction is complex than it may appear. Two marrying individuals need to adjust to one another's capabilities regarding emotions and behaviours alike.

Table 2. Validity

	CR	AVE	MSV	ASV	RGO	DRO	MS
RGO	0.933	0.777	0.312	0.219	0.881		
DRO	0.927	0.586	0.176	0.150	0.354	0.765	
MS	0.851	0.535	0.312	0.244	0.559	0.419	0.731

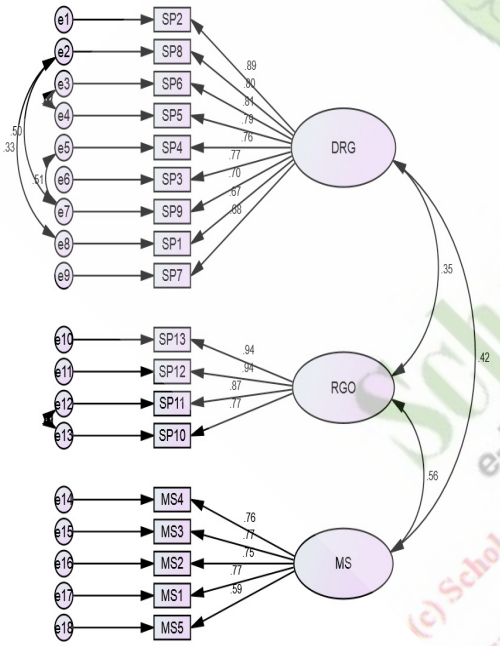

Figure 2. Final Model.

On the basic level comprising of each other's personality, thet need to adjust simultaneously to the broader social atmosphere on various matters including those pertaining to family, friends, household, work etc (Fonseca, 1966, p.200)[7]. Some studies indicated that component of spiritual life in reliance on inner core of spiritual intelligence had the largest contribution in predicting martial satisfaction and after that the component of "perception of and communication with the origins of the universe" increased this contribution significantly. The present study also develops a model involving marital satisfaction, direct relationship with god and indirect relationship with god. This communication is similar to communication with people in some way, in that it causes satisfaction in married life. Individuals, who believe in religion by heart and are successful in acting based on their religious beliefs, will be more prosperous in terms of empathy, perception, responsibility and flexibility. Therefore, such individuals have great capabilities in improving their relationships and interactions and as a result, they will have more consistency and satisfaction in their marital relationships (Roohani & Manavipoor, 2008)[27].

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Overview of Different Techniques Utilized in Designing of a Legged Robot

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Abstract

This paper focuses on the various techniques which are implemented to design a small scale legged robot. It specifies various parameters which play a vital role for designing of robot. It also provides the basic level analysis method which can be used to deal with calculation of force, generation of foot profile, calculating dimension of linkages and different method to help the robot to navigate across rough terrains using sensors and various other algorithm or programs, which instantly optimizes the foot profile of the robot to overcome any obstacle

Keywords: Jerk Reduction, Link Optimization, Walking Robot

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1. Introduction

For making the robots more efficient that previous one it is beneficial to use legs instead of wheels or rollers. Various mechanisms are available for actuating the leg assembly as per command of operator. Names and the structure can be varied by using different no of legs like 4 legged robot is called Quadra pad, six legged is called Hexapod and 8 legged is called as Octopod robot[1]. All these structures are having higher degree of freedom, better accuracy in working and all terrain mobility. As seen in previous robots having less ground clearance, they are not able to overcome many of the obstacles around them, but in case of legged robots the availability of higher ground clearance enables robot to conquer any difficulty as per required. One of the mechanisms used is Klann Mechanism which is most suitable for the legged robots as it has very simple structure[2]. The mechanism provides better stability and balance to the body if optimized properly. The out thus obtained can be redeveloped as per required shape and size.

Based on the type of application the control of legged robot may or may not depend upon microprocessor. Force transmission is depending upon the number of legs of robot. Designing of legs is crucial for better performance of robot. Besides designing the robot, detailed analysis should be involved in understanding the mechanism and its behavior during the working. Legged robot works better on the sleeper and sloppy floor. Since it has point contact for a brief moment of time with the ground, the risk involved with the condition of terrain have no adverse effect on the gait of the legged robot. The range and height of the robot is fit for traversing through landscapes which are unfamiliar to wheels. The minimum degree of freedom of such mechanisms is at least 2 that are along the vertical and the translational axis. By varying the dimension of every link purposeful gait can be obtained.

Now-a-days due to various environmental issues, numerous disasters are arising and it is difficult for our current technologies to cope with it[3]. The possibilities for any wheeled robots to achieve this task are very slim, hence the legged robots created curiosity for disaster management. The potential of a legged mechanism to navigate irregular terrains shows more promise, in rescuing people from disaster sites. In defense sector, soldiers have to carry twice their weight so such legged robots can provide support. Certain applications are underway such as utilizing a legged robot as a wireless robot which can lead the troupe. Having better weight distribution, it can be used for waste material handling on industrial floor. It can also be used as transporting media from source to its processing area.

According to statistics, 23% of worldly population comprises of disabled people which find doing certain activities like hacking, trekking, climbing etc. difficult[4]. To enable them to overcome such difficulties special purpose robots can designed, which can help them to experience the tasks. Biological gaits are analyzed for robot to perform various tasks as described above[5].

Through observations of animals in nature, it is clear that legs are more reliable for overcoming the terrains. Through advances in technology, underwater sea exploration has become possible but traversing through irregular, unstructured terrain is a problem. To overcome these difficulties the robots are equipped with legs (kinematic linkages)[6]. The robots are provided with

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many sensors to detect the terrain and simulate the gait which is essential for overcoming the obstacles. These underwater robots are creating interest for researchers to go deeper in this field for exploring depths. Similar advancement has been made in aerospace[7]. In order to explore the surfaces of planets, various programs involving legged vehicles have proven to be better than wheeled robots. Precision and stability of such robots has enabled various operations which require rigid structure and posture.

2. Necessity of Legged Robots

1. Legged robots can traverse on any type of surfaces which is unable for robots with wheels. Also, wheels are designed to work on prepared surfaces like smooth surfaces, roads, rails. Where in case of legged robot it is not required.
2. Legged robots can overcome any type obstacles whereas wheels need to somehow travel over it, or had to choose a different path for travelling.
3. Wheels require a continuous path to travel whereas legs can step over isolated paths and move on. For example, in an earthquake conditions the wheeled robot does not perform at many condition so legged robot come into picture and work efficiently.
4. Legged robots can avoid undesirable jamming in ditch which cannot be avoided in a wheeled robot
5. In a defense sector for many operations are performed where legged robots perform as weight carrier or armor carrier.

3. Literature Review

3.1 Optimization of Linkages

Optimizing the design of linkages by Utilization of sensors to enhance adaptively of the robot to overcome challenging land marks[1]. Interchangeability in mechanical design of the linkages results in flexibility and less maintenance of the robot[4]. By increment in number of links the weight distribution and force transmission is improved. Detail discussion of profile generation at every stage of crank revolution[6]. Relation between the rocker and ground point contact, duration of contact, time of engage-mint and disengagement is analyzed[7]. For monopod operation hopping principle is used which appears in the form of pogo stick used as leg for motion[17]. Various mechanisms such as Klann and Theo Jansen linkages have been utilized for optimization of linkages[20].

3.2 Reduction of Jerk

Reduction of jerk in robot, due to impact of leg while operation by utilization of spiral spring at the end of the rocker[1]. Actuators are driven by time chain controlled by integrated circuitry and microprocessors. Actuation is also use for jerk and vibration elimination by providing a ramp starts and ramp stop using a high torque stepper motor[3]. Dynamic controls of vivid gaits are produced by advanced electrical circuitry. Better stability is achieved by increasing the number of appendages and providing a singular plane thickness (avoid tipping) [13].

3.3 Methods to Navigate the Robot

Use of fault detection and diagnosis method (FDD Method) fault tolerant gait for adaptive locomotion. FDD method deals with failure of mechanism at uneven terrains and helps the robot to map the terrain and choose a particular gait[5]. Advancement in field of legged robot using sensors and actuators[10] and wireless transmission for navigation without risk of life by isolating the operator from the machine[11]. Whiskers as a sensory detector for navigating the terrain. Utilization of sensors introduces closed loop system for detection of obstacles and optimizing the gait required to navigate. Use of advance algorithm of probes to sense and trace ground irregularities and select a gait which is suitable to traverse the ground[14]. The algorithm can produce bilaterally symmetric design which shows more promise on irregular surface[15]. Use of Mobile Phones to Control the robot and computer software to formulate and execute the gait information[16]. Passive dynamic walking is one of the techniques used to overcome navigation in biped walking.

4. Methods used for Estimating Various Parameters

4.1 To obtain the desired foot profile the method utilized are

1. Two gear method (Bermester curves)

Initially, the desired profile is constructed, and then the alignment and orientation of the kinematic linkage is fixed on the basis of the profile required using 2-Gear system. Fig1shows computer generated profile using 2-gear method. In this system, the center of the gear and the crank are connect and a link is produced, the end point of the larger link which traces the profile is made to follow the curve and the gear position are varied accordingly. The new position of the gear is provided a third link (centre to centre distance of gear) which dictates the motion of the first two linkages. Based on the profile this procedure is repeated for every new position of the gear obtained.

2. Iterative method (Trial and error)

This method is generally used to obtain a desired profile. The length of the links, no of the linkages, the angle and orientation,

thickness and the spacing between the links are few of the lot of variables to be considered. Fig 2 gives the iterative method using CAD software. A set of variable are predetermined and the remaining parameter are calculated by a simple technique till the profile is obtained. This method hold good if the set variables are carefully determined else can result in countless hours of work which is not advisable.

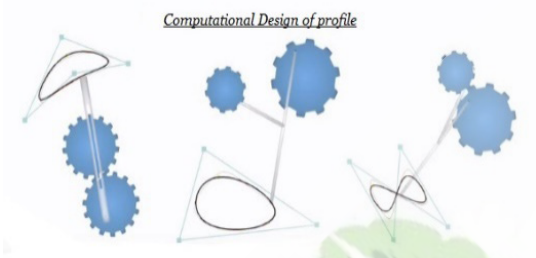

Figure 1. Computer generated profile using 2-gear method.

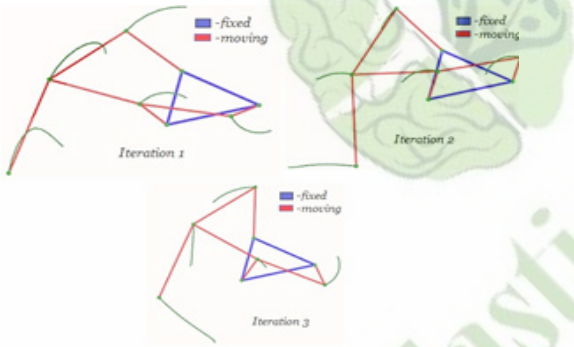

Figure 2. Iterative method using CAD software.

3. Forward and inverse kinematics method

Forward and inverse kinematics both involves using kinematic equations in order to determine the foot position of the robot and to find the joint of the leg. In forward kinematics, the joint positions, or angles of each joint, are known and the end effectors position can be calculated. Conversely, in inverse kinematics, the foot position is known and the related joint positions can be derived. Modeling the motion and positioning of a two link leg model is essential for the dynamics analysis of the robot as well as the gait animations. The two link leg models represent the position of the foot and are the joint angles of the hip and the knee, correspondingly, and denote the dimensions of the thigh and shank, respectively.

4.2 Method used to calculate dimension in linked mechanism are

1) Geometric ratios:

In this method, the length ratio of each corresponding link is calculated based on its point of rotation (ICR). By understanding the motion of one link with respect to another, its angular orientation can be noted with each position of the link. The dimensions of the links are deduced based on size of the entire body and the weight carrying capacity.

2) Iterative method (Trial and error):

In this method, a length of a particular link is predetermined and based on its other links are calculated. This method hold good if the set parameters are carefully determined.

4.3 Methods utilized to obtain various gaits

1) Time Chain:

By providing time chain to the crank, the angular position of the crank with respect to other crank can be set. By providing appropriate angular lag in between the cranks (Crank number is based on the number of the motors used), specific gaits of the foot can be obtained.

2) Arrangement of motors:

In case of motorized robot, by arranging the motors which perform a specific function that is either to move clockwise or anti-clockwise, a particular gait can be obtained. Illustrative: For a Quadra-pod, if each leg is controlled by a stepper motor then the motors with clockwise and counter-clockwise can be arranged such that the front left leg moves initially followed by the hind right leg then the front right leg moves followed with left hind leg. Such movement of leg is called a "walk". Similarly, different arrangement can provide different possible gaits.

3) Complex algorithm:

This is one of the advanced methods used till date. It utilizes programming the gait by carefully calculating the angular positioning of the leg with respect to crank or the pivot joint. Based on the type of system used to actuate the rocker (leg), a program is produce and fed to a microcontroller which governors the gait of the robot. Use of codes divides the operation of providing input to the system, analyzing it and generating the gait among the accessory devices. This eliminates overloading and permits smooth individual functioning of each component irrespective of the other. Algorithms also provide immediate response of the robot if the new obstacles arise. This degree of flexibility for gait optimization with every changing obstacle is high compared to any other form of gait generating method.

5. Analysis Techniques used

5.1 Force Analysis

First, mechanical analysis of a single leg was conducted before the quadruped robot was analyzed as a whole. Since all four legs are identical, the forces and torques present in one leg are similar in

the other three legs. With the analysis for a single leg completed, mechanical analysis for the whole robot model was conducted. For each analysis, a FBD was drawn for the rigid body as a whole and its individual components were studied as shown in Fig 3.

Once the mechanical analysis of one leg can be determined, analysis of an assembly is conducted. From the modeling results of the single leg, the torques calculation in each hinge are made in terms of reaction forces applied at the tip and the kinematic variable of the legs and the known physical properties of the legs.

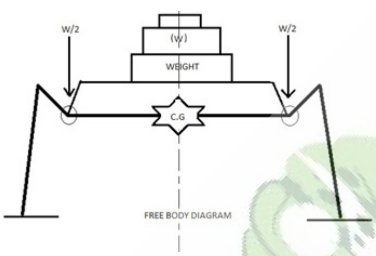

Figure 3. Free Body Diagram of skeleton of legged robot.

5.2 Instantaneous Centre of Rotation (ICR's) for Dimensional Analysis

The instantaneous center method of analyzing the motion in a mechanism is based upon the concept that any displacement of a body having motion in one plane, can be considered as a pure rotational motion of a rigid link as whole about some center, known as instantaneous center or virtual center of motion. The number of instantaneous centers in a considered kinematic chain is equal to number of combinations of two links:

$$N = \frac{n\,(n-1)}{2}, \quad n = Number\ \ of\ \ links$$

The Kennedy's Theorem states that if three bodies move relatively to each other, they have three instantaneous centers that lie on a straight line. When the two links are connected by a pin joint, the instantaneous center lies on the center of the pin.

Procedure to obtain center of rotation:

1. Determine the number of instantaneous centers.

Table 1. Comparison of various driving components

Parameter	Mechanisms	Actuators and Sensors	Stepper Motors	Combinations
A) Motions	Restricted due to Joints and fix points. [1,4,6,11,12,19]	Smooth due to simple structure. [1,16,18]	Accurate since the step is predetermined. [5,16]	Sooth and accurate.[1,19,20]
B) Degree of Freedom	Depend upon the structure and the number of joints, number of linkages and the plane of motion. [6,8,12]	Depends on the placement of the elements. Number of components may affect the degree of freedom. [3,16]	Depends on the placement as well as the constrained provided. [2,16]	Varies according to use of number of components. Depends on the placements of elements as required. [1,9,20]
C) Stability	Depends upon the structure and placement of mechanism. [4,11,19,20]	Number of joints affects the stability of actuator system. [2,16,18]	More the number of motors, better the stability. [5,18]	It has all the advantages in case of stability. [1,14,20]
D) Number of Inputs	Generally one. To increase the number of inputs the modifications made. [6]	Depend upon the motions required and the expected outcomes. [3,16]	Depend upon the motion of individual motors and the expected outcomes from systems. [5,12,16]	This system can have number of inputs controlled through one control centre.[3,14]
E) Gaits	Limited gaits can be obtained. [6,9,11,12,18]	More compared to mechanism systems. [15,18]	Various complex gaits can be obtained. [4,5,8,16]	Number of components affects the gait to be obtained. [8,9,11,15]
F) Sensitivity	Less sensitive to inputs. [6,19]	More sensible than mechanical components. [2,7,8,13,16]	Motors are more sensitive to inputs. [11-14]	Better sensitivity. [7,11,14,16]
G) Load Capacity	Generally, the load carrying capacity is less. [2]	Has better load carrying capacity since the losses are less. [15]	More load as compared. [11]	Better load carrying capacity. [14,15]
H) Force Transmission	Good force transmission. [9,12]	Better force transmission. [6,15]	Comparatively good force transmission. [14,12]	Most efficient force transmission. [15,18,20]
I) Efficiency	Depend upon the condition and number of components in system. [18,20]	More efficient in all aspects compared to mechanism systems. [4,16]	Efficiency depends upon the number of control points. [15,16]	It is most efficient system used in robotics. [14,15,18,20]

2. Locate the fixed and permanent centers by inspection.
3. Locate the remaining neither fixed nor permanent centers by Kennedy's theorem(this is done by circle diagram)
4. On the circle diagram, join the points by solid lines to show that these centers are already found

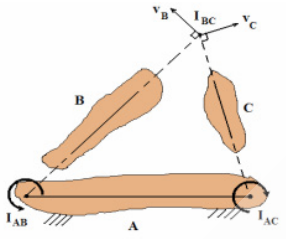

Figure 4. Instantaneous centre of rotation.

To find the other instantaneous centers, join the two corresponding points. The line joining them forms two adjacent triangles in the circle diagram. Instantaneous centre of rotation is shown in Fig 4.

5.3 Vibration Analysis

Most of the vibration arises when the rocker makes ground contact causing the impact to be transmitted through the body.

Formulating the characteristic equation of mechanism by carefully studying the motion, its displacement Y and Z and the relative relation between them,

$$m\ddot{x} + c\dot{x} + kx = c\dot{y} + ky$$

$$\ddot{x} + 2\zeta\omega_n\dot{x} + \omega_n^2 x = 2\zeta\omega_n\dot{y} + \omega_n^2 y$$

$$x(t) = Re[z(t)]y(t) = Y\cos(\omega t)w = Y\,Re(e^{-i\omega t})$$

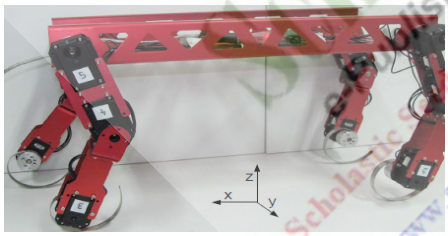

Figure 5. Dynarobin - a compliant quadruped robot design[1].

$$\ddot{z} + 2\zeta\omega_n\dot{z} + \omega_n^2 z = 2\zeta\omega_n\left(\frac{d(Ye^{-i\omega t})}{dt}\right) + \omega_n^2 Ye^{-i\omega t}$$

$$z(t) = Ze^{-i\omega t}$$

$$Z = \frac{\omega_n^2 + 2\zeta\omega\omega_n i}{-\omega^2 + \omega_n^2 + 2\zeta\omega\omega_n i}; \qquad Y = \frac{1 + 2\zeta ri}{1 - r^2 + 2\zeta ri}$$

$$|H(\omega)| = \left|\frac{Z}{Y}\right| = \sqrt{\frac{1 + (2\zeta r)^2}{(1 - r^2)^2 + (2\zeta r)^2}}$$

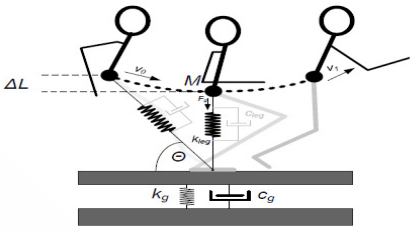

Figure 6. The SLIP model behavior[1].

Here, $H(\omega)$ represents the "Displacement Transmissibility" which tells how motion is transmitted from the base to the mass at various driving frequencies

By calculation of magnitude of base excitation appropriate damping system can be used such as Dynarobin, which utilize a spiral spring to reduce vibration during ground contact Fig 5.

6. Conclusion

This paper gives a brief idea about the various parameter involved in the designing of legged robot. Different techniques involved in analyzing the foot profile are studied and methods to obtain optimum gaits are derived. The paper reflects comparison between various components used as the driving mechanism of robot as shown in Table 1 and specifies best possible alternative for the same. Analysis techniques like force analysis, I.C.R, vibration analysis are few of the core methods for analysis of the legged robot. This paper highlights methods which are man the future

7. Future Scope

We hope that this paper provides basic clarification for future aspirants who aim at building a robot on small scale. By utilizing this knowledge with realization of these few amongst the many methods available, one can aim to create a prototype without being under the false impression of choosing a wrong methodology to make a legged robot, also a simple comparison between various driving source is provided to provoke the understanding of cost, time, energy, efficiency and reliability of various component while making a robot. Above mention techniques of analysis can help in creating a simple robot.

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Micro Variables Identification for SUPPLY Chain Management Practices in Context of Flexible System in Indian Gas Industry

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Abstract

Present paper recognizes a set of micro variables for the Supply Chain Management (SCM) practices in context of flexible system (FS) practices and groups them into different categories for gas industry in India. Grounded on a detailed literature analysis, twenty-four micro variables were recognized and a structured questionnaire was created and distributed to middle level managers to senior level managers from various sectors of Indian gas industry. In total 309 valid replies were obtained on a five point Likert scale ranging from unimportant to most vital. Statistical analysis was used to create the reliability and validity of the questionnaire. Factor analysis identified five factors of SCM practices in context of FS Practices. Further, descriptive statistics was used to find their importance in Indian gas context. Present work would help practitioners and Indian gas managers for understanding the importance of these variables and their role in SCM practices in relations of FS practices.

Keywords: Flexible System Practices, Indian Oil and Gas Industries, Supply Chain Management (SCM), Total quality Management (TQM)

1. Introduction

The three segments in gas sector are upstream segment, midstream segment and downstream segment. Among these the upstream segment primarily includes companies that are involved in production activities and exploration. The midstream segment comprises of companies in storage and transportation, and the downstream segment includes of players that are involved in petroleum products refinement, processing and marketing. This would reflect into growing energy needs India many times in future. In a supply chain, upstream suppliers and downstream distributors are linked to serve its customers. For profits maximization, the firm must maximize benefits and minimize costs along the supply-chain. The concept of SCM issues and its relationship with in information technology has been studied (Shahrzad, et al., 2013)7.

The flexibility to adapt to changing market needs and develop Innovative products in current competitive environment is vital for success (Nigel and Slack, 2005)1. Flexibility of an organization and its capability to reply to new consumer's needs governs the competitiveness of it in the market. Organizations re-organized to work efficiently to generate a diverse portfolio of services or products in spite of large quantities of a limited product portfolio.

2. Literature Survey

Today flexible system means a system to produce reasonably valued customized products of high quality that can be quickly sent to customers. Some authors define flexibility as "ability of the manufacturing system to cope with the alterations effectively" (Buzacott and Gupta, 1989)2. According to him, "Manufacturing systems that are flexible can utilize the flexibility as an adaptive response to unpredictable conditions." The study conducted by (Buzacott and Mandelbaum, 1990)8 considered flexibility as mandatory in a "process or system so that it is able to respond adjustment in the system's environment or a conversion in the decision maker's opinion of reality".

3. Flexible System

According to Saxena and Wadhwa (2009)5, as complexity and competition have increased, flexibility-based SCM has appeared as an increasingly important issue for companies. Rao and Wadhwa (2000)6 have stressed on design flexibility and manufacturing flexibility and advocated that product flexibility could often be more efficiently derived as design. Zhang et al., (2003) proposed another framework for the flexibilities. According to

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Saxena and Wadhwa (2009), as complexity and competition have increased, flexibility-based SCM has developed as an increasingly vital issue for companies. They have included some other flexibility which is related to human being also. The seven components in a flexible system is proposed by Prakash (2011)9 are volume flexibility, manufacturing flexibility, labour flexibility, material handling flexibility, machine flexibility, routing flexibility, and mix flexibility. Their studies are related to the competence and customer satisfaction by analysing the relationships among the different flexibilities.

4. Flexible Approach

The framework for flexibility, which was introduced by Nilsson and Nordah, (1995) shows the notions of, output flexibility, which is found in the relationship between the company and its customers, and input flexibility, which is found in the relationship between the company and its suppliers. Flexibility in manufacturing organization means the "ability to cope with changes and variations in market place.

Enterprise flexibility means producing choices at many stages in the enterprise, evolving ways and means of change across the variety of choices, and providing freedom of choice at various actors in the enterprise to create this change happen with least efforts and time (Sushil, 2000)10. This flexibility in the production processes has become very crucial for an organization to remain competitive and profitable.

5. SCM

Supply chain networks as the network which provides a specific product or product group following the chain discussed by (Hertz, 2001) from raw material to the final consumer. A quality-SCM framework proposed by Robinson (2004) that can be used to place prior work in outlook, as well as identify three specific opportunities for future SCQM research. The concept SCM identified by Min and Mentzer (2004)12 as including agreed goals and vision, information sharing, risk and award sharing, cooperation, process integration, long-term relationship and agreed supply chain leadership.

6. SCM Program

SCM is a concept that is gaining in popularity and importance by (Dag, D. and Stevenson, 2010) brings some clarification to the thought of SCM by discovering some of the more prevalent SCM definitions, frameworks. The management of the supply chain and the roles of various actors involved differ from industry to industry and company to company by (Rajendra et al., 2011)14 present's main activities of supply chain and the step-by-step approach for understanding a complete picture of supply chain.

7. SCM Practices

The contest for firms today is to take a SCM initiative and apply it effectively as the future shall see a competition among supply chains. Gunasekaran, et al. (2001) explored that SCM needs to be assessed for its performance in order to evolve an efficient and effective supply chain.Suhong (2005) develops, conceptualizes and validates six dimensions of SCM practices (customer relationship, quality, strategic supplier partnership, internal lean practices, information sharing, information and postponement). They need to emphasis on SCM practices that have impact on improving SCM activities and eventually performances (Arawati, 2011).

8. Gas Sector: An Overview

Gas as organizations is part of an industry in which effective customers relations are mostly incremental and focus on process up-gradation. Damiebi et al. (2010) did an empirical study and recognized that some critical success factors in mega production projects can be applied to deep-water gas projects. Mehdi Sheikh (2012)22 identified the key success factors of the upstream area of gas industry due to global attentions to limited natural resources and significance of efficiency in the gas value chain. Wan Mahmood et.al. (2009)21 integrates the overall business strategy in upstream operations that contain of work management, performance management and asset management.

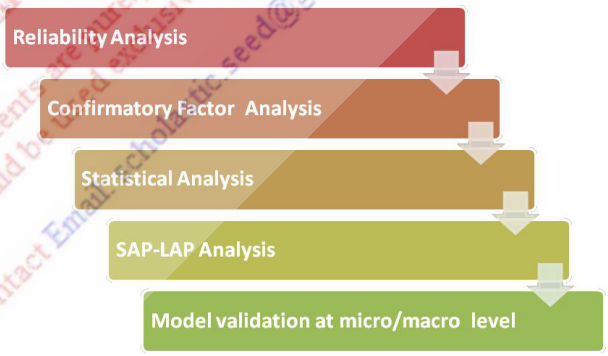

Figure 1. Methodology for analysis at micro level.

9. Methodology for the Micro Study

The micro study variables were considered on the basis of primary data and interview of the concerned person in the selected industry. The quantitative and qualitative data have been collected through questionnaire, interview and observation techniques. Literature review and industry expert's opinions helped to form

connection among variables and managed the conceptual framework to be tested through qualitative as well as quantitative methods. For testing the proposed framework, a questionnaire survey and a statistical tool (Refer Figure 1) were used. Synthesis of both research methods led to validating the conceptual framework and results in learning/ discussion.

10. Reliability Analysis

Reliability is concerned with the ability of an instrument to measure consistently. In order to calculate reliability, calculating alpha is a good practice in education research once multiple-item measures of a concept or construct are employed.

An alpha value of 0.7 or more specifies a reliable measurement instrument for data that are used for fundamental research. It should be noted that the reliability of a tool is closely related with its validity. An instrument cannot be valid unless it is reliable. However, the reliability of a tool does not depend on its validity (Nullay, 1994).

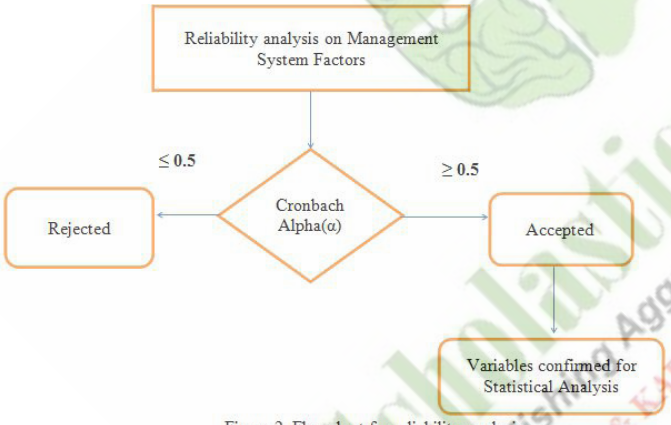

Figure 2: Flowchart for reliability analysis

It is likely to objectively measure the reliability of an instrument and in this study we describe the meaning of Cronbach's Alpha, the most widely used objective measure of reliability. Internal consistency describes the amount to which all the items in a test measure the same concept or construct and hence it is related to the inter-relatedness of the items within the test.

11. Confirmatory Factor Analysis (CFA)

Factor analysis addresses the problem of interrelationships between a big numbers of variables, and explains these variables in terms of their common underlying dimensions (Zhang et al., 2000). Scales were considered to have face validity (Neuman, 2003), and they do measure the key practices of management system activities performed within the research context. According to Hair et al. (2005), factor loadings more than 0.30 are measured as important; loadings of 0.40 are considered as more important, while loadings which are more than 0.50 are very significant. As such, a factor loading of 0.50 was used as the cutoff point (Hair et al., 2005).

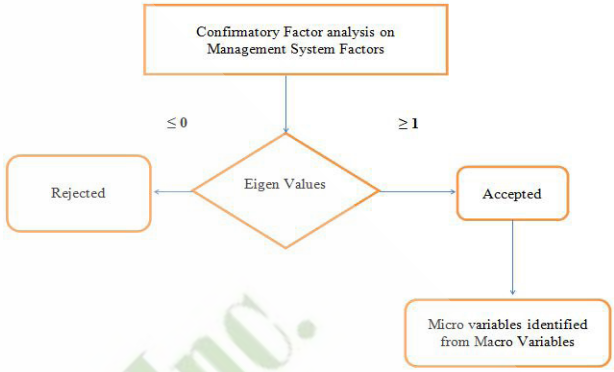

Figure 3: Flowchart for confirmatory factor analysis

Factor analysis is used to calculate construct validity. The main purpose of factor analysis is to recapitulate or condense the information into a smaller set of new composite dimensions (factors) without losing majority of information (Hair et al., 2005).

12. Statistical Analysis on Data

Statistics analysis on data is the study of to collect, organize, analyze, and interpret numerical information from data. It involves descriptive statistics comprising of several methods of organizing, picturing and summarizing information from data.

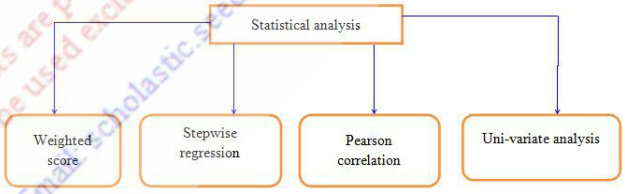

Figure 4: Steps in the statistical analysis

The questionnaires were sent to different levels of respondents in various departments of oil and gas industry. The data collected was scrutinized and incomplete questionnaires were discarded. The data was then entered in Microsoft Office (MS Excel) for tabulation with the help of computer software "Statistical Package for Social Sciences (SPSS-16) for testing of the collected data.

13. Result and Discussion

Reliability analysis is concerned with the capability of an instrument to measure consistently (Tavakol et. al., 2008). Hence

reliability tests were conducted for the instrument, a low value of alpha could be due to a low number of questions, poor inter-relatedness between items or heterogeneous constructs (Mohsen, 2011).

In the present reliability analysis, 340 filled in questionnaires were received from the industries out of which 31 were incomplete. Finally, 309 filled questionnaires were selected for analysis. It means that the response rate was 61.8 per cent, which is considered to be good in Indian context where industry institute linkages are not so strong. The questionnaire consist of 9 distinct parts for which reliability check was necessary. Internal consistency of the data was measured using reliability measurement. Cronbach's Alpha measures how well a set of key performance indicators (or variables) measures a single one-dimensional latent construct. It is a coefficient of reliability (or consistency). If the value of alpha is high, and then there is proof that the items are measuring the same underlying construct which means that they have reasonably good reliability. The values of Cronbach's Alpha obtained are given in Table 1.

Table 1. Cronbach-alpha (α) values

S. No.	Questionnaire	Cronbach Alpha (α)
1	a1.1-a1.6	Not Applicable
2	a2.1-a2.2	Not Applicable
3	a3.1a3.6	Not Applicable
4	b1.1-b1.10	0.67
5	b2.1-b2.8	0.822
6	b3.1-b3.6	0.812
7	c1.1-c1.10	0.831
8	c2.1-c2.11	0.759
9	c3.1-c3.6	0.725

Table 2. Rotated component matrix factor loadings

ITEMS	Factor 1: TQM Practices	Factor 2: FS Practices	Factor 3: SCM Program	Factor 4: SCM Practices
TQMTPM	0.826			
TQMTMW	0.890			
TQMEPE	0.622			
FSPIDT		0.668		
FSPSOP		0.840		
FSPFLX		0.774		
SCMECR			0.865	
SCMBDT			0.752	
SCMCBA			0.744	
CUSTRLP				0.815
STATRLP				0.855

Note: i. Extraction method: principal component analysis
ii. Rotation Method: Varimax with Kaiser Normalization

A portion of the questionnaire was related to demographic nature of the respondents hence reliability coefficient calculation was not applicable to it. The reliability coefficients of the TQM program, principles and practices was found (α =0.67, 0.812 and 0.822) to be significant. The reliability coefficients of the variables of FS program, principles and practices was found (α =0.831, 0.759 and 0.725) to be significant. Also the reliability coefficients of the variables of SCM program, principles and practices was also found (α =0.873, 0.795 and 0.849) to be significant.

Table 3. Summary of confirmatory factor analysis for macro variable

Macro variable	Micro variables confirmed by factor analysis	Excluded variables in factor analysis	Cumulative (per cent) of the variance
FS Practices	Interdepartmental task Forces Standard operating Procedures Flexible approach toward product, routing, volume and process	----------	51.99
SCM Program	Effective customer Relations Building trust Co management base activities	----------	42.72
SCM Practices	Customer relationship Strategic relationship	----------	66.39

14. Concluding Remarks

This paper explains the design of the questionnaire, its validation and testing. A questionnaire is defined as a set of questions developed to advance the required information necessary for testing the formulated hypotheses. The research objectives and hypotheses were translated into specific research questions. The reliability analysis was done to find the Cronbach's alpha and the values come within the acceptable range (0.5) are considered for further analysis. Then the CFA was done to reduce the data in groups which are known as micro variables. The varimax rotation was carried out at macro and micro level and the values which are having Eigen values more than 1 are considered as the micro variables of the study. The univarite analysis helps to link the relationship among the macro and micro variables in terms of mean.

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Thermal Barrier Coating on IC Engine Piston to Improve Engine Efficiency

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Abstract

The piston is considered as most important part of I.C engine. High temperature produced in an I.C engine may contribute to high thermal stresses. Without appropriate heat transfer mechanism, the piston crown would operate ineffectively which reduce life cycle of piston and hence mechanical efficiency of engine. The literature survey shows that ideal piston consumes heat produced by burnt gases resulting in decrease of Engine overall Efficiency. In this project work an attempt is made to redesign piston crown using TBC on piston surface and to study its Performance. A 150 cc engine is considered and TBC material with different thickness is coated on the piston. 3D modeling of the piston geometry is done 3D designing software Solidworks2015. Finite Element analysis is used to calculate temperature and heat flux distribution on piston crown. The result shows TBC as a coating on piston crown surface reduces the heat transfer rate within the piston and that will results in increase of engine efficiency. Results also show that temperature and heat flux decreases with increase in coating thickness of YSZ.

Keywords: Finite Element Analysis, Piston crown, TBC, YSZ

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1. Introduction

An Internal Combustion Engine is that kind of prime mover that converts chemical energy to mechanical energy. In I.C Engine, engine can be called the heart of a vehicle and the piston may be considered the most important part of an engine. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod. Piston in an IC engine must possess the Strength to resist gas pressure, Must have minimum weight, Must be able to reciprocate with minimum noise, Must have sufficient bearing area to prevent wear, Must seal the gas from top and oil from the bottom, Must disperse the heat generated during combustion, Must have good resistance to distortion under heavy forces and heavy temperature.

2. Piston Terminology

1. Crown: It is top surface of piston which is subjected to tremendous force and heat during normal engine operation.
2. Piston ring: It is part on piston having ring shape which seals the gap between piston and cylinder wall.

3. Skirt: It is portion of piston closest to crankshaft that helps align the piston as it move in cylinder block.
4. Wrist pin boss: It is bore that connects the small end of connecting rod to piston by a wrist pin.
5. Total length of piston: Total length of piston is the length from piston crown to bottom of piston. It is sum of Top land length, length of Ring section and skirt length.
6. Ring land: It is reliefs cut into the side profile of piston where piston ring sit
7. Ring Groove: An area located around the perimeter of the piston that is used to retain the piston ring.
8. Top land: The portion from piston crown to top ring land is called top land.

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3. Selection of IC Engine

Different two wheeler IC engine pistons are studied for its performance and Durability. In this project work two wheeler 150cc Honda Unicorn Engine is considered.

Engine type = air cooled 4-stroke

Bore × Stroke (mm) = 57×58.6

Displacement = 149.5CC
Maximum Power = 13.8bhp at 8500rpm

Maximum Torque = 13.4Nm at 6000rpm
Compression Ratio = 9.35/1

Mechanical Efficiency = 80%

4. Piston Geometry Design

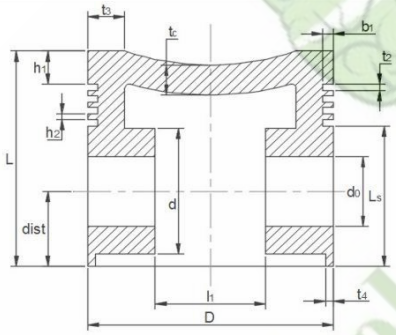

Figure 1. Piston terminology.

Figure 2. Detail view of cross sectional piston.

Mechanical Efficiency, η = B.PI.P
B.P = 2πNT = 2 × ×6000 ×13.4 = 8.420 KW 60 60
I.P = 8.420 = 10.52 KW
0.8
I.P = P × A × L × N_2
10.52 × 103 = P × 4 (0.057)2 × 0.0586 × 26000×60 P = 14.06 × 10^5 N/m^2
Max pressure = 10 × P
10 × 14.06 × 10^5
14.06 MPa
Assuming piston material as Aluminum Alloy Steel = (100 to 160) N/mm^2 Take, σ_t = 160 N/mm^2

1) According to Grashoff's formula
Thickness of piston head
<equaiton not proper in MS word>

2) Design of piston ring
Radial thickness of piston ring,
<equaiton not proper in MS word>
cylinder wall, σ_p = Permissible tensile strength Assume, P_w = 0.025 MPa
σ_p = 110 N/mm^2
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Take, t_1 = 2 mm
Axial Thickness
t_2 = (0.7 to 1)t_1
Take, t_2 = 0.8 t_1 = 1.6 mm

3) No of piston rings
D t2 = 10 ×n
57
1.6 = 10 ×n n = 3.56
Take n = 4

4) Width of top land
h_1 = (1 to 1.2) t_c = 1.1 t_c = 8.04 mm

5) Width of ring land
h_2 = (0.75 to 1) t2
0.8 t2 = 1.28 mm

6) Radial depth of piston ring groove
b1 = 0.4 + t_1 = 2.4 mm

7) Maximum thickness of piston barrel at top end
t_3 = 0.03D + b + 4.5
= 8.61 mm

8) Thickness of piston barrel at open end
t_4 = (0.25 to 0.35) t_1
=0.25 t_1 = 1.827 mm

9) Piston pin dia.
d_i = 0.03D= 17.1 mm

10) Outer diameter of piston pin
F = Pb × d0 × *l*1
Where, Pb = bearing pressure in bush at small end of connecting rod
Assume, Pb = 30Mpa *l*1 = (2 to 2.5) d0 Take, *l*1 = 2.5 d0
F = Pb × d0 × 2.5d0
do = √2.5 F×Pb = 21.87 mm

11) Diameter of piston boss
d = 1.4 × do = 30.62 mm

12) Length of piston pin in the connecting rod bushing l1 = 45% of the piston diameter = 25.65 mm

13) Length of skirt

L_s = (0.6 to 1.1) D

= 0.6 × 57= 34.2 mm

The center of the piston pin should be 0.02 D to 0.04D above the centre of the skirt.

14) Total length of piston

L = Top land + ring section + skirt length

h1 + 4t2 + 3h2 + Ls

8.04 + 4 × 1.6 + 3 × 1.28 + 34.2

52.48 mm

5. Modeling of Piston

From all the geometries calculated for piston Design are modeled using Solidwork 2015.Designing and modeling of flywheel is done using SOLIDWORKS 2015. Solidworks is a solid modeler that makes use of parametric feature-based approach for creating models and assemblies. The following figures show the present as well as re-designed geometries of flywheel.

Figure 3. 3D model of piston without and with TBC Coating.

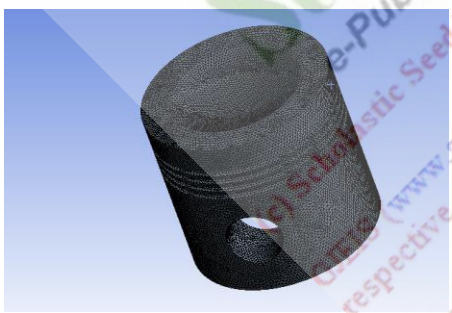

Figure 4. Meshing of IC Engine Piston.

6. Coating Material Selection

Thermal Barrier Coatings are used to provide a barrier to the flow of heat. Thermal Barrier Coatings (TBC) performs the important function of insulating components such as gas turbine and aero engine parts operating at elevated temperatures. Different TBC materials are short listed and best one is selected using weighted residual method. In Yittria Stabilized Zirconia (YSZ) is stands at the tops in terms of Low thermal conductivity and High Young's Modulus.

The thickness coating on piston crown increases from 0.2 mm to 0.6mm to study nature of study at different coats.

Table 1. Material properties of TBC

Materials	Thermal conductivity (W/m k)	Modulus of Elasticity (GPa)	Coefficient of Thermal Expansion (1/k)	Melting Temperature (k)
Zirconates	2.17	21	15.3×10^{-6}	2973
Yittria Stabilized Zirconia	2.12	40	10.7×10^{-6}	2973
Alumina	5.8	30	9.6×10^{-6}	2323

7. Finite Element Analysis

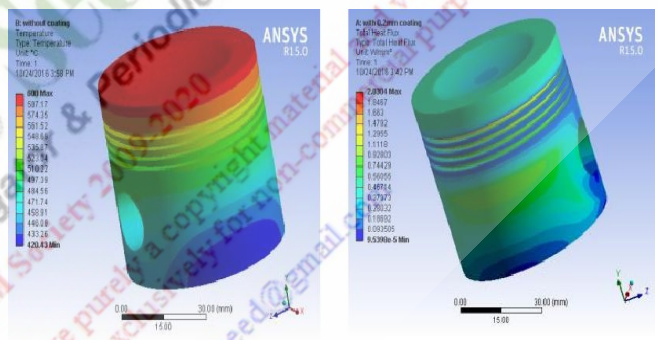

Figure 5. Temperature and heat flux distribution of uncoated piston.

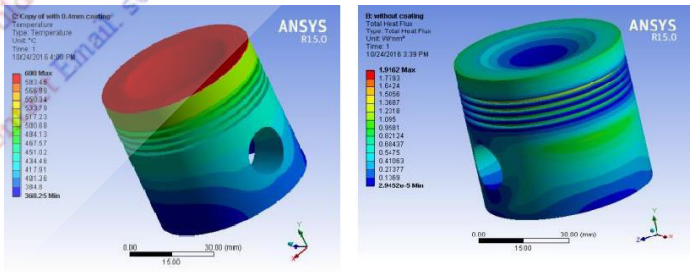

Figure 6. Temperature and heat flux distribution of 0.2 mm coated piston.

8. Results and Conclusion

Amount of heat transfers through piston is calculated by using Finite Element Analysis software. ANSYS 15.0 is a Finite Element Analysis tools used to study the performance of the component.

In this project, focus is study the amount of heat transfer and Temperature variation throughout piston surface. Finite element analysis is done on both uncoated piston and coated piston with different thickness. Define element size as 1mm for meshing of piston. Boundary conditions are Provide 600°C temp on top surface of piston crown and convection along remaining surface with film coefficient of 0.0002w/mm²°C and ambient temperature as 29°C.

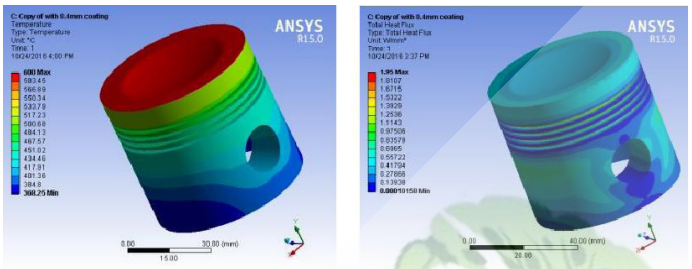

Figure 7. Temperature and heat flux distribution of 0.4 mm coated piston.

Table 2. Temperature and heat flux distribution on piston crown

Piston Geometry	Temperature at top land (°C)	Heat flux at top land (W/mm²)
Uncoated piston	600	0.95
Piston with 0.2mm coating thickness	560	0.74
Piston with 0.4mm Coating thickness	500	0.65
Piston with 0.6mm Coating thickness	473	0.467

Finite Element analysis results on piston crown with uncoated surface subjected to 600 c° and coated piston crown surface subjected to lesser temperature. As the amount of coating increases temperature at the piston crown surfaces decreases. From the result it is concluded that the piston having YSZ coating on piston crown has less temperature and heat flux at top land as compared to uncoated piston resulting in saving in amount of heat which loses through piston. This saved energy increase the overall performance of the engine.

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A Defect Diagnosis in Bearings of a Centrifugal Pump using Vibration Analysis

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Abstract

This paper presents an overview of defect diagnosis in bearings of a centrifugal pump. The data obtained using vibration-based condition monitoring (VCM) technique was recorded at regular intervals. The analysis provided using conventional methods would then be used for pump fault prognosis and trend pump conditions. Having studied the conventional method of analysing results off-line, the research uses a VCM system to predict bearing faults on-line. Several techniques for pattern recognition were considered, including Feed Forward type Neural Network (FF-NN) and Recurrent Neural Networks (RNN). The author decided to adopt the Artificial Neural Network (ANNs) to propose a solution and classify bearing faults. Since bearing faults don't begin to appear before prolonged pump operations, the faults on bearings were simulated using a test-rig pump where an electrical discharge machine (EDM) would generate pit marks on bearings and the vibration signals thus collected be fed into the neural networks. An easy method of designing neural network models is by using the MATLAB Neural Network Toolbox. To carry out the analysis, only MATLAB models that are specifically functional to vibration signals are chosen for pump bearing fault diagnosis.

Keywords: Bearing Fault Analysis, Centrifugal Pump, Fault Classification, Neural Networks, Rotating Equipment, Vibration-based Condition Monitoring

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1. Introduction

Artificial Neural Networks (ANNs) have previously been used to detect and analyze faults in blast furnace cooling water pumping systems in steel works (Ilott et al., 1997)[2]. Their combination with vibration analysis techniques for routine identification of machinery faults have been well documented over the years in several researches. While Ogunfunmi et al. (1993)3 and Gao et al. (1998)1 have used Boltzmann neural networks for the diagnosis in bearing faults, Wang et al. (1998)5 investigated rotating shaft faults using Feed Forward Neural Networks. However, the author through this paper, would like to add to the existing research works in the field of vibration analysis to monitor centrifugal pumps specifically in the waste water industry.

Inspired by Yang's (et al., 2002)8 in-depth diagnosis of motor bearing condition using ANNs, the author initiated a literature review of diagnosis tools in industry and the different approaches used to classify fault patterns in vibration responses of rotating machines. When looking at bearing conditions specifically, several approaches based on signal pre-processing techniques have been investigated by researchers. However, according to the research of Wang et al. (2003)6, power spectrum and bispectrum approaches have been most successful in categorizing almost all of the bearing condition patterns. Apart from using pit marks generated vibration signals as inputs to ANN, prior researches have also used alternative characteristics of vibration signals like Root Mean Square (RMS), Kurtosis and variance (Samanta et al., 2003)4. Such time-domain features can be successfully used to achieve the accurate classification of the faulty condition of an equipment.

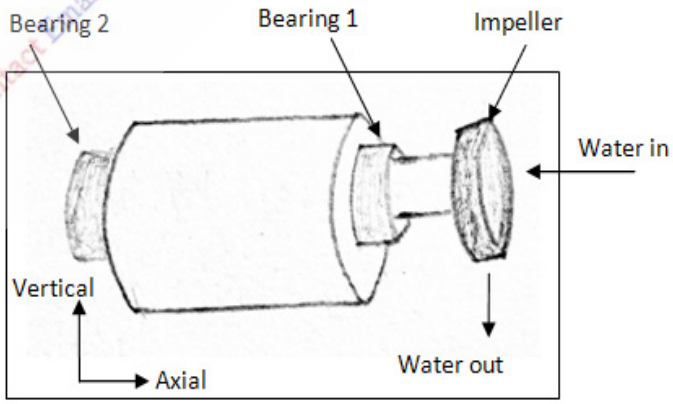

Figure 1. Schematic of Laboratory test-rig pump

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2. Simulation of Defect on a Test-Rig Pump

The author realized that achieving the necessary results of a VCM system for a centrifugal pump at a water pumping station would take a very long time and therefore, a laboratory test-rig was utilized in simulating common pump faults in a horizontal centrifugal water pump. In the process, the pump was run at 360 W and 3000 rev/min.

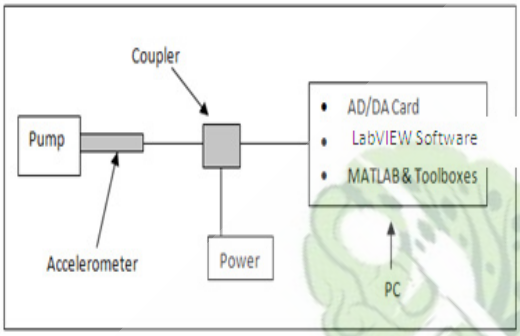

Figure 2. Vibration Sensing and data acquisition system.

As indicated in Figure 2, Kistler miniature accelerometer was used as a vibration sensor. For power supply and amplification, a Kistler single coupler was used. Proceeding with the analysis, three components on the test-rig were monitored, namely both the bearings and the impeller, as shown in Figure 1 and vibration signals were collected in vertical and axial directions.

3. Feature Extraction and Bearing Defect Classification

Feature extraction algorithm is an important presentation technique as it reduces training time and input dimension of the network, thereby improving generalisation capability of the network. The aim of employing feature extraction is to present efficiently the important features of the original data. For the investigation in this paper, time domain vibration signals obtained from the test-rig pump were pre-processed as per the classification criteria of the bearing faults before any of the vibration data was provided as input to the neutral network. This classification can be carried out using both traditional and artificial intelligence methods.

In spite of several literatures being available on ANNs, their haven't been many applications of ANN in defect diagnosis of bearings in waste water pumps. Non-availability of faulty bearings meant that six different artificial bearing faults were to be created on new bearings using EDM technique and vibration signals collected under similar conditions. The six defect setting types had the following features- hole diameter 0.5 mm and depth 0.3 mm. More detailed description is provided in Table 1 below, which includes the MLP target of six category ranges for six bearing fault types set to be compared against simulated outputs.

Table 1. Network Output Categories for Bearing Classification

Pump Bearing Condition Setting	Network Target Output	Category Output Range	Bearing Defects
Setting 1	0	-0.1 – 0.1	One Ball
Setting 2	0.2	0.1 – 0.3	Two Balls
Setting 3	0.4	0.3 – 0.5	Inner Race
Setting 4	0.6	0.5 – 0.7	Outer Race
Setting 5	0.8	0.7 – 0.9	Cage
Setting 6	1.0	0.9 – 1.1	One Ball, Inner & Outer race, cage

4. Targets for MLP Networks

As a result of the above set up, the ANN had 11 frequency domain vector inputs and 1 time domain vector input with one set of data being 24 elements in length (2 × 12). Thus, with six bearings having 10 samples in a 24 element vector each, the total input matrix size was 24 × 10 × 6 = 1440 elements. Figure 3 below shows the ANN input pattern classification of bearing defects. As explained earlier, vibration data collected in both axial and vertical directions from the faulty bearings was to be pre-processed in RMS calculations (Time, Frequency and Band-Frequency Domains) and used as inputs to the networks. Along with time domain RMS values, the RMS values in frequency domain range from 0 to 5kHz and between 0 and 4kHz in ten frequency bands. The distribution of values is slightly irregular for the sake of faulty bearings presenting a significant change in characteristic fault frequencies in creating high resonance harmonics of defect frequencies and side-bands around them. The distribution is as follows- 0 to 100Hz, 100 to 200Hz, 200 to 300Hz, 400 to 1000Hz, 1000 to 1500Hz, 1500 to 2000Hz, 2000 to 2500Hz, 2500 to 3000Hz, 3000 to 3500Hz, 3500 to 4000Hz.

5. Network Training Results

The simulation result for two layer networks tabulated in Figure 4 below indicate that the network displayed results worth 96.7% accuracy at hidden layer having 10 neurons. Furthermore, the

trend line on the graph helps us reassert the 3rd order polynomial function that training time increases with the number of neurons in hidden layer.

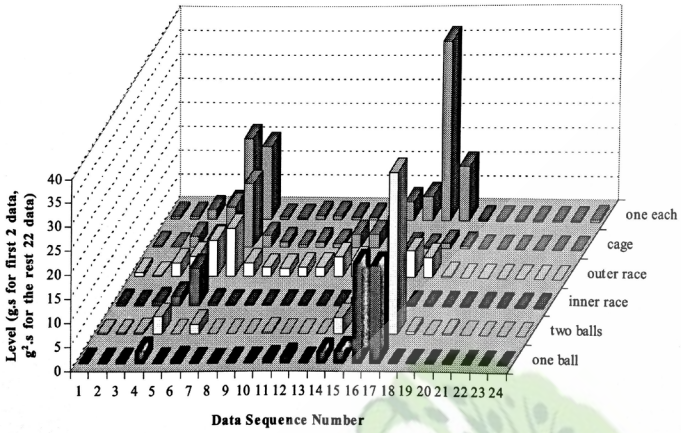

Figure 3. ANN input pattern for Bearing Fault Classification

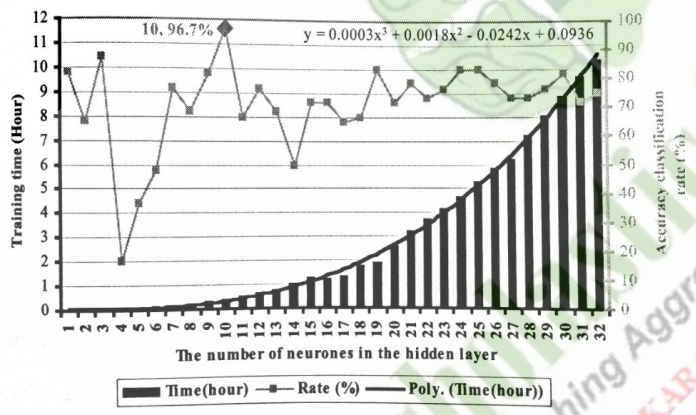

Figure 4. MLP Network Simulation results for Bearing Faults Classification.

It is appropriate to predict that if the neurons in the hidden layer reaches 40 with the existing trend, the training would take 20 hours. Wang et al. (2000)7 used similar investigation model to train neural networks on a similar 2-layer MLP network to achieve a 100% classification rate with the two networks having first and second hidden layer neurons of value 20 & 2 and 30 & 25 respectively.

6. Conclusions

Using ANN in MATLAB toolbox, failure patterns in bearings of a centrifugal pump were classified by investigating their parameters using feature extraction methods. Simulating 6 different bearing faults on a laboratory test rig, the trend line obtained in network training results classified the bearing faults at 96.7% accuracy classification rate. Further literature reviews indicated that a 100% accuracy was achievable if the classification was done using 'cascade-forward back propagation' neural networks at 2 hidden layers. The proposed model of an MLP network construction for pattern recognition is a systematic way of finding the performance networks in a large number of similar models using MATLAB program as per the transfer function.

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Design of Gas Cylinder using Composite Material as per ASME Standards

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Abstract

A gas cylinder or tank is a pressure vessel used to store gases at above atmospheric pressure. Many pressure vessels are made of carbon steels these material results in increase in weight and transportation cost. The Literature survey shows that gas cylinders fails due to corrosion and difficult to transporting. In this Project work, the aim is to design a gas cylinder as per ASME standards using composite material which can be used for our day today life. Solidworks 2015 is used for 3D modelling of the cylinder and Finite Element Analysis is used to test the performance of the cylinder made of composite material and compare with Cylinder made of Steel. The results shows that stress induced in the both cylinder is nearly equal but composite cylinders results in height amount of weight saving and corrosion resistance and also decrease the transportation cost.

Keywords: E Glass Epoxy, Finite Element Analysis, Solidworks

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1. Introduction

1.1 Introduction to Gas Cylinder

A gas cylinder or tank is a pressure vessel used to store gases at above atmospheric pressure. To store and transport any gas from one position to another position without any safety is very hazardous to human life, hence gas cylinders are used for this purpose. Gas cylinder maintains gas at desired pressure without any change due to change in temperature. Gas cylinder not only used to store liquefied petroleum gas which is used for household purpose but also other gases such as Oxygen used in hospital incase of any emergency, to store oxygen and acetylene for welding purpose, to store hydrogen, nitrogen and other gases for any industrial purpose under pressure.

2. Types of Gas Cylinders

There are three types of gas cylinders

1. High Pressure Cylinders – High pressure cylinders come in a variety of sizes. Some examples of gases supplied in High pressure cylinders include Nitrogen, Helium, Hydrogen, Oxygen and Carbon Dioxide.
2. Low Pressure Cylinders – Low pressure cylinders come in a variety of sizes. Some examples of gases supplied in low pressure cylinder are LPG and refrigerant gases.
3. Acetylene Cylinders.

Figure 1. Different sizes of Gas Cylinder.

3. Selection of Gas Cylinder

Different types of gas cylinders are studied based on application for its performance. In this project work, focus is to design gas cylinder for domestic purpose with composite material.

Perimeter = 102cm

Diameter of cylinder = 320mm Length of cylinder = 360mm

Volume of the Gas = 47.8 liters

The pressure acting inside gas cylinder is independent of volume. It is depend on ambient temperature and composition of propane and butane. The LPG inside gas cylinder consists of 70% propane and 30% butane.

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Table 1. Internal Pressure variation with temperatures

Temperature (°C)	Pressure (MPa)
16	0.4688
21	0.5653
27	0.6618
32	0.786

5. Material Selection

Generally gas cylinders are made up of steel material. Any gas cylinder made of metallic materials has a major drawback of severe bursts in worst cases. Due to safety reason now day's gas cylinder made up of composite materials such as Fiber Reinforced Plastic Composites. These Composite pressure vessels are light in weight and high strength. Fiber

Reinforced Plastic gas cylinders doesn't explode due to porosity formation of materials. In this project, E-glass FER is considered as composite material for manufacturing of gas cylinder as compared to Plane carbon Steel.

Table 2. Material Property Table of Gas cylinder

Sr. No.	Properties	E-glass FRP	Plane Carbon Steel
1	Density, Kg/ 3	2100	7800
2	Young Modules in Axial Direction, GPa	45	210
3	Young Modules in Transverse Direction, GPa	12	-
4	Poisons ratio	0.28	0.28
5	Yields Stress, MPa	1020	220.59

6. Parameters and Strength Calculation of Gas Cylinder

Gas Cylinders are designed as per Pressure vessel design of ASME standards. Gas cylinders contains three different types of end shapes i.e. Elliptical, Semi-Elliptical and

7. Plane Carbon SteelGas Cylinder

1. Thickness of cylindrical shell

Assuming Internal Pressure, P = 0.6948 MPa and Radius, r = 160 mm

As per ASME Standard for Pressure vessels made of metals,

<Eq Problem in MS word>

Where, S = Max Allowable Stress

Pressure inside the cylinder is P = Design pressure = 1.05 × Working pressure

Take, Working pressure = 0.6618 MPa = 1.05 × 0.6618

P = 0.6948 MPa

E1 = Joint Efficiency Take, E1 = 0.85

R = Radius of cylinder = 160mm

<Eq Problem in MS word>

2. Thickness of Cylinder head Select hemispherical head

Thickness of head is same as that of cylindrical shell Thickness = 2.39 mm

Length of straight flange = 3t

= 3 × 2.39

= 7.17 mm

Radius of curvature = 160mm

8. E-Glass Epoxy Gas Cylinder

ASME standards are different for Design of Pressel vessel made of Composite materials. Assuming Internal Pressure, P

= 0.6948 MPa and Radius, r = 160 mm

1. Thickness of cylindrical shell made of Minimum thickness of cylindrical shells under internal pressure should be greater of (a) and (b)

(a) Longitudinal Stress

<Eq Problem in MS word>

As grater thickness is 4.798 mm hence thickness of cylindrical shell equal to 4.798 mm.

2. Thickness of Cylinder head

Select hemispherical head

Thickness of head is same as that of cylindrical shell Thickness = 0.5138 mm

Radius of curvature = 160mm

9. Theoretical Strength Calculation of Gas Cylinder

When cylinder is subjected to internal pressure "P",

Stresses and Deformation will be produced in both cylindrical and Head portion of the cylinder. Two types of stresses are induced in the Cylinder i.e. circumferential stress or Hoop Stress and Longitudinal stress.

1. Plane Carbon SteelGas Cylinder

Cylindrical portion

<Eq Problem in MS word>

2. E-Glass EpoxyGas Cylinder

Cylindrical portion

<Eq Problem in MS word>

Hoop Stress

<Eq Problem in MS word>

10. 3D Modeling of Gas Cylinder

Modeling of gas cylinder is done by using Solidworks 2015. Since cylinder made of plan carbon steel and E Glass epoxy has different thickness, two 3D models are created using solid works part modeling feature.

Figure 2. 3D model of gas cylinder.

FEA is carried out by using ANSYS Workbench 15.0 to find equivalent stress, shear stress and total deformation. Assuming Boundary and Loading conditions as follow, Pressure: 0.668MPa,

Frictionless Support,

Automatic meshing with 16792 Elements and No. of nodes 33497

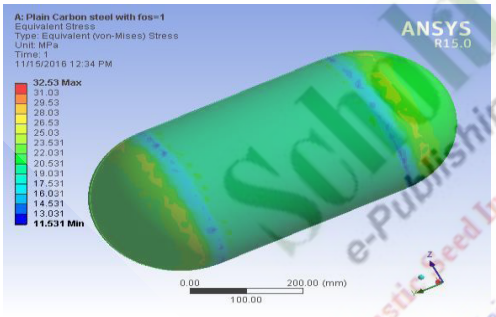

Figure 4. Equivalent stress on steel gas cylinder.

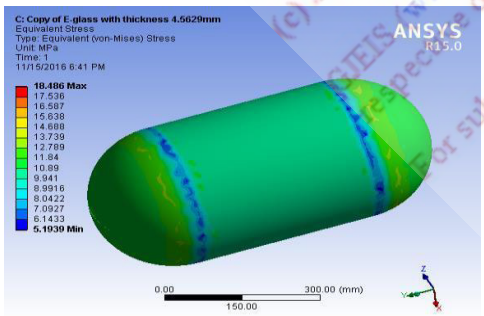

Figure 5. Equivalent stress on E-glass gas cylinder.

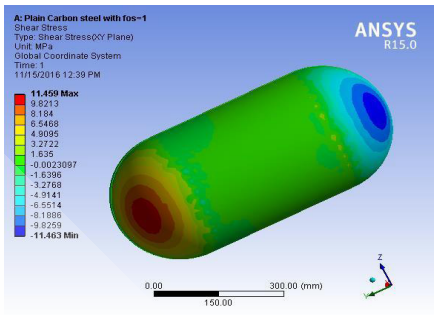

Figure 6. Shear stress distribution of steel gas cylinder.

11. Finite Element Analysis

FEA is carried out by using ANSYS Workbench 15.0 to find equivalent stress, shear stress and total deformation.

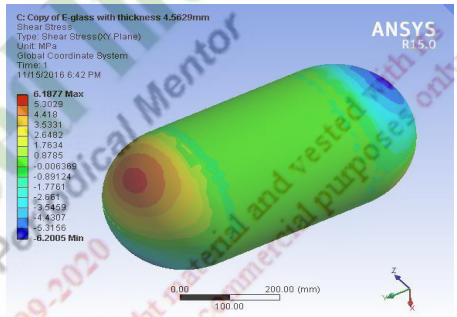

Figure 7. Shear stress distribution of E-glass gas cylinder.

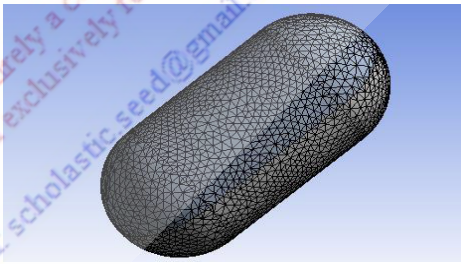

Figure 5. Meshing of gas cylinder.

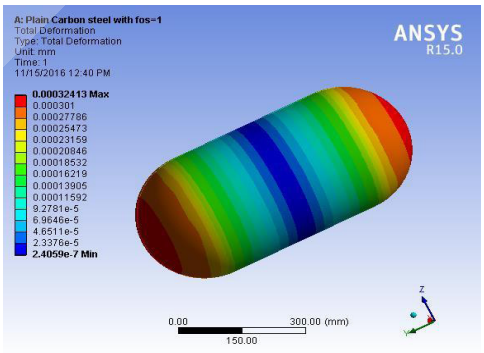

Figure 8. Total deformation of Steel gas cylinder.

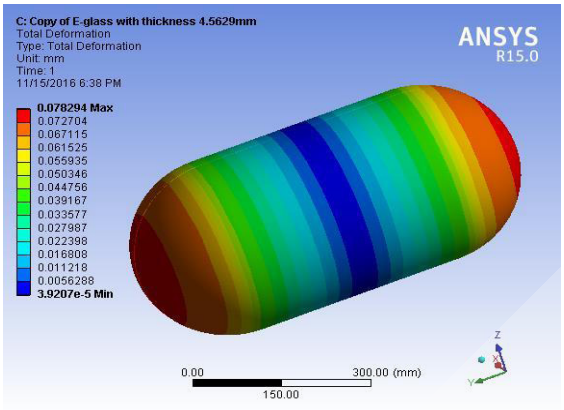

Figure 9. Total deformation of E-glass gas cylinder.

12. Result and Conclusion

Table 3. Theoretical and Analytical comparison

Sr. No	Parameters	Plain Carbon Steel		E-glass Epoxy	
		Theoretical	Analytical	Theoretical	Analytical
1	Equivalent Stress	22.15 MPa	26.53 MPa	11.03 MPa	13.79 MPa
2	Max. Shear Stress	11.07 MPa	11.45 MPa	5.15 MPa	6.187 MPa
3	Max. Deformation	0.0322 mm	0.000324 mm	0.0735 mm	0.0782 mm

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Based on analysis result of LPG cylinder made up of two different materialshave stress and deformation values within the limit. The uses of composite will also results in corrosion resistant and Increase in life of the component. Hence it is conclude that gas cylinder made up of E-glass Epoxy can be used for household purpose.

The weight of LPG gas cylinder can be saved enormously by using E-glass Epoxy composite.

Weight of the Plain Carbon Steel cylinder shell = 13.15 kg Weight of the E-glass Epoxy cylinder shell = 6.6886 kg Weight saving = 6.46 kg

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A Comparative Study of Customer Satisfaction in SBI and ICICI Bank

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Abstract

Banking industry is passing through a challenging phase. The demonetisation policy introduced by the government has affected the banking industry to a great extent. This industry plays a significant role in the economic development of a country but it is facing huge challenges due to increased competition, technological developments, changing customers' needs and policies of government. In this competitive and fast changing era, it becomes imperative for a bank to satisfy the needs of the customers. They need to keep a close eye on the satisfaction level of customers. Satisfying customers is the key to retain them for a longer period. Banks need to frame policies and strategies for satisfying and retaining customers. The cost of making new customers is high than the cost of retaining customers. The banks are spending a lot of time and energy to frame polices about customer satisfaction. The study has been conducted to compare the satisfaction level of customers of SBI (Public Sector Bank) and ICICI (Private Sector Bank). The study will provide information about the differences in satisfaction level of customers of both banks and banking sectors and will be helpful for framing new policies relating to the customers. The study has been conducted on SBI and ICICI bank in Delhi-NCR.

Keywords: Customer, Customer Satisfaction, Overall Customer Satisfaction, Promotional Material, Prices and Procedural Complexities, Service Quality

1. Introduction

Indian banking industry is developing rapidly. Indian government has played a significant role in the development of banking industry. The industry has undergone enormous changes after liberalisation. Many new private sector banks were established and they augmented the competition in banking industry. At the same time new foreign banks entered the industry with new technologies posing a great challenge for the banking industry. The technological advancements have totally changed the banking operations. Now all the banks operate through computers. The banking operations are not limited to branch banking but they also operate through ATM, Mobile Banking, and Internet Banking. ECS debit, ECS credit, stop payment and RTGS have made the banking easy. The banks have enhanced their operations. Now their functions are not limited to accepting deposits and providing loans but they are also providing various types of investment schemes, insurance schemes and other services to customers. Customer care services are a big support for the customers; these services are available 24×7 for the customers. The customers can enquire anytime and get information sitting anywhere from the concerned bank. All banks are offering similar type of products and services which has further increased the competition and made it difficult for the banks to attract new customers. The banks have to provide similar type of services differently to satisfy the existing customers and attract new customers. A satisfied customer remains with the bank for a longer period and gives positive feedback about the bank. The dissatisfied customer gives negative feedback about the bank and harms the goodwill of the bank. Hence it becomes imperative for the banks to keep a close eye on the satisfaction level of customers.

2. Customer Satisfaction

Customer satisfaction is the performance indicator of a business. It is used as a measurement of how well expectations of customers are met by the service provider. A customer is satisfied if his expectations are met and dissatisfied if his expectations are not met by the service provider. Customer satisfaction has been defined differently by different researchers.

Parasuraman (1985)[6] have defined satisfaction as a predictor of service quality.

Gundersen et al (1996)3 have defined satisfaction as a post consumption evaluative judgement regarding a product or service.

Oliver (1980)5 defined satisfaction as a result of comparison between pre purchase expectations and the actual performance during and after consumption.

LIU Huiqun and ZHAO Xin, (2009), Positive disconfirmation gives satisfaction and negative disconfirmation gives

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dissatisfaction better performance than the expected product or service results in satisfaction and worse performance than the expected product or service results in dissatisfaction.

Customer satisfaction in banking sector can be measured by measuring the satisfaction level for various service attributes as well as by measuring overall satisfaction level for the bank. When a customer interacts with the service provider and consumes the service, he develops certain opinion about the service provider that causes him to say how happy or satisfied he is with the service provider. Thus, the overall customer satisfaction is the opinion of a customer about a service provider which he develops after a long interaction process. The measurement of overall satisfaction level describes the opinion about the service provider in one word while the measurement of various attributes describes the reasons of satisfaction or dissatisfaction.

3. Review of Literature

A lot of research work has been done relating to customer satisfaction in banking sector. The researchers have used service quality as a measurement of customer satisfaction.

Parasuraman, Zeithaml and Berry (1985) developed a conceptual model of service quality and defined ten determinants of service quality. These are: tangibles, credibility, reliability, competence, responsiveness, security, access, courtesy, communication and understanding the customer. Later on in 1988 they contracted the list of ten determinants and specified five determinants of service quality such as Reliability, Assurance, Tangibility, Empathy and Responsiveness.

Zeithaml et al (2000)[10] have concluded that customer perception of service quality, the quality of the product, customer's emotional factors, the prices levied by the bank, banking situational factors like convenience all affect the level of customer satisfaction.

Paul Kumar Manoj and Barman Arup (2010)7 conducted a survey to study the customer satisfaction in rural banking and identified twenty one factors of customer satisfaction. These factors were grouped into six classes like work culture, efficiency factor, furnishing and basic amenities provided by the branch to its customers, product variety, accessibility and friendliness, procedural complexities and locational factor. The factor analysis was used to analyse the customer satisfaction level and customers were found dissatisfied with the service quality of bank.

Deribe and Deribe (2013), customer satisfaction can be evaluated on the basis of services provided by the banks. It was found that the customers were satisfied with the services of the bank. The study also revealed the problems encountered by the customers in banking transactions. Network problems, delay in loan approvals, less investment in modern technologies were the major problems encountered by the customers.

Shanka (2012)8 revealed that all service quality dimensions like empathy, responsiveness, assurance, tangibility and reliability are positively correlated with customer satisfaction. Improvement in the service quality leads to better customer satisfaction which in turn leads to customer loyalty and commitment. Empathy is the dominant service quality dimension.

Singh and Arora (2011)9 assessed the extent of customer satisfaction with different parameters of service quality like employee behaviour, accessibility, infrastructure, ambience, awareness of IT enabled services, and working hours. It was concluded that small number of customers are using IT enabled services because of the lack of facility, improper awareness. Customers were having complaints regarding delay in transactions and charges, staff of the nationalised banks need training on stress management and public dealing, infrastructure and ambience of the nationalised banks required improvement and the customers of foreign and private sector banks were not satisfied with high charges, communication and accessibility. They suggested to increase the number of branches in foreign and private banks.

Chavan and Ahmad (2013) revealed nine factors of customer satisfaction in their study i.e. tangibility, convenience and availability, accuracy, e-fulfilment, responsiveness, promptness, empathy and personal assistance.

Mistry (2013)4, conducted a study to measure customer satisfaction in public and private sector banks of Surat city and confirmed that reliability, responsiveness, assurance are the most significant factors affecting satisfaction level of customers. Tangibility and empathy also affect the satisfaction level of customers but to a lower extent.

4. Research Methodology

4.1 Objective

To examine the satisfaction level of customers of SBI (PSB) and ICICI Bank (PVTSB).

To compare the satisfaction level of customers of SBI (PSB) and ICICI Bank (PVTSB).

4.2 Research Design

The study adopts the descriptive research design.

4.3 Data Collection

The data has been collected through primary and secondary sources. The primary data has been collected through a structured questionnaire. The secondary data has been collected through web-sites, journals and books.

4.4 Sampling Area

The study has been conducted in Delhi-NCR.

4.5 Sampling Design

The study adopts the random as well as judgemental sampling design.

4.6 Sample Size

200 questionnaires were distributed among customers; only 187 of them were selected for analysis. 13 questionnaires were incomplete and were rejected for analysis.

4.7 Data Collection Instrument

The data has been collected through a structured questionnaire. The customers have been asked to describe their satisfaction level on five point scale from highly dissatisfied to highly satisfied.

5. Findings and Discussion

Table 1. Sample Profile

Customers	Public Sector Bank (SBI)	Private Sector Bank (ICICI)	Total
Frequency	95	92	187
Percentage (%)	50.8	49.2	100

As per table 1, the sample consists of 187 customers. In the sample 95 customers are from SBI and 92 customers are from ICICI bank. The proportion of customers of public and private sector banks is almost same.

Data has been analysed using SPSS version 23.

Age: As per table 2, the sample includes 40.6% customers from the age groups of below 30 years, 41.2% customers from the age group of 30-50 years and 18.2% customers from the age group of above 50 years. In SBI 33.7% customers are from the age groups of below 30 years, 40% customers are from the age group of 30-50 years and 26.3% customers are from the age group of above 50 years. In ICICI bank 47.8% customers are from the age groups of below 30 years, 42.4% customers are from the age group of 30-50 years and 9.8% customers are from the age group of above 50 years.

Table 2. Age

Age	SBI (PSB)	ICICI (PVTSB)	Total
Below 30 years	32(33.7)	44(47.8)	76(40.6)
30-50 years	38(40)	39(42.4)	77(41.2)
Above 50 years	25(26.3)	9(9.8)	34(18.2)
Total	95(100.0)	92(100.0)	187(100.0)

Sex: As per table 3, sample includes 67.4% male customers and 32.6% female customers. In SBI 55.8% customers were males and 44.2% customers were females. In ICICI bank 79.3% customers were males and 20.7% customers were females.

Table 3. Sex

Sex	SBI (PSB)	ICICI (PVTSB)	Total
Male	53(55.8)	73(79.3)	126(67.4)
Female	42(44.2)	19(20.7)	61(32.6)
Total	95(100.0)	92(100.0)	187(100.0)

Marital Status: As per table 4, the sample includes 70.1% married customers and 29.9% single customers. In SBI 76.8% customers were married and 23.2% customers were single and in ICICI bank 63% customers were married and 37% customers were single.

Table 4. Marital Status

Marital Status	SBI (PSB)	ICICI (PVTSB)	Total
Married	73(76.8)	58(63.0)	131(70.1)
Single	22(23.2)	34(37.0)	56(29.9)
Total	95(100.0)	92(100.0)	187(100.0)

Qualifications: As per table 5, the sample includes 12.3% under graduates, 52.9% graduates, 32.1% post graduates and 2.7% customers with other qualifications like MBBS and CA etc. In SBI, 16.8% customers were under graduates, 46.3% were graduates, 31.6% were post graduates and 5.3% customers were having other qualifications and in ICICI bank 7.6% customers were under graduates, 59.8% were graduates and 32.6% were post graduates.

Table 5. Qualifications

Qualifications	SBI (PSB)	ICICI (PVTSB)	Total
Under Graduate	16(16.8)	7(7.6)	23(12.3)
Graduate	44(46.3)	55(59.8)	99(52.9)
Post Graduate	30(31.6)	30(32.6)	60(32.1)
Any Other	5(5.3)	0(0.0)	5(2.7)
Total	95(100.0)	92(100.0)	187(100.0)

Monthly Family Income: The sample includes 25.1% customers from the income group of below 30000 Rupees, 32.1% customers from the income group of 30000-60000 Rupees, 17.1%

customers from the income group of 60000-100000 Rupees and 25.7% customers from the income group of above 100000 Rupees. In SBI 21.1% customers belong to the income group of below 30000 Rupees, 43.2% customers belong to the income group of 30000-60000 Rupees, 12.6% customers belong to the income group of 60000-100000 Rupees and 23.2% customers from the income group of above 100000 Rupees. In ICICI 29.3% customers belong to the income group of below 30000 Rupees, 20.7% customers belong to the income group of 30000-60000 Rupees, 21.7% customers belong to the income group of 60000-100000 Rupees and 28.3% customers belong to the income group of above 100000 Rupees.

Table 6. Monthly Family Income

Monthly Family Income (In Rupees)	SBI (PSB)	ICICI (PVTSB)	Total
Below 30000	20(21.1)	27(29.3)	47(25.1)
30000-60000	41(43.2)	19(20.7)	60(32.1)
60000-100000	12(12.6)	20(21.7)	32(17.1)
Above 100000	22(23.2)	26(28.3)	48(25.7)
Total	95(100.0)	92(100.0)	187(100.0)

6. Distribution of Customers as per Satisfaction Level

Table 7 indicates distribution of customers for various variables according to their satisfaction levels in percentages. HD, D, N, S and HS means highly dissatisfied, dissatisfied, neutral, satisfied and highly satisfied respectively. DG means dissatisfied group this is the total of highly dissatisfied and dissatisfied customers, SG means satisfied group and this is the total of satisfied and highly satisfied customers. The satisfaction level of customers has been measured for various variables. The variables are prices charged by the bank, timely resolution of problems, behaviour of employees, banking hours, location of the branch, promotional material, interior of bank, waiting time, procedural complexities, error free record, safety and security and knowledge of employees. These variables have been named as V1, V2, V3, V4, V5, V6, V7, V8, V9, V10, V11 and V12 respectively.

Table 7 indicates that in both type of banks the proportion of satisfied group is more than the proportion of dissatisfied group for all variables. In case of SBI (PSB), V8 (waiting time), V9 (procedural complexities), V2 (timely resolution of problems), V7 (interior of the bank), V3 (behaviour of employees), V12 (knowledge of employees) and V4 (banking hours) are the most dissatisfying variables. Hence SBI needs to focus more on these variables. The management should make efforts to speed up the transactions and reduce the waiting time of customers by appointing more efficient employees and installing some more counters. The procedural complexities involved in opening of accounts and disbursement of loans etc. must be reduced. Special staff must be appointed to resolve the problems of the customers quickly and they should be given immediate and personal attention. The interior of the bank also needs improvement; the interior must be attractive. Training programs must be organised for employees to enhance their knowledge and skills. The banking hours must be enhanced according to the needs of the customers. In case of ICICI bank (PVTSB), V1 (prices), V10 (error free record), V8 (waiting time) and V9 (procedural complexities) are the most dissatisfying variables. ICICI bank needs to focus more on these variables. Since the biggest problem in ICICI bank is prices charged by the bank. The bank management must make

Table 7. Distribution of Customers as per Satisfaction Level

	State Bank of India (PSB)							ICICI Bank (PVTSB)						
	HD 1	D 2	DG 1+2	N 3	S 4	HS 5	SG 4+5	HD 1	D 2	DG 1+2	N 3	S 4	HS 5	SG 4+5
V1	0	2.1	2.1	23.2	62.1	12.6	74.7	3.3	20.7	24	25	42.4	8.7	51.1
V2	1.1	9.5	10.6	14.7	61	13.7	74.7	2.2	2.2	4.4	19.6	56.5	19.6	76.1
V3	2.1	5.3	7.4	20	51.6	21.1	72.7	2.2	1.1	3.3	15.2	56.5	25	81.5
V4	1.1	4.2	5.3	10.5	65.3	18.9	84.2	1.1	1.1	2.2	10.9	60.8	26.1	86.9
V5	1.1	2.1	3.2	8.4	58.9	29.5	88.4	1.1	0	1.1	10.9	56.5	31.5	88
V6	1.1	3.2	4.3	31.6	53.7	10.5	64.2	1.1	1.1	2.2	26.1	45.6	26.1	71.7
V7	1.1	8.4	9.5	23.2	55.8	11.6	67.4	1.1	0	1.1	13	41.3	44.6	85.9
V8	4.2	24.2	28.4	25.3	41	5.3	46.4	3.3	3.3	6.9	13	44.6	35.9	80.5
V9	6.3	8.4	14.7	29.5	47.4	8.4	55.8	6.5	0	6.5	21.7	44.6	27.2	71.8
V10	0	3	3	15.8	55.8	25.3	81.1	1.1	14.1	15.6	23.9	44.6	16.3	60.9
V11	1.1	1.1	2.2	11.6	50.5	35.8	86.3	1.1	0	1.1	15.2	50	33.7	83.7
V12	0	7.4	7.4	26.3	47.4	18.9	66.3	1.1	2.2	3.3	13	50	33.7	83.7

Table 8. Group Statistics

Variables	Banks	N	Mean	Std. Deviation	Std. Error Mean
Prices charged by the bank	SBI	95	4.0101	.48644	.04991
	ICICI	92	3.4961	.99446	.10368
Timely resolution of the problem	SBI	95	3.7545	.84152	.08634
	ICICI	92	3.8746	.81801	.08528
Behaviour of employees	SBI	95	3.8371	.89058	.09137
	ICICI	92	4.0074	.80552	.08398
Banking hours	SBI	95	3.9688	.75024	.07697
	ICICI	92	4.0987	.71180	.07421
Location of the bank	SBI	95	4.1419	.73763	.07568
	ICICI	92	4.1791	.70403	.07340
Promotional/informative material	SBI	95	3.6739	.73898	.07582
	ICICI	92	3.9289	.81789	.08527
Interior of the bank	SBI	95	3.6827	.82797	.08495
	ICICI	92	4.2817	.77530	.08083
Waiting time	SBI	95	3.1825	.99858	.10245
	ICICI	92	4.0652	.95853	.09993
Procedural complexities	SBI	95	3.4246	.98266	.10082
	ICICI	92	3.8587	1.03331	.10773
Error free record	SBI	95	4.0297	.73606	.07552
	ICICI	92	3.6067	.95952	.10004
Safety	SBI	95	4.1918	.76165	.07814
	ICICI	92	4.1534	.75482	.07870
Knowledge of Employees	SBI	95	3.7771	.83980	.08616
	ICICI	92	4.1275	.80198	.08361

policies to reduce the interest charges on loan, rent on locker and other services. The customers are not satisfied with the accuracy of the records hence the bank management must ensure the accuracy of the records. The waiting time must be reduced by speedy transactions. There should be ease in the transaction processes.

8. Comparison of Satisfaction Level of Customers of SBI (PSB) and ICICI (PVTSB)

$H_{0:}$ There is no significant difference in the satisfaction level of customers of public and private sector banks.

To test the null hypothesis, t-test has been conducted on various variables affecting the level of customer satisfaction.

The mean scores as per table 7 are more than three and indicate that the customers are satisfied with their banks. In case of public sector bank (SBI), the mean scores for prices, safety and error free record are higher than private sector bank (ICICI) and indicate higher satisfaction in public sector bank (SBI) than private sector bank (ICICI). For all other variables, the mean score for private sector bank (ICICI) are higher than public sector (SBI) bank and indicates higher satisfaction in private sector (ICICI) bank.

Table 9. Independent Sample t-test

Variables	Levene Sig.	Equality of variances	t-test	Sig.	Result of Hypothesis
Prices charged by the bank	.000	No	4.467	.000	Rejected
Timely resolution of the problem	.560	Yes	-.989	.324	Accepted
Behaviour of employees	.097	Yes	-1.370	.172	Accepted
Banking hours	.651	Yes	-1.213	.227	Accepted

Location of the bank	.875	Yes	-.353	.725	Accepted
Promotional/ informative material	.726	Yes	-2.239	.026	Rejected
Interior of the bank	.816	Yes	-5.103	.000	Rejected
Waiting time	.045	Yes	-6.163	.000	Rejected
Procedural complexities	.593	Yes	-2.944	.004	Rejected
Error free record	.000	No	3.374	.001	Rejected
Safety	.912	Yes	.346	.729	Accepted
Knowledge of Employees	.278	Yes	-2.917	.004	Rejected

As per table 8, the significance value is less than .05 for prices, promotional material, interior, waiting time, procedural complexities, error free record and knowledge of employees, null hypothesis cannot be accepted for these variables and there is a significant difference in the satisfaction level of public and private sector banks.

The significance value is more than .05 for timely resolution of problems, behaviour of employees, location, banking hours and safety null hypothesis can be accepted and there is no significant difference in the satisfaction level of customers of public and private sector banks for these variables.

9. Overall Satisfaction Level of Customers

Table 10. Mean

	SBI (PSB)	ICICI (PVTSB)
Overall Satisfaction Level of Customers	3.9053	3.9239

As per table 9, the mean score of overall satisfaction level of customers is greater than three; it indicates that the customers of SBI and ICICI bank are satisfied with their banks.

As per table 10, the proportion of satisfied group is more than the dissatisfied group. In case of SBI the 80.8% customers are satisfied and in ICICI bank 82.7% customers are satisfied with their bank.

Figure 1

Figure 1 indicates that the overall satisfaction line of SBI and ICICI bank are very close to each other. The overall satisfaction line of ICICI bank is slightly higher than the overall satisfaction line of SBI, indicating that the satisfaction level of customers ICICI bank is slightly higher than the customers of SBI.

10. Conclusion

The study finds that the customers of SBI (PSB) and ICICI bank (PVTSB) are satisfied with their banks but the satisfaction level of customers of ICICI bank for various attributes is higher than the customers of SBI. The ICICI bank is outperforming SBI in terms of interior, promotional material, location of branches, bank timings, behaviour of employees, procedural complexities, waiting time and knowledge of employees. SBI need to improve the interior of their branches, provide more promotional material, improve the locations by establishing new branches, increase the banking hours, and reduce the procedural complexities and waiting time. There is also a need to provide training to employees to enhance their knowledge and improve their behaviour towards customers to compete with private sector banks and to improve the satisfaction level of customers. The ICICI (PVTSB) bank lags behind SBI (PSB) in terms of prices and accuracy. There is a need to reduce the prices like interest rate on loans and charges on other services and to provide more accurate records to customers to increase their satisfaction level.

Table 11. Distribution of Customers for Overall Satisfaction Level

	State Bank of India (PSB)							ICICI Bank (PVTSB)						
	HD 1	D 2	DG 1+2	N 3	S 4	HS 5	SG 4+5	HD 1	D 2	DG 1+2	N 3	S 4	HS 5	SG 4+5
OSLC	2.1	2.1	4.2	14.7	65.3	15.8	80.8	1.1	0.0	1.1	16.3	70.7	12.0	82.7

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An Efficient Truck Dock Allocation Algorithm

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1. Objective

In Supply chain industry, movement of the cargo on the roadside is an integral segment of the business. The cargo moves between the cities and sometimesacross the countries by the Trucks. Timely delivery of the Cargo to the end consignee depends on various factors. One of them is the inefficient truck dock allocation mechanism; which contributes the major tangible delays in the whole process. The inefficiency of the Truck Docks Management inside the warehouse represents the significant financial burdens on the trucking and warehouse management companies. Based on the internal performance tracking data, on an average, a truck wastes roughly 20-25 minutes after arrival inside the warehouse to get the correct truck dock allocated for loading and unloading of the Cargo. Considering the movement of 100-200 truck on an average in a warehouse per day contributes to 35 to 40 wasted person-hours in a single warehouse, this results in $800 per day or $292,000 per annum, which is a significant amount to lose, the influence may higher be considering all the warehouse across the network.

This white paper highlights the effective algorithm for the truck dock management, their allocations, timelyavailability, the service requirement inside the Air Cargo terminal/warehouse.

2. Methods Procedures

This white paper deals with the algorithmic aspects of Truck Dock allocation within the Air cargo warehouse terminal. Truck dock algorithm process allocates truck to available docks. Truck dock allocation operates in two phases.

In the first phase of Truck dock allocation, a reservation for time is requested. This is called time allocation. In the second phase, the actual truck dock is allocated. This allocation is done only when there is confirmation of the truck being available at the terminal entrance or available at Truck Park.

Therefore, having a time allocation only prevents over reservation rather than guaranteed truck dock availability. This is because the actual availability of truck dock is based on the arrival of trucks on time (as per reservation time), completion of load/unload operation by the estimated time and possible exceptions, likea requirement for follow-on trucks.

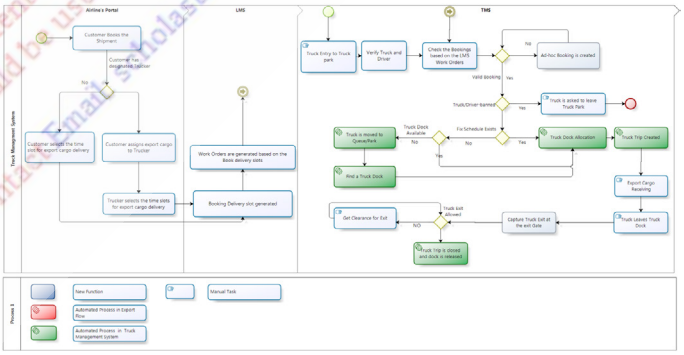
3. Definitions, Acronyms, and Abbreviations

3.1 Functional Terms

Term	Description
TMS	Truck Management system
BPM	Business Process model
SLA	System Level Agreements.
TCO	Truck Controlling Office
DG	Dangerous Goods
IMP GEN	Import General
AVI	Live Animal
CR	Cool Room

4. Truck Dock Allocation Concepts

4.1 Business Process Model– High-Level Process Flow



4.2 Truck Dock purpose

'Purpose' is a generic categorization used to define the capability of a Truck dock, Nature of cargo and so on. 'Purpose' is used to define attributes of a Cargo Reservations, Truck, and Truck Docks. Each truck dock is associated with one or more purpose. The 'Purpose' of a truck dock indicates the kinds of truck/cargo

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it can handle. Similarly, every pickup/drop of a Truck would also have a 'Purpose' associated. This 'Purpose' is either declared/ derived while Cargo reservation or at the Terminal Entrance or at the Truck Controlling Office (TCO).

Truck Dock Purpose includes:

- Import Bulk
- Import Pre-pack
- Imp Perishable
- Imp Cool Room
- Imp Dangerous Goods
- Export Bulk
- Export Pre-Pack
- Export Dangerous Goods
- Export Perishable
- Export Cool Room
- Valuable
- Odd Size

4.3 Managing Dock Purpose

Each truck dock has defined purpose. Each Truck dock is associated with primary purpose, second/third/fourth/fifth purposes. For example, Truck Dock TD101 may have a primary purpose of DG (Dangerous Goods), and the second purpose of IMP GEN (Import General), third as AVI (Live animal). This means that TD101 is primary to be allocated for DG, but then it can also handle IMP GEN or AVI Shipments.

The truck dock purpose can change over time and may also be different for different times of the day or different days of the week. To manage these settings for a truck a truck dock properties template is used along with a schedule that indicates applicable times when the template is applicable.

Dock No → ↓Purpose	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Primary	DG	DG	DG	DG	DG	AV I	AV I	AV I	GE N	GE N	GE N	GE N	GE N	GE N	GE N	GE N	CR	CR	CR	CR
2ND	GE N	GE N	GE N	AV I	AV I	GE N	GE N	GE N									GE N	GE N		
3RD				GE N	GE N															
4TH																				
5TH																				

Template 1

Dock No → ↓Purpose	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Primary	DG	DG	DG	DG	DG	AV I	AV I	AV I	GE N	GE N	GE N	GE N	GE N	GE N	GE N	GE N	CR	CR	CR	CR
2ND	GE N	GE N	GE N	AV I	AV I	GE N	GE N	GE N									GE N	GE N		
3RD				GE N	GE N															
4TH																				
5TH																				

Template 2

Dock No → ↓Purpose	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Primary	DG	DG	DG	GE N	GE N	AV I	AV I	GE N	GE N	GE N	GE N	GE N	GE N	GE N	CR	CR	CR	CR	CR	CR
2ND	GE N	GE N	GE N			GE N	GE N													
3RD																				
4TH																				
5TH																				

4.4 Truck Dock Properties Template

A truck dock properties template is used to configure the primary purpose and subsequent purposes of all the truck docks in the terminal and save it as one reference-able set.

4.5 Truck Dock Template

Template ID	Dock No	primary Purpose	Sec 1 Purpose	Sec 2 Purpose	Sec 3 Purpose
1	1	DG	GEN		
1	2	DG	GEN		
1	3	DG	GEN		
1	4	DG	AVI	GEN	
1	5	DG	AVI	GEN	
1	6	AVI	GEN		
1	7	DG	AVI	GEN	
1	8	AVI	GEN		
1	9	GEN			
1	10	GEN			
….					
2	1	DG	GEN		
2	2	DG	GEN		
2	3	DG	GEN		
2	4	GEN			
2	5	GEN			
2	6	AVI	GEN		
2	7	AVI	GEN		
2	8	GEN			
2	9	GEN			
2	10	GEN			
….					

4.6 Template Schedule

Once the template is ready, the template is made applicable using a schedule. A Schedule indicates the time of the day and the days of the week when the template is applicable. Based on the schedule and the template the system generates the truck dock properties for a given day. The Schedule should be such that there is some or other template applicable for all hours of the day.

4.7 Truck Dock Zone

A truck dock zone is a group of truck docks that are physically close to each other and is served by one set of resources. The truck zone is are source grouping of docks and has significance in the way resource handles delivery of cargo to be available at a truck dock.

The concept will have an impact only when the truck has a reservation and the cargo will be pre-staged at buffer area of the booked zone and any truck dock for that purpose is not available in that zone during allocation.

4.8 Truck Dock pool

Since actual truck, docks are not allocated when Cargo reservation, it is sufficient to maintain the count of available truck docks

Truck Dock Template Schedule

Schedule ID	Template ID	From	To	SU	MO	TU	WE	TH	FR	SA
1	1	06:00	09:59		Y	Y	Y	Y	Y	
2	1	06:00	14:59	Y						Y
3	2	10:00	23:59		Y	Y	Y	Y	Y	
4	2	00:00	05:99	Y	Y	Y	Y	Y	Y	Y
5	2	15:00	23:59	Y						Y

4.9 Dock properties (purpose)

Zone	Zone 1																Zone 2			
Dock No → ↓Purpose	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Primary	DG	DG	DG	DG	DG	AVI	AVI	AVI	GEN	GEN	GEN	GEN	GEN	GEN	GEN	GEN	CR	CR	CR	CR
Secondary 1	GEN	GEN	GEN	AVI	AVI	GEN	GEN	GEN									GEN	GEN		
Secondary 2				GEN	GEN															
Secondary 3																				
Pools….																				

for each 'Purpose'. Truck docks are grouped into pools based on unique combination of primary and secondary 'Purpose'. Additionally, the Truck Dock pool is segregated based on the Truck dock zone. Truck dock pools are derived from the actual truck dock properties defined for each truck dock. The following table indicates the Truck Dock pools that are derived from a typical configuration of Truck dock zone and truck dock purpose.

4.10 Truck Dock Pools

Pool ID	Zone	Dock Count	primary Purpose	Sec 1 Purpose	Sec 2 Purpose	Sec 3 Purpose
1	901	3	DG	GEN		
2	901	2	DG	AVI	GEN	
3	901	3	AVI	GEN		
4	901	6	GEN			
5	902	2	GEN			
6	902	2		GEN		
7	902	2				
		20	Total			

The above chart shows the total dock count is 20, the number of docks that can handle GEN is 18 (3 + 2 + 3 + 6 + 2 + 2), DG is 5 (3 + 2), AVI is 5 (2 + 3) and CR is 4 (2+ 2).

The docks associated within a Pool are also maintained.

Dock in Pool

Pool ID	Dock ID	Pool ID	Dock ID	Pool ID	Dock ID
1	1	4	9	6	17
1	2	4	10	6	18
1	3	4	11	7	19
2	4	4	12	7	20
2	5	4	13		
3	6	4	14		
3	7	5	15		
3	8	5	16		

4.11 Truck Dock Reservation

The reservation of truck dock is done by the Agent in advance before truck arriving at the Warehouse terminal. The reservation of truck dock requires incoming purpose (import/export), the type of cargo, tonnage and other parameters that help decide the appropriate truck dock for that truck.

4.12 Identifying 'Purpose' of a Reservation

Reservation starts with the process of identifying the cargo to be picked-up (import) or delivered (export). Cargo that is in a reservation can be of one or more types, with each type being of different quantity. To identify a matching truck dock, the cargo type needs to be considered. If a cargo is of only one type (say DG), then it obviously requires a DG compliant Truck duck. However, if the cargo is a combination of DG and General Cargo, the tonnage of DG Cargo being booked decides whether a DG dock is required or a General Doc is sufficient. Further, they are other factors that overrule the cargo type for Dock selection. If a cargo is identified as Customs controlled, it is required to be at a Dock close to Customs detention area. Therefore, to enable identification of the 'Purpose' of a reservation, it requires measuring multiple factors to arrive at the possible 'Truck Dock Purpose'.

The purpose of the reservation is the primary cargo type of the reservation.

The primary cargo type of the reservation is identified. For this, the identification of cargo type for each shipment will be done. Cargo type will be same as truck dock purpose as stated in the truck dock purpose identification table. After this, the primary cargo type will be identified as below.

{Cp, p} = max ({Cn, (Wn x Tn/T)})

n – The nth cargo in the list of different cargo types in the reservation

Cp – Primary cargo type of reservation

Cn – Cargo type of n

Wn – Weight factor for the Cargo type n (used to apply weight for a cargo type)

Tn – Tonnage of this type of cargo

T – Total tonnage

Examples

Purpose: Gen, DG, Custom Controlled

Weight factor for Cargo type: GEN - 1, DG – 2, Custom Controlled – 4

	Description	Calculation as per formula	Primary Cargo type (Max)
1	1.2 Tons Dangerous Goods, 3.5 Tons General Cargo, total 4.7 Tons	GEN = 1 x 3.5/4.7 = 0.745 DG = 2 x 1.2/4.7 = 0.511	GEN
2	1.5 Tons Dangerous Goods, 2.5 Tons General Cargo, total 4 Tons, Custom controlled 0.5 Tons	GEN = 1 x 2.5/4 = 0.745 DG = 2 x 1.5/4 = 0.75 Custom= 3 x 0.5/4 = 0.5	DG
3	3.5 Tons General Cargo, total 3.5 Tons, Custom controlled 1.5 Tons	GEN = 1 x 3.5/3.5 = 1 Custom= 3 x 1.5/3.5 = 1.28	CC

S.No.	Incoming Purpose	Reservation	Shipment Type	Controlled	IMR	Special handling Code	ULD	Derived Purpose	Truck Dock Purpose
	Imp Cool Room								Imp Cool Room
	Imp Bulk / Pre-Pack					PER			Imp Cool Room
		Imp				PER		Imp Cool Room	Imp Cool Room
	Imp PER								Imp PER
	Imp Bulk / PPK				Y	PER			Imp PER
		Imp			Y	PER		Imp PER	Imp PER
	Imp Bulk / PPK					Odd Size			Odd Size
		Imp				Odd Size		Imp Bulk	Odd Size
	Imp PPK		PPK				20 Ft		20 feet Container
		Imp	PPK				20 Ft	Imp PPK	20 feet Container
	Imp Bulk		Bulk						Imp Bulk
		Imp	Bulk					Imp Bulk	Imp Bulk
	Imp PPK		PPK						Imp PPK
		Imp	PPK					Imp PPK	Imp PPK
	Imp PER			Y					C&E PER
	Imp Bulk / PPK			Y					C&E
	Imp Bulk / PPK					DG			Imp DG
	Imp DG								Imp DG
		Imp				DG		Imp DG	Imp DG
	Export Bulk								Export Bulk
		Export	Bulk					Export Bulk	Export Bulk
	Export PPK & Bulk								Export PPK
	Export PPK								Export PPK
		Export	PPK					Export PPK	Export PPK
	Export DG								Export DG
		Export				DG		Export DG	Export DG
	Export PER								Export PER
		Export				PER		Export PER	Export PER
	Export Cool Room								Export Cool Room

Note: Controlled here means the content of the shipments

Below is the table that will map the shipment type, other factors to the truck dock purpose. Also in case the reservation exist the system will put the purpose as specified in 'Derived Purpose' is controlled by Customs and in Customs Status is 'On Hold'.

4.13 Maintaining Timeslot Allocations for Reservation

The availability status of truck docks is maintained on the timeline by tracking the availability of truck docks for each time slots over time. The time slots are of 15 minutes' interval. For each time slot, the list of Truck dock pools and for each pool, the dock availability is maintained. Each time slot – pool has the following attributes:

- Dock count – the total docks in the pool for this timeslot
- Reservation Quota – the number of docks available for reservation
- WI Quota – the dock available for Walk-in
- Reservation Allocated – the number of docks booked
- Reservation Unallocated – the number of bookable docks still remaining.

It should be noted that the all the counts are maintained for each time 15 minutes' timeslot.

4.15 Find Possible Reservation Timing

When a dock is required for reservation, the attributes of the shipment (including the Special Handling Code, Weight) are considered. Based on this information the system will

- Determine whether these shipments can be handled at a given truck dock: This is to eliminate cases of a combination of shipments that cannot be clubbed together in one reservation because the dock required for some shipments are different from the others. The system will have a configuration that lists the combination of cargo types that will not be allowed in a single reservation. If such a combination is found on the reservation, the reservation is rejected.
- Estimate the time required: The estimation duration of occupying the truck dock will be calculated based on the tonnage of the shipments selected. This calculation will be based on the formula. This will be x Kg/min where x is

4.14 Timeslot wise Pool Allocation

Time Slot	Truck Pool ID	Dock Count	Reservation Quota	Walk-In Quota	Reservation Allocated	Reservation Unallocated	Reservation Adjusted	Walk-In Adjusted Unallocated	WI Adjusted Allocated
10:00	1	3	2	1	1	1	0	1	0
10:00	2	2	1	1		1	0	1	0
10:00	3	3	2	1		2	0	1	0
10:00	4	6	4	2	1	3	0	2	0
10:00	5	2	1	1		1	0	1	0
10:00	6	2	2	0		2	0	0	0
10:00	7	2	0	2		0	0	2	0
10:15	1	3	2	1	1	1	0	1	0
10:15	2	2	1	1		1	0	1	0
10:15	3	3	2	1		2	0	1	0
10:15	4	6	4	2	1	3	0	2	0
10:15	5	2	1	1		1	0	1	0
10:15	6	2	2	0		2	0	0	0
10:15	7	2	0	2		0	0	2	0
10:30	1	3	2	1	1	1	0	1	0
10:30	2	2	1	1		1	0	1	0
10:30	3	3	2	1		2	0	1	0
10:30	4	6	4	2	1	3	0	2	0
10:30	5	2	1	1		1	0	1	0
10:30	6	2	2	0		2	0	0	0
10:30	7	2	0	2		0	0	2	0

the parameter different for different cargo type. The user will be able to specify the additional time to be added for certain special cargo like controlled or DG. For Export Pre-Pack/ Mix Pre-Pack, it will be a fixed time period (configurable). In case the reservation has both bulk and Pre-Pack than the time for each will be added together.

- Identify the truck docks purpose of the reservation as detailed above and then identify truck dock pools that match the 'truck dock purpose' identified for the reservation.
- identify the time slots available (as detailed bellow), which can be recommended to the agent

Based on the above considerations, information is displayed to the user who is performing the reservation. The user has advised the time slot from the proposed list.

To find the possible time slot, two pieces of information is required

- The purpose of the reservation and
- The duration of the reservation.

The purpose of the reservation will be derived as mentioned above. The duration of reservation (Estimated duration) is calculated. The estimatedduration is divided by the slot time (15 minutes) to find the total number of slots (Allocation Slots) required. In case 2 docks are required for the cargo collection then the estimated duration for each dock will be half of the calculated duration.

To find the available time when the reservation can be made, the 'Time Slot Wise Pool Allocation' is queried to find the time when the required number of contiguous slots are available in pools that can handle the purpose indicated in the reservation. The pools are queried first by primary purpose of the pool and then by secondary purpose, and so on. In a given time, first, the primary purpose pools are chosen rather than the secondary pools. The availability of docks in a slot is known by the 'Reservation Unallocated' for that pool in that time slot. If the shipments are stored in 'Floor goods', then the pool on the floor goods level will be chosen. If the shipment is stored at 'Floor Goods' on multiple levels, then the level having the maximum storage weight will be considered and if the shipment is stored at 'Floor Goods' on the single level then that level will be considered. The possible time when a reservation can be known is provided to the user to choose from.

5. Reservation

When a reservation is made against a time slot, the slots which contribute to the reservation has one count reduced from the reservation Unallocated for each time slot for which the reservation is made, thereby reducing the available truck docks. 'Purpose' of a reservation is calculated at based attributes of reservation which includes the Cargo types, Tonnage of each cargo type etc. For example, if a reservation is made for Truck pool id 1 from 10:00 to 10:30, two slots of 10:00 and 10:15 for truck pool id 1 will be booked (as indicated above).

5.1 Truck Dock Allocation

5.1.1 Maintaining Timeslot allocations for Walk-in

The availability status of truck docks for Walk-in has also maintained time slot wise along with the reservation. The walk-in quota available at a given timeslot; called 'Walk-in Adjusted'; is the sum of specified Walk-in quota and any docks in the reservation quota that have lapsed because of no reservation, or cancellation or no-show cases. The Walk-in Adjusted is the total docks available for allocation that have no reservation.

To begin with, Walk-in Adjusted is the same as Walk-in Quota. But after the reservation time for a slot (30 minutes before the slot time) expires, the docks that are not booked ('Reservation Unallocated') are added to the 'WI Adjusted Unallocated'.

5.1.2 Maintaining Dock Allocation in the Pool Allocation

When a dock is allocated for a period of time, one count is reduced from the available count (Reservation Unallocated / WI Adjusted Unallocated) and one count increased in the allocated count (Reservation Allocated /WI Adjusted Allocated) for each of the timeslots for which the dock is allocated.

6. Dock Allocation

At reservation, a truck dock is blocked in a given truck dock pool. However, the actual allocation of a Truck dock happens only when the truck arrives at the terminal. Some trucks arrive without a reservation, in which case a truck dock needs to be allocated from the Walk in quota.

Reservation Summary

Reservation ID	Truck No	Truck Pool ID	Purpose	Time Slot From	Time Slot To	Allocation Duration	Estimated Duration
1	US 2003	1	DG	10:00	10:30	45	42
2	US 2004	2	GEN	10:00	10:45	60	49

Timeslot wise Pool Allocation

Time Slot	Truck Pool ID	Dock Count	Reser-vation Quota	WI Quota	Reser -vation Unall-ocated	Reservation Allocated	Reservation Adjusted	WI Adjusted Unall-ocated	WI Adjusted Allocated	Remarks
10:00	1	3	2	1	0	1	1	2	0	
10:00	2	2	1	1	0		1	2	0	
10:00	3	3	2	1	0		2	3	0	
10:00	4	6	4	2	0	1	3	5	0	
10:00	5	2	1	1	0		1	2	0	
10:00	6	2	2	0	0		2	2	0	
10:00	7	2	0	2	0		0	2	0	
10:15	1	3	2	1	0	1	1	2	0	
10:15	2	2	1	1	0		1	2	0	
10:15	3	3	2	1	0		2	3	0	
10:15	4	6	4	2	0	1	3	5	0	
10:15	5	2	1	1	0		1	2	0	
10:15	6	2	2	0	0		2	2	0	
10:15	7	2	0	2	0		0	2	0	
10:30	1	3	2	1	1	1	0	1	0	
10:30	2	2	1	1	1		0	1	0	
10:30	3	3	2	1	2		0	1	0	
10:30	4	6	4	2	4	1	0	2	0	
10:30	5	2	1	1	1		0	1	0	
10:30	6	2	2	0	2		0	0	0	
10:30	7	2	0	2	0		0	2	0	

All 'Reservation Unallocated' have been set to zero for time slot 10:00 and 10:15, the number moved to 'Reservation Adjusted' and added to the 'WI Adjusted Unallocated'*

* Considering time 09:50

7. Dock Status

At reservation, a truck dock is blocked in a given truck dock pool. However, the actual allocation of a Truck dock happens only when the truck arrives at the terminal. Some trucks arrive without a reservation, in which case a truck dock needs to be allocated from the Walk in quota.

The dock status is maintained and reflects the current occupancy state of the dock. Typically, a Dock is 'occupied' or 'free' or 'reserved' or 'unavailable'. If a dock has been allocated, the truck number and the allocation from and to are indicated. Current status of the dock is the actual status as detected by the truck monitoring system. A Truck dock is considered for allocation only if the current status is free. If the dock is 'occupied' even after the Allocation time ('Allocation to') the truck is overstaying, but still, cannot be considered for allocation. Therefore, a dock is available for allocation only if it is 'free' and has does not have an active allocation against it.

Dock ID	Current Status	Truck No.	Allocation From	Allocation To	Remarks
1	Free				Dock is free for allocation
2	Occupied	BA 4522	10:00	10:45	Dock is occupied, work in progress
4	Occupied	BC 2932	09:30	10:15	Dock is occupied, even though allocation expired at 10:15, the truck is overstaying *
5	Allocated	AR 9726	10:30	11:15	Dock is free but it is already allocated and is awaiting the arrival of the truck, allocation starts at 10:30 *

* Current time being 10:25

8. Truck with Reservation

If a truck has a reservation, the pool id against which it is booked and Truck docks for that pool id are retrieved. The Truck docks of that pool are checked for availability (using the Dock status info); if any of the truck docks in the pool is 'free' it is allocated.

If none of the docks in the booked pool are 'free', then an alternative dock could be found in another pool. This requires careful examination because there should be no effect on future reservations in the other pool because of this movement. The alternative pool that would be found should preferably be in the same Truck dock zone. This is because retrieval orders from Shipment Storage would have already been sent to Shipment Storage to retrieve the cargo to the buffer area of that zone, and Shipment Storage would have moved the goods to the buffer area of the Zone associated with the reservation pool. Movement of goods to another zone would result; on an average; 20 minutes. Hence shifting of reservation to another zone is not preferred.

The order of preference for alternate pools is (a) pools in the same Zone with pool's primary purpose matching; (b) pools in same Zone with pool's subsequent purposes match; the pool having more number of available truck docks will be preferred (c) pools in adjoining zone with pool's primary purpose / subsequent purposes matching. If no matching pool is found the truck is expected to wait for an allocation in the Truck park and the truck is put in the wait queue.

Once an alternate pool is identified, check if a truck dock is free in any of the identified pools, if a truck dock is free in any of the identified pools, try to allocate by:

1. **Allocating in Walk-in Quota:** Check if the walk-in quota (WI Adjusted Unallocated) is more than one for all the timeslots required for the duration of this reservation and if yes allocate the dock.
2. **Swap equal Reservation:** Check reservation against the identified pool and to find reservation records that can be swapped. The swap requires the reservation duration and the start time of reservation to be same. Swapping requires no change expect the swap of the pool id for the identified reservations.

Once the pool with a match is identified and the quota is available either in the walk-in or by swapping of reservation, the free dock identified is marked as allocated and the truck number and 'from and to' time of the allocation is updated in the Dock status.

If no matching pool or no sufficient quota is found, or not the swappable reservation is found or no free dock is found, the truck is put in the waiting queue.

9. Truck without Reservation

If a truck has no reservation, a free dock has to be identified from the Walk-in quota. First based on the identified Truck dock purpose (as indicated in the Table in the previous section), Pools with the primary purpose matching the identified Truck dock purpose and then pools with matching subsequent purpose are examined. If the shipments are stored in 'Floor goods', then the pool on the floor goods level will be chosen. If the shipment is stored at 'Floor Goods' on multiple levels, then the level having the maximum storage weight will be considered and if the shipment is stored at 'Floor Goods' on the single level then that level will be considered. In the identified pools, first check if there are unallocated docks in the walk in quota (WI Adjusted Unallocated), if yes, check the physical status of the Dock status, if they are free, if yes allocate, if not the truck transferred in the wait queue.

10. Conclusions

The proposed algorithm is proved to be a workable solution and more feasible for the truck dock allocations within the Air cargo warehouses. This provides the overall visibility on the availabilityof the truck docks, timely allocations, better monitoring and optimized dwell time for the trucks. It processes the lesser time in assigning the availabletrucks-dock to each truck entered in the terminal and guides the truck from the shortest(predefined) route towards the allocated dock. This help to optimize the dwell time of the truck in truck park or moving around in the terminal.

Since this algorithm also captures the information for the required time for loading /unloading of the cargo as per the characteristicslike X minutes requires to load/unload the XYZ category of cargo with y tonnage, hence in addition to this, it also help in measuring the service level agreements(SLAs) defined for the trucks for the specific services. This help to optimize the resourceavailability and performance at the truck docks.

At last, once the truck is loaded/unloaded at the truck dock, the truck dock is marked as vacant for the subsequent truck to be parked so it can be assigned to the subsequent truck entered in the Air cargo warehouse terminal.

As the issues highlighted in the problem statement, the truck dock are allocations are optimized, dwell time at the truck park and truck docks are optimized, resources are monitored, SLAs are monitored in the effectiveways. This will help in reducing the stated losses the particular area of the supply-chain business.

A vice thought to the observed problem may lead to the terrific solution which can help in saving the time, cost energy and social life of many persons. This white paper is based on the real problems observed during the early days of the professional life. However, the complete solution took the time to evolve and sketched on the paper. Now, this needs to be designed and convert to the system. This is the ultimate goal of writing the white paper.

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Performance Driven Development Framework for Web Applications

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Abstract

The performance of web applications is of paramount importance as it can impact end-user experience and the business revenue. Web Performance Optimization (WPO) deals with front-end performance engineering. Web performance would impact customer loyalty, SEO, web search ranking, SEO, site traffic, repeat visitors and overall online revenue. In this paper we have conducted the survey of state of the art tools, techniques, methodologies of various aspects of web performance optimization. We have identified key web performance patterns and proposed novel web performance driven development framework. We have elaborated on various techniques related to different phases of web performance driven development framework.

1. Introduction to Web Performance Optimization (WPO)

Pages with good performance increase revenue[2,3] and improve the search engine ranking[1]. Page performance also has positive impact on user traffic[56,57] and the download rate impacts the perceived success by end users[71].

Web performance optimization (WPO) involves all methods to improve the performance of web page[87]. The key components used in WPO are web content, images, videos, CSS/JS files, XML/JSON files and such presentation components. WPO also involves various performance rules, techniques and processes to improve end to end performance optimization of the web page.

1.1 Organization of the Paper

The paper is organized as follows. We will start with introduction concepts of WPO and we will then examine various aspects of WPO such as impact and dimensions of WPO in the introduction section. In the next section we elaborate the performance driven development framework. We explain each step in the performance driven development framework including performance based design, performance based development, performance based testing and performance monitoring. In each of these phases we discuss relevant performance rules, design principles and performance best practices. Wherever applicable, we will provide the Java-based web application examples

1.2 Impact of WPO

WPO has impact in following aspects:

- Customer churn: Research indicates that customers would abandon the slower web pages[88,91,92]
- User impact: User experience is drastically impacted due to page performance. The performance of landing/ gateway pages and key processes is directly co-related to overall user experience
- Site Traffic: Site traffic is impacted if the page takes more than 3 seconds[89] and most users expect the page to load within 2 seconds[89].
  - Conversion rate increases 74% when page loads within 2 seconds[96]
  - Page abandonment rate increases to 40% if page takes > 3 seconds[97]
  - Nearly half the population expects the page to load within 2 seconds[97]
- Revenue: Online revenue is directly correlated to the performance of key pages and transactions for ecommerce sites
- Multi-device optimization: An optimized web page also impacts the performance on various devices.
- Search engine ranking: Google includes site speed in search ranking algorithm
- Omni-Channel advantage: A good performing page can also be easily access by mobile devices.

The impact of WPO on page performance is depicted in the Figure 1.

<Figure 1 Missing>

Figure 1. Impact of WPO.

The high level impact on three categories is depicted in Figure 2

1.3 Dimensions of WPO

The process of Web optimization can be analyzed from several dimensions:

- Optimization of Request pipeline processing Systems: In this category we will examine all the systems involved

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in the web request processing pipeline. This involves browser software, CDN, proxy server, network, load balancer, web server, application server, integration middleware, backend services, database server and such

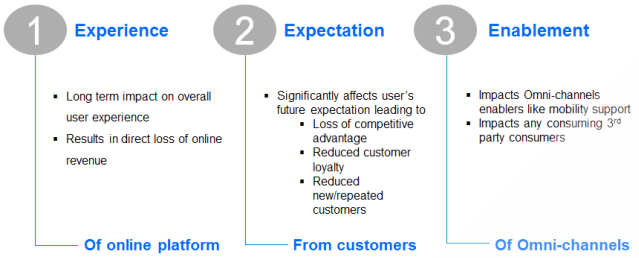

Figure 2. Impact categories of WPO.

- Client-side and server side optimization: Client-side performance optimization includes all optimizations performed on client-side presentation components such as HTML pages, images, assets and such. Server side optimization includes performance tuning of server –side components such as fine-tuning business components, setting optimal server configuration, right infrastructure sizing and such
- Design time and run time optimization: Design time optimization includes the static and offline performance optimizations activities such as performance code reviews, performance testing, and offline performance tuning and such. Run time and dynamic performance optimization activities include real-time performance monitoring and notification, run time performance optimization and such.
- Web component optimization: Another aspect of web optimization is to optimize each of the constituent's web components such as HTML, images, JavaScript, CSS, Rich media files and such.

Figure 3. Performance Driven Development framework.

2. Performance Driven Development Framework

Performance driven development approach can be adapted in following phases for ground-up development project:

- Defining sound performance based design guidelines
- Implementing the design guidelines during development
- Thorough testing strategy to cover all performance scenarios

Table 2. Categorized Performance Rules

Category	Performance Rule	Impact on web performance
Request Optimization	Reduce the number of HTTP Requests	Reduces the consumed bandwidth and data transferred
	Merge the static assets such as JS and CSS files	Merging would reduce the number of HTTP requests and would improve the page response times by about 38%[66]
	Remove all duplicate file includes	
	Remove all invalid URLs which result in HTTP 404	Avoids unnecessary and invalid HTTP requests
	Load the JavaScript sascynhronously	This would reduce the blocked loading of JS files
	Minimize usage of iframes	iFrames block the loading of parent window till iframe source is loaded and hence affects load times
	Minimize redirects	Minimize additional requests
	Cache DNS records	We can reduce the DNS lookup time through DNS cache maintained at browser level
	Remove any unused CSS, JS file includes	Minimizes HTTP requests
Web object size optimization	Minify JS and CSS files	Minification would reduce the size of JS and CSS file
	Compress images	Compresed images would reduce overall page size
	Leverage gzip for HTTP compression	Compression would reduce the overall page size by about 70%[66]
	Remove white space in the HTML document	Removal of white space would reduce the overall page size

HTTP Header Optimization	Leverage cache headers for static assets (images, JS, CSS, JSON and other binary files) using Cache-Control header with max-age directive	Allows browsers to optimally cache the assets
	Use expires header for the assets	Avoids additional resource request
Asset placement	Place CSS files at the top	CSS elements in the head tag
	Place JS files at the bottom	JS files at the bottom would improve the perceived page load time. I would avoid the blocked loading of other assets
	Externalize inline JS or CSS	Enables browser caching and parallel downloads
Image optimization	Asynchronous image load	Load the images on-demand and in asynchronous when they are visible in the user's view port.
	Optimize image size	Use the right size image based on the requesting device
	Convert JPEG image formats to progressive format	This would reduce the overall image size
	Optimize image dimensions	Specify the exact width and height for all images
	Use image maps	Reduces multiple image requests
	Use CSS sprites	All images are combined into a single one and the required image is displayed using style rules. This reduces number of image requests
	Other techniques: inline images	
Network optimization	Usage of CDN	CDN would optimize the resource request by serving the resource from nearest location to the requestor
	Use multiple asset hosting servers (for hosting images, videos and other multi-media content)	Allows browsers to download the content in parallel.
External Dependency optimization	Identify all external scripts and HTTP requests which impact the page performance and which block the page load and optimize them	
Web Application design optimization	• Perform regular and iterative performance testing to identify performance bottlenecks and fix them. Use automated and manual performance code reviews at regular intervals. • Use light-weight service based integration model and load the data asynchronously on-demand	Iterative performance testing uncovers performance bottleneck during early stages

- Continuous real-time monitoring

The various phases are depicted in figure 3.

2.1 Web performance Design

In this section, we will look at the design guidelines and best practices for achieving optimal web performance. The books[66,67] provide excellent performance guidelines from web performance stand point. Web developers and architects can use this as reference while developing web applications. Some of these optimizations are also available as filters for Apache's mode_pagespeed module[52].

As 80%66 of load time is spent in making HTTP requests for non-HTML content, we could look at ways to optimize these web components in table 2.

The key page performance design principles are listed below:

- Light weight design
  - Include only core functionality on landing/gateway JSPs
  - Highly optimized/compressed marquee image and other media
  - SLA-based 3rd party integrations on frequently used JSPs
- Search centered experience

- Position highly optimized search as key tool for information discovery
- Provide intuitive information architecture

- Think Asynchronous alternatives
  - Use AJAX tags in page to optimize perceived page load time
  - Lazy loading data model for page components
- Omni-channels optimized
  - Page components for mobile devices
- Layered architecture
  - Separation of concerns

Given below are performance anti patterns in a typical Java web application:

- JSP Page size contributors
  - Media (Marquee image, flash, video)
  - JavaScript files
  - CSS
  - Uncompressed/un-optimized images
- JSP Includes/calls
  - Numerous JS/CSS includes
  - Duplicate calls
  - Broken links
  - Unnecessary calls
- Other common causes
  - Placement of JS/CSS calls
  - Bloated size of JSP
  - Frequent resource requests with huge payload
  - Inline styles and JS logic

2.2 Performance based Development

Performance based development is the key step in the performance driven development framework. Firstly, in this phase we will identify the performance bottlenecks and performance anti patterns and then we will apply all the performance optimization rules and best practices. We will also look at content optimization and the impact of security on WPO. In this section we will also look at optimizing performance for existing web applications.

2.2.1 Web Performance bottlenecks and Web Performance anti-patterns

Let us look at common performance bottlenecks and anti-patterns which impact the web performance. Table 1 provides a list of commonly occurring performance bottleneck

2.2.2 Performance Optimization Practices

Given below are the performance optimization best practices and thumb rules which can be used during development stages:

Table 1. Performance Bottleneck and anti-patterns

Bottleneck Area	Performance anti-patterns
Web page Design	• Heavy landing/gateway pages • UI design with many components and functionality • Pages designed with huge images/flash files
Third-party components	Third-party Scripts and widgets would block page load and impact overall page performance.
Network bandwidth	Usage of sub-optimal network bandwidth across internal systems
Server configuration	Not adopting optimal server settings for parameters such as heap memory, thread pool size, connection pool size etc.
Infrastructure capacity	• Usage of sub-optimal memory, CPU, disk capacity for servers • Not conducting load testing, stress testing, endurance testing and related performance tests
Performance testing	• Not conducting all necessary performance tests (such as load test, stress test, endurance test) for web application • Conducting performance testing at the end of the application development • Not conducting Omni-channel testing to test performance on mobile platforms.
Page code	• Not conducting performance code review • Not performing iterative performance testing
Service calls	• Non validated frequent service calls • Heavy usage of synchronous service calls
Integration design	• 3rd Party component integration without proper SLA framework
Process validation	• Lack of performance testing of overall steps and/or for process/transaction
Omni channel strategy	• Absence of mobility enabled sites or lack of multi-device testing.

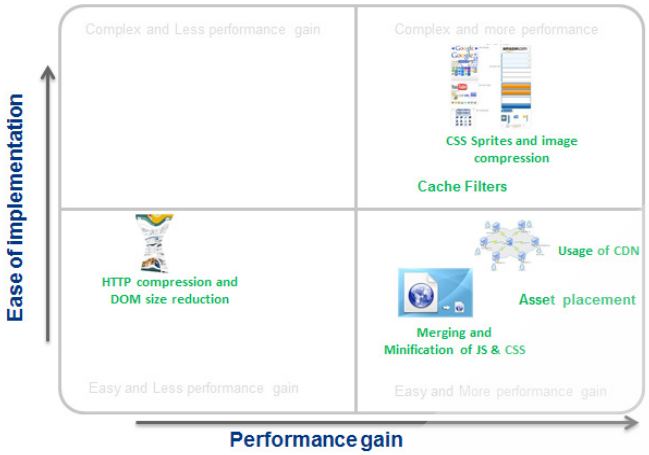

Figure 4. Performance Effort matrix.

Given below are the performance optimization rules for a Java-based web application and these rules can be used for performance code review and as a performance checklist:

- Maximum usage of AJAX
- Cache list items in web page
- Properly scoped managed beans for JSF
- Precompiled JSP
- Optimize intervals for checking JSP and servlet modification
- Usage of JSP cache
- Tune session timeouts (optimal 30 mins) and call session. invalidate() for logout
- Disable JSP/Servlet auto-reload
- Heavy objects in HttpSession needs to be avoided
- Usage of gzip compression wherever supported
- Include the static JSP fragments like header, footer using include directive instead of include action
- Wherever required pre-load servlet and cache the application data using "load-on-startup" feature
- Perform client side validation to avoid un-necessary server round trip
- One time creation of cached data in init() method
- Disable auto-reload feature unless required.

Figure 4 provides the performance effort matrix which provides the effort needed for implementing each of the performance rules and its impact on the overall page performance.

2.2.3 Content Optimization

A web page consists of multiple content sections. The content would come from HTML content fragment or from web content stored in CMS. Let us look at ways to optimize the web content retrieved from CMS.

- While designing the content strategy think of content in chunks instead of a monolithic content. Modular content chunk will make the content reusable and enhance the caching optimization
- Use adaptive technique techniques (such as progressive enhancement/degradation) while creating the content. This will automatically make the content optimal for all devices
- Cache the content at chunk level. Fine tune the caching period based on the content update frequency. Perform on-demand chunk cache invalidation when new content is published.
- Adopt user-friendly information architecture for easier and faster discovery of relevant content
- Tag the content chunks with relevant metadata and tags that helps in accurate information discovery.

2.2.4 Security and WPO

Security is one of the key concerns for web applications. Security for web applications can be enforced at various levels. One of the most commonly used security constraint is to use secured socket layer (SSL) to ensure transport level security. SSL is a default choice for web pages hosting confidential information such as user credentials, user personal information and such. SSL would also impact the page performance[78] due to additional overhead.

Asset Category	Optimization Rules	Impact on page performance
Static Assets (JS, CSS, JSON, XML)	Merge into minimal sets Minify the merged files CSS at Top and JS files at bottom	Merging reduces number of HTTP requests Minification reduces the overall page size speeding the page load Appropriate positioning improves perceived page load On an average 30% page size reduction through merging and minification.
Binary Assets (Image, media, Flash)	Use compressed format and CSS Sprites Use CDN for edge side caching	Optimizes the overall page size Improves performance on mobile devices CDN would provide optimized performance for multi-geographies. On an average 25% page size reduction through usage of CSS sprites On an average 10% improvement in page load time through CDN caching.
Web page related	Remove any duplicate/un-necessary calls Reduce the white spaces Compress/g-zip HTML content	Reduces number of HTTP requests Optimized DOM size for the end web page On an average 20% page size reduction through HTML compression

The most commonly used techniques for optimizing performance in such scenarios are as follows:

- Set proper expiration times for the objects so that browser can cache the objects appropriately[74]
- Use CDN which support SSL acceleration modules for forward caching

2.2.5 Performance Optimization of Existing Web Applications

In order to optimize the performance of the existing web application we can follow these three-step process:

- Apply 80-20 rule: Identify 20% of pages/processes which is most frequently used
- Root cause analysis: Leverage tools to identify the component-wise and asset-wise size and load times
- Iterate & Monitor: Iteratively cover remaining pages and transactions

2.3 Web Performance Testing

Figure 5 provides the four dimensions of a performance testing.

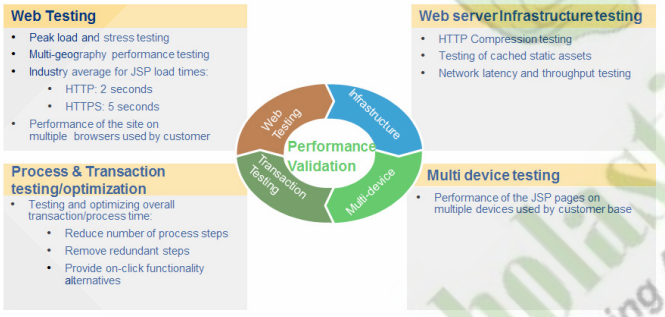

Figure 5. Dimensions of performance testing.

2.3.1 Web Testing

In this category the web application is subject to peak load and stress load testing. The testing would be conducted for application distributed across various geographies and on all supported browsers and user devices. The industry standard for page load time is 2 second for HTTP and 5 seconds for HTTPS pages. The testing would be conducted to validate this performance SLA at various loads.

2.3.2 Infrastructure Testing

Various infrastructure components such as web server, database server, application server would be tested and monitored at various loads. Server resources such as CPU, memory would be monitored along with network latency and throughput during the testing process.

2.3.3 Process and Transaction Testing

In this phase the key business transactions and processes are tested end to end. Processes like product checkout process, user registration process and such crucial business activities are ideal candidates for testing. We would explore optimization alternatives such as reduction in process steps, process automation, removal of redundant process steps, providing one-click alternatives (such as one-click checkout) in this phase.

2.3.4 Multi Device Testing

In this phase the functionality will be tested for performance and user experience on various devices and browsers.

2.4 Web Performance Monitoring

The last step in performance based design is the continuous performance monitoring. Various steps and activities of the performance monitoring process is depicted in figure 6.

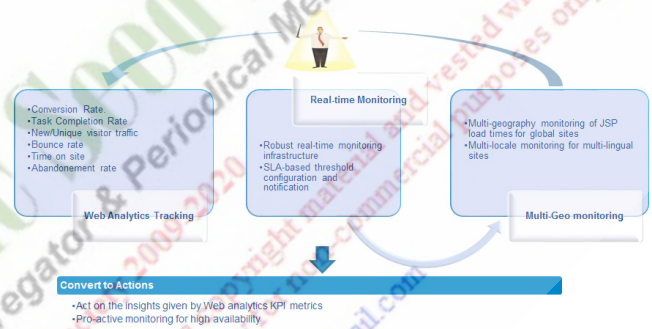

Figure 6. Performance monitoring process.

2.4.1 Performance Tracking

In this phase, we would use web analytics tools to track and monitor page performance metrics such as visitor traffic, page load time (PLT), conversion rate, time on site, bounce rate, abandonment rate and such.

2.4.2 Real Time Monitoring Infrastructure

A monitoring infrastructure would including real time monitoring software and configuration setup to check for performance SLAs on continuous basis.

The performance metrics and SLAs will be tracked in real time and reports/notifications would be sent to site administrators in case of SLA violation

2.4.3 Multi Geo Monitoring

For a globally distributed web site a real-time monitoring would be done from various goes to test the performance for various languages and geo-specific sites.

All the insights gathered through monitoring would be converted into actions and the pro-active monitoring would be an essential component for high availability.

2.4.4 Web Performance Governance

Governance is defining "What" will be governed by "Who" and "How". Figure 7 provides various aspects of performance governance. Performance governance will consists of various governing bodies from Business, IT and Enterprise Architecture, Security and Infrastructure Groups

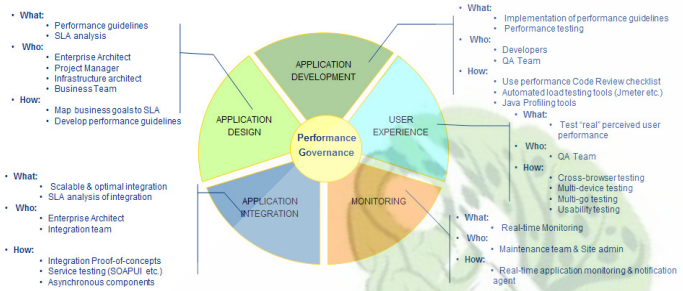

Figure 7. Performance governance.

3. Conclusion

In this paper we examined various aspects of web performance optimization. We proposed a novel performance driven development framework and detailed various aspects of the framework. In each of the phases, we elaborated the web performance optimization techniques such as asset optimization, performance design checklist, performance thumb rules, and performance best practices needed in those phases. Finally we elaborated on performance governance and its various elements.

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Financial Inclusion or Financial Destruction: A Case Study of Microfinance Institutions

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Abstract

Microfinance sector, in India has played an significant role in the progress of the Indian rural as well as urban economy. A large number of Micro Finance Institutions (MFIs) in India are serving to the financing needs of rural and semi-urban Indian population. For achieving the target of financial inclusion in India this sector cannot be ignored. Generally daily wage earners, marginal farmers, women working from homes are the clients of MFIs. Such clients work only cash basis. Collection of loan is generally done by MFIs on weekly or fortnightly basis. The objective of the paper is to analyze the short and medium term positive and negative effects of many government decisions including demonetization on MFIs in India. This study will give more insights about the impact of the demonetization and other government policy framework on MFIs in India.

Key words: CE, Demonetization, MFIs, PAR30, PAR90, PAR180

1. Introduction

Microfinance sector has been serving India since a long time for achieving the object of financial inclusion. Financial inclusion is the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low-income groups at an affordable cost (Dr. C. Rangarajan Committee (2008). Presently, There are 73 NBFC-MFIs registered with RBI which 51 are MFIN members. The study examines the performance of MFIs impacted due to different microfinance variables and government policy during the period 2011-2016. This period is very important for a many reasons mainly because Indian government and RBI took initiatives for making microfinance sector an organized one. Microfinance bill was passed in this period. During this period more emphasis was given on financial inclusion by introducing microfinance regulations and setting up regulatory authority. This period noticed new highs in microfinance sector after AP Crisis and also faced downward trends due to unhealthy government decisions. Many variables such as disbursements, amount of loan, no. of loans, collection efficiency, portfolio at risk, demonetization, loan waiver policy which affect microfinance sector are taken into account as illustrative variables so as to have a complete understanding of positive and negative impact on MFIs during 2011-2016 (study period)

This paper has been divided in V sections. In section I, a brief introduction of MFIs, their working process and demonetization in India has been given. Section II of this paper states the objective of this paper. In section III, research methodology used in paper has been explained. In section IV, analysis and interpretations of results have been presented. Section V, presents Summary and conclusions. In section VI, references have been given.

2. Objectives of the Study

The objective of the present study is to evaluate the positive as well as negative impact of demonetization and other government policy frame work on the working of MFIs in India. To achieve the objective of the paper, study for the period 2013 to Oct.2016 as pre demonetization period and Nov. 2016 to March 2017 as post demonetization period has been conducted.

3. Research Methodology

3.1 Data Collection

To achieve the objectives of the study secondary data is used which is collected from various sources i.e. publications of MFIL, reports of CARE RATING, RBI guidelines for MFIs and from websites of MFIL, CARE, RBI, etc. Quarterly. The relevant data have been collected for the period 2011 TO March 2017.

4. Analysis and Interpretations of results

4.1 Growth of MFIs in post AP Crisis Period

The real growth of MFIs in India can be analysed only after 2010 when RBI and Indian government initiated steps to revive

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this industry. The period after 2010 can be considered as post ANDHRA PRADESH CRISIS (herein after AP Crisis) period in India. Up to 2010 Portfolio at risk (PAR 30) for the industry increased significantly. It was a direct result of AP Crisis. Before AP Crisis PAR 30 of this sector was less than 1%. This variable increased up to 22% after AP Crisis. According to micrometer of MFIN, During FY 12-13, MFIs disbursed 18.10 mn loans. It was an increase of 5% over FY 11-12. In the same period an increase of 10% in disbursement of loans was noticed for Non AP MFIs. During the year 12-13 loan disbursements by large MFIs accounted for 82%[1]. There were many reasons behind this growth. As mentioned in MICROMETER of MFIN JUNE 2012[3], in April 2011, ministry of finance (MOF) constituted committee for drafting new Microfinance Bill. In May 2011 RBI issued detailed guidelines covering loans to MFIs by Banks. In July 2011 Draft Micro finance Bill 2011 was put in the public domain. In Oct 2011 MoF constituted committee for framing Vision Document for Financial inclusion 2020. According to MICROMETER of MFIN Nov. 2013[6] During Q1 FY 13-14, MFIs disbursed 4.78 mn loans, an increase of 42% over Q1 FY 12-13. However, loans disbursed decreased by 23% compared to Q4 FY 12-13 as disbursement activity typically peaks during the last quarter of the financial year. During Q2 FY 13-14, MFIs disbursed Rs 76.61 bn, an increase of 50% over Q2 FY 12-13 and 22% over last quarter Q1 FY 13-14. Similar growth was noticed in further period. RBI regulations and govt. efforts were responsible for this growth. Financial inclusion was one of the most important agenda of Indian govt. Since 2013 growth in micro finance sector can be analyzed. A clear rising pattern can be viewed (Figure 1). During Q1 fy 14-15, MFIs disbursed over 6.3 mn loans worth Rs 94.2 bn. Compared with Q1 fy 13-14, number of loans disbursed grew by 34% and loan amount disbursed by 48%.During Q3 fy14-15,MFIs disbursed over 8.2mn loans worth Rs132.6bn Compared with Q3 fy13-14,number of loans disbursed grew by 33% and loan amount disbursed by 46%. In April 2015, RBI took a great step by increasing the lending limit by MFI from Rs. 50000 to Rs.1. by this step of RBI, the client of MFI could borrow double amount as compare to earlier. This allowed lenders to give out more loans to the same customers. It can be seen that on quarter to quarter basic this sector enjoyed growth. However increment in loan amount with less increment in clientage was a matter of concern.

4.2 Growth Of MFIs in post Demonetisation Period

Growth of microfinance sector had to face a check when the Indian Government ceased to recognise Rs.500 and Rs.1000

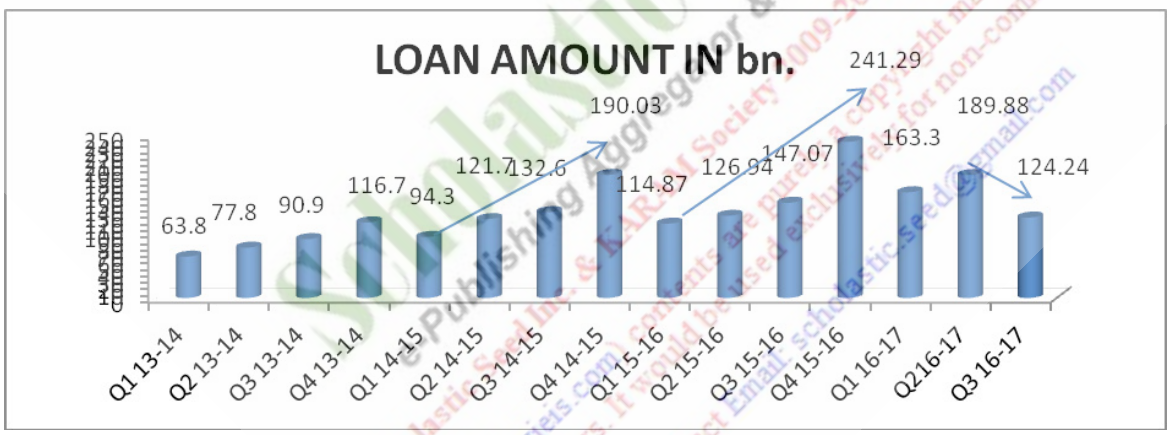

Figure 1. Source: MFIN Publications.

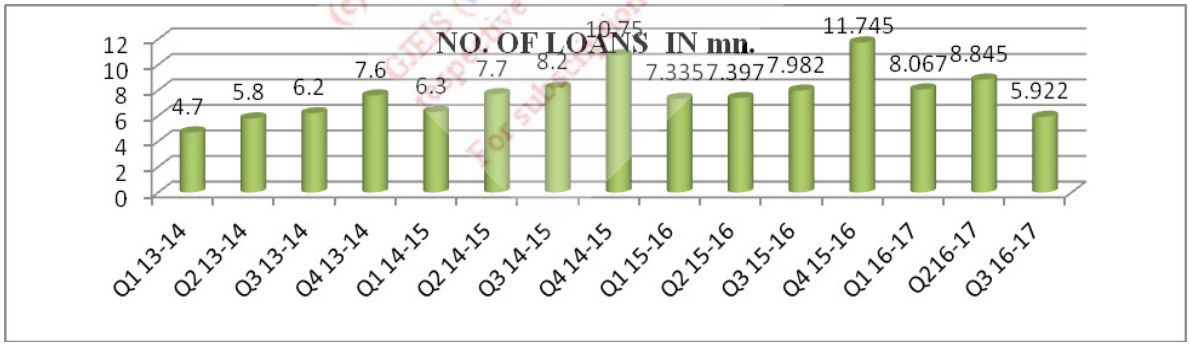

Figure 2. Source: MFIN Publication.

rupee denominated bank notes ("Specified Bank Notes" or "SBNs") as legal tender with effect from November 9, 2016. As clear from figure 1 and figure 2, this industry faced a sharp decline in total amount of loan disbursed and no. of loans during Q3 2016. Amount of loan by MFIs was declined from 189.88 bn in Q2 2016 to 124.24 bn.Q3 2016(34.57%). It was followed by decline in no. of loans which were 8.84 mn in Q2 2016 and declined up to 5.92 mn. in Q3 2016((33.03%).On analysis it can be seen that there had been good growth in amount of loan from Q2 to Q3 since 2013 i.e. 13.55% growth in 13-14, 9% growth in 14-15 and 15.86% growth in 15-16 which was sharply declined i.e.34.57% in post demonetization period

4.3 Portfolio at Risk (PAR)

Portfolio performance of MFIs can be measured with the help of PAR to a certain extent. PAR 30, PAR 90 and PAR 180 are relevant tools for this purpose. PAR 30 indicates the total principal value outstanding of loans that have at least one payment more than 30 days overdue. PAR 90 indicates the total principal value outstanding of loans that have at least one payment more than 90 days overdue. PAR 180 indicates the total principal value outstanding of loans that have at least one payment more than 180 days overdue. Growth of MFIs during pre demonetization period can be noted with Figure 3. After analyzing this figure it is clear that during the period Q1 2013 to Q2 2016 PAR30, PAR90 and PAR180 were under 1% which can be considered as desirable risk. However there was noticed tremendous increment in PAR30 in post demonetization period which was 7.52%. similarly PAR90 was increased from an average of 0.23% to 0.41% and PAR180 was increased from 0.20% to 0.91%. Demonetization created shortage of cash in economy which played major role in this increment.

4.4 Collection efficiency of MFIs during post demonetization period

Since 2013 Indian Microfinance industry was growing at a very fast pace due to low penetration of formal banking system to majority of population. The industry has been considerably impacted from demonetization announcement on November 8, 2016 due to high dependency on cash transactions. The average collection efficiency of the Microfinance Industry has gone down from 99% in October 2016 to 70% during Nov 7 – Nov 25, 2016. Average Collection efficiency in the states Karnataka, Tamil Nadu, Maharashrta and UP which consist of 48% share (figure 5) of microfinance industry was declined up to 77.75% (figure 4). This was due to less supply of new currency, disruption in borrower's cash flow, lengthening of working capital cycle and government intervention in deposit and withdrawing of cash. In 3rd week of Nov., RBI extended the time limit for repayment of loan which was treated as waiver of loan on account of borrower. This misconception held responsible for less collection efficiency. In Post third-week of November 2016, the collection efficiency improved to more than 80% but remained stable at this point till March 2017. During this period the states, Uttarakhand, Uttar Pradesh, Delhi, Haryana, Rajasthan, Maharashtra, Punjab and Madhya Pradesh were the worst impacted states (figure 4). The states in Southern and Eastern part of India have been the least affected. Collective collection efficiency (CE) of MFIs decreased up to 82% and disbursement as % of CE was decreased up to 34 % in Dec.2016 (figure 6)

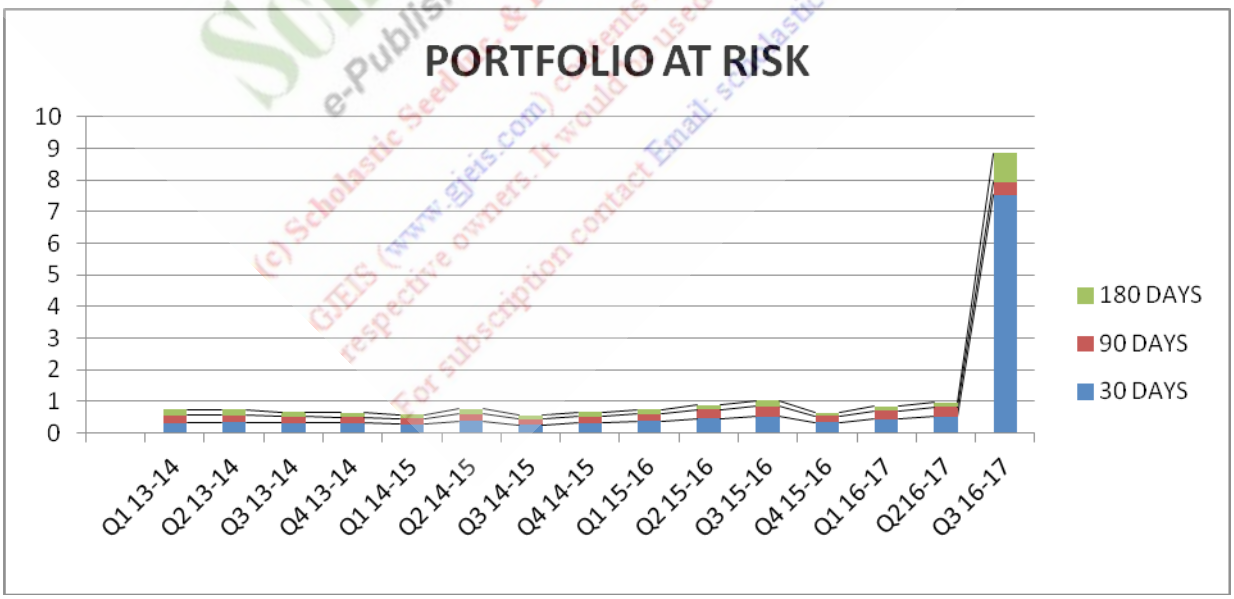

Figure 3. Source: MFIN Publications.

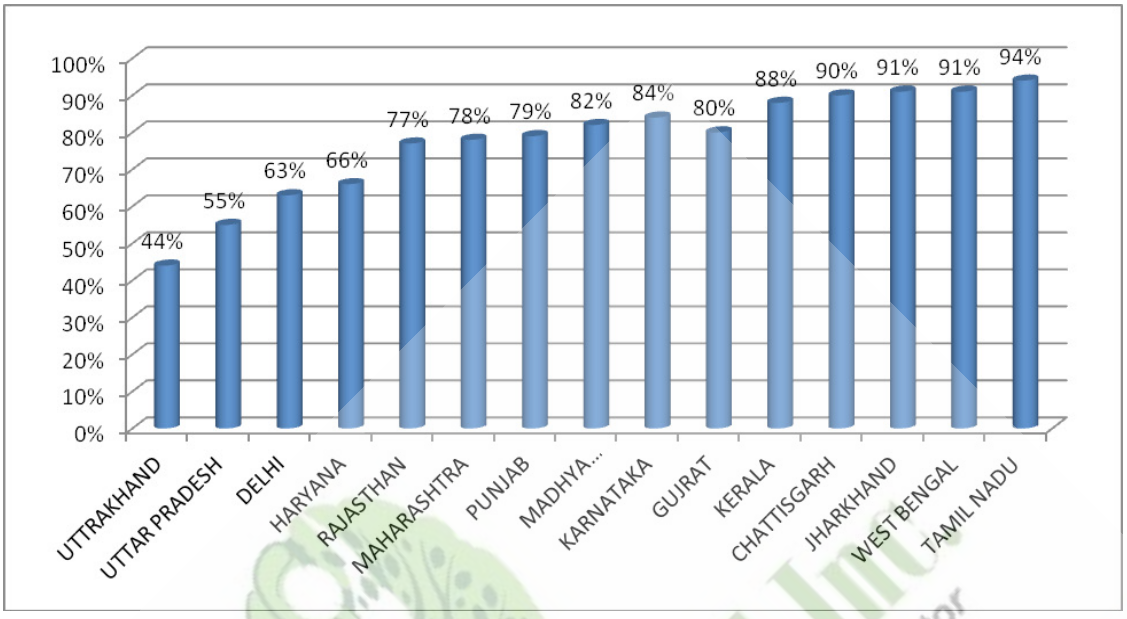

Figure 4. State wise collection efficiency in post demonetization period Source: CARE RATING State wise Portfolio share as on 31st Dec 2016.

Figure 5. Source: MFIN Publications.

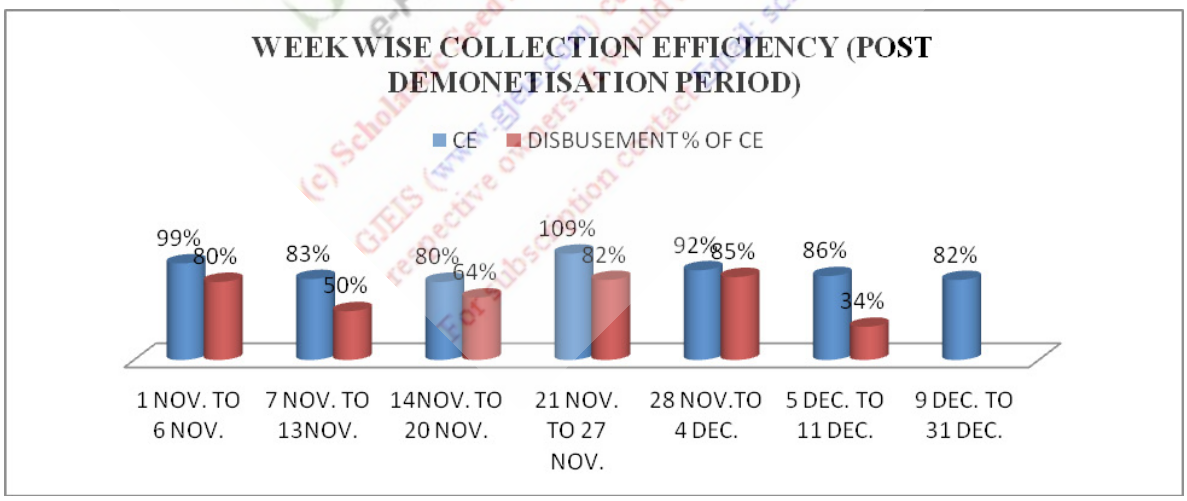

Figure 6. Source : CARE RATING (Data for disbursement % of CE during 9 Dec. to 31 Dec. not available).

5. Summary and Conclusion

Since 1992 till March 2017 microfinance industry has faced many ups and down. Till 2010(AP Crisis) govt. had never thought for any regulations and setting up of any regulatory authority for this sector. Being unorganized, this sector developed itself. However NABARD had been playing a great role for providing finance in this sector. In the absence of any regulatory guidelines, this sector faced big disaster in 2010 in the form of AP Crisis when PAR30 increased up to 23%. In 2012 the microfinance institutions (development and regulations) bill 2012 was passed in which regulatory guidelines for MFIs were proposed. This was a positive up move for this sector. Power was given to RBI to decide upper limit of providing loan to a customer by MFIs. MFIN and SA DHAN were appointed as regulatory authority for MFIs. Upper limit of interest rate was also fixed up to 25%. All these initiatives proved as golden keys for financial inclusion. Growth in MFIs can be seen with the facts that during Q1 2013 to Q4 2015, total amount of loan was increased from 63.8bn to 241.29bn and no. of loans for the same period were increased from 4.7mn to 11.745mn. PAR 30 during this period was also under 1%. This growth was noticed in pre demonetization period. In Q3 2016 demonetization decision once again badly hit this sector when a sharp decline in amount of disbursements, no. of loans and collection efficiency was seen. Par30 during this period (up to 31 Dec.) was also increased up to 7.52%.Not only this but govt. promises to waive off loan amount of farmers during Q4 2016, badly deteriorated financial backbone of MFIs especially working in UP. Each coin has two faces. On the basis of this fact, some positive effects can also be noticed of different govt. decisions during this period. Passing of microfinance bill converted this sector from unorganized to organized one. Portfolio risk of MFIs came to desirable bottom line i.e 1%. Fixation of upper limit of interest rate helped in more financial inclusion. Digital india campaign of govt. helped this sector to be more digitalized. It can be concluded that Microfinance sector can grow in India to a great extent to achieve the target of financial inclusion with govt. positive support but unhealthy policies can dump it in financial destruction.

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Design and Development of a Multi-Purpose Trolley

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Abstract

Trolley is the device used for carrying load or to transport the material from one point to another. For different types of application various types of trollies are available in the market. Depending upon the specific use the one will select the trolley, but it is limited to do a specific work. To overcome this problem, a new trolley was designed which could be used for multi-purpose. There are many types of trolley available in the market for various fields like airport, shopping malls, industries, hospitals etc. to carry the heavy or light loads. This paper contains the development of trolley, which includes design on the basis of creativity skills and fabrication, which can be used for more than one type of task. The trolley designed is the integration of airport trolley and shopping mall trolley. One more advantageous feature added to the design was a motorized wheel which reduces the human effort for carrying of load and also it can be operated manually if required.

Keywords: Automation, Creativity Techniques, Design, Innovation, Multi-Purpose Trolley, Product Development

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1. Introduction

The objective of this research is to design and fabricate a trolley based on the creativity techniques for the multi-purpose. It also provides a better control which are operated by mechanically or electronically for wheel movements in forward and reverse direction. An innovative concept of two in one facility has been conceived and being implemented. The research includes the integration of trolley used at airport and at shopping mall based on the creativity techniques. It is more effective and convenient for the use at airport and as well as at shop mall[2].

The design of trolley is completely based on the creative problem solving process which includes following eight stages:

- Analyzing the environment
- Recognizing a problem
- Identifying the problem
- Making assumptions
- Generating alternatives
- Choosing among alternatives
- Implementing the chosen solution
- Control

2. Methodology

The basic methodology to integrate creativity skills with product development process are:

a. Selection of Product: Classify the range of product and select the one for development.

The product selected is trolley. Trolley used at various fields for a specific work. The intention for selecting the trolley is to integrate two designs or two field of applications into a single product design.

b. Market Survey: Carry out market survey to find the scope of development for selected product.

Depending on the market survey, two field of applications, which includes Airport and Shopping mall are selected. On the basis of requirements, the trolley is redesigned into the single standard design which can be used in both areas.

c. Problem definition: Define the problem regarding the current product.

The trolley used at airport have the unique design operated with the help of brakes. The structure is heavier to move and critical to direct. At the same time the trolley used at shopping mall have the same problem of rigidness and also the customer finds it difficult to direct sometimes.

d. Area of improvement: Depending on the type of product, one need to identify various aspects for development to improve the design.

The following four aspects are identified and selected to improve

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- Aesthetics
- Ergonomics
- Functionality and
- Cost

e. Set of creativity skills/techniques: Creativity skills/techniques are selected to get a best solution for the problem identified.

The design is done on the basis of following creativity techniques.[6]

- Assumption Busting
- Brainstorming
- Browsing
- Creative Problem Solving
- Dimensional Analysis
- Flow charts
- Gap analysis
- Listing
- Using Experts
- Value Engineering

f. Integration and intersection of creativity technique and product development process.

During this phase the concept and idea is generated using the above listed creativity techniques.

g. Development of product

i. Introduction:

The literature survey done for the selected product and feedback taken from the customers to improve on design. So product is finalized on the basis of market need.

ii. Flow Chart:

The flow chart is than prepared which indicates the entire process and checklist. It includes the check point after every stage to verify the process of development simultaneously.

iii. Sketching:

The basic three dimensional sketch of the product is than prepared based on the imagination and need. This sketch represents the basic concept and look of the product.

iv. Design:

With the use of few creativity techniques and theoretical aspects, the design process started which indicates the type of material, safe dimensions, design safety, factor of safety etc.

v. Concept Screening:

The entire design is verified once again to allow for the alteration or re-modification.

vi. Finalized Design:

After brain storming process the design, material selection, dimensions, safety and process was finalized.

vii. Product Design Specification:

The components are than listed along with the material and dimensional specifications.

viii. Fabrication Processes:

The processes like welding, joining, cutting, painting etc. are planned as per the sub assembly and assembly.

ix. Bill of Material:

The component name, component material, number of units used in product manufacturing etc. are tabulated in the sequence of assembly.

h. Result, Discussion and Conclusion

After completion of design, fabrication and finishing the product, it is tested for loading conditions. The results are further discussed and concluded.

3. Materials and Methods

The structure of proposed trolley is shown in figure no.1. A full four side structure is being developed to carry and withstand the load up to 150kg including the self-weight of the trolley.

The trolley has strong frame and supporting structure. Two caster wheels are proposed as front wheels which are freely rotating. The rear wheels which are connect to battery of 180Watts, 12Volts D. C. motor with a speed of 1500RPM. The gear box of speed ratio of 1:80 is attached on the rear shaft which reduces the actual moving speed of trolley.

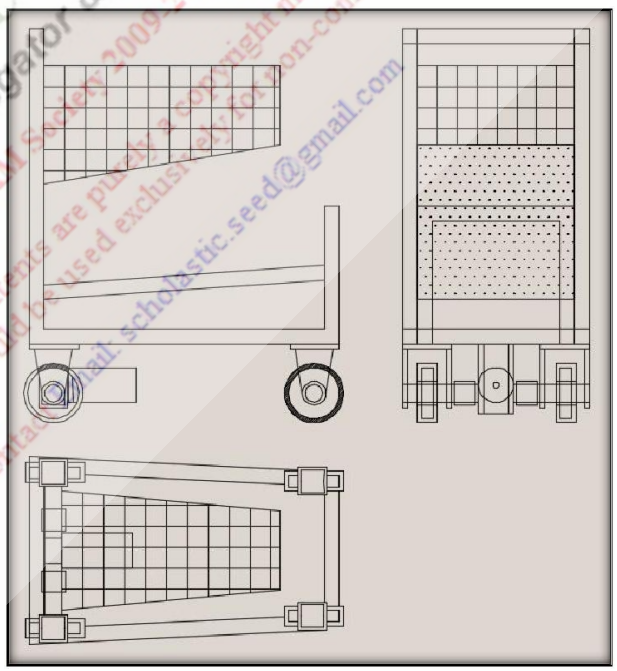

Figure 1. Sketch of Multi-purpose Trolley Actual Sub-Assembly

A switch is provided at the back of the trolley, which is nearer to operator, to move trolley either in forward direction or in

reverse direction. The frame base is metallic and covered with the sun mica coated wooden sheet to improve the aesthetic look of trolley and to cover all the electrical accessories. The height, width and length of the trolley is in proportion and ergonomically sound. The base front part is covered with another vertical hollow channel like structure to support the luggage.

The design resembles an airport trolley with different section. Here the square sections are used instead of circular sections and the joints are welded to provide the additional strength

As the trolley designed for multiple uses especially for two field applications viz. airport and shopping mall as described above, additional cart of wire frame structure is provided with the attachment as an additional accessory. The cart is over hanged at one end, hence the design looks aesthetically good at the same time the cart is attached with the help of hooks on the back vertical frame. Various slots are provided to adjust the height of cart as per the user requirement which makes it user friendly.

4. Standard Components and Assumptions

The following components are standard and taken directly from the market and depending on these standard components other design calculations are carried out:

- Motor: 180Watts, 12Volts, 1500RPM D.C. motor
- Gear box with speed ratio of 1:80
- Bolt and bush as per requirements

Let,

d : Diameter of shaft in mm

P_w : Power transmitted in watts

T : Torque developed in N-m

N : Speed of shaft in RPM (Revolutions per minute)

: Shear stress of shaft and key material in MPa

σ_{cr} : Crushing stress of key material in MPa

σ_R : Resultant stress in MPa

σ_o : Direct stress developed due to axial loading in MPa

σ_b : Bending stress developed due to eccentricity in MPa

: Bending moment produced due to effort on frame in N-mm

Z : Section Modulus in mm^3

P : Effort in N

A : Area of frame section in mm^2

bk : Width of key in mm

t_k : Thickness of key in mm

L_k : Length of key in mm

R : Radius of shaft in mm

b : Width of frame section in mm

t : Thickness of frame section in mm

5. Design Calculations

The shaft, key and square section for frame is designed and according to safe dimensions the components are taken for fabrication of trolley.

a. Shaft:

As shaft is the main component which is used to carry the load as well as torque. Hence, designing a shaft on the basis of strength:[4]

The power of motor is 180Watts and speed is 1500RPM. The gear box reduces this speed to (1500/80 ≅ 19RPM)

As we know,

<eq not clear in MS word>

T = 14.25 N-m

On the basis of strength,

<eq not clear in MS word>

For selected material value of shear strength, τ= 28MPa

14.25 x 103 =16π x 28 x d3 d = 13.43 mm ≅ 14 mm

b. Key

Key is the element which connects bush and gearbox to transfer the same amount of power. Square key, which is equally strong in crushing and shear, is assumed.[3,4] Shear stress for selected MS material τ = 28MPa

And Crushing stress σ_{cr} = 56MPa[1]

$T = b_k * L_k * \tau * R$

$14.25 \times 10^3 = 5*175*\tau*7$ $\tau = 2.32MPa < 28MPa$

Hence, assumed *key of 5x5x175 is safe in shear.*

$T = 0.5 t_k * L_k * \sigma_{cr} * R$

$14.25 \times 10^3 = 5*175*\sigma_{cr}*7$ $\sigma_{cr} = 4.65MPa < 56MPa$

Hence, assumed *key of 5x5x175 is safe in crushing.*

c. Bush

For transition fit of bush with shaft, a standard metallic bush selected for M25 bolt having following specifications:

Length of bush = 50mm Internal diameter of bush = 14mm External diameter = 25mm

d. Bearing

Bearing is the device used to reduce the friction between the shaft and wheel. The shaft is of 14mm diameter hence with the clearance a standard bearing which have internal diameter of 15mm is selected from design data book.

Bearing selected is 6002.[1]

e. Frame square section design

Frame is the rigid structure and act as a base to sustain the entire load. Therefore it is required to design the frame in such a way

that it won't break or bend. Hence assuming the effect of direct stress (σ_o) as well as bending stress (σ_b).[4]

$\sigma_{R\,=}\ (\sigma_o) + (\sigma_b)$

$(\sigma_o) = \ = {}^{500}{}_{*}$

<eq not clear in MS word>

Assuming square section,

Therefore b=t

$\sigma_{R\,=}\ (\sigma_o) + (\sigma_b)$

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$t = 35.25\ mm \cong 38\ mm\ b = 38\ mm$

f.Wire frame basket

A wire frame basket is an additional attachment provided at the top of the trolley to carry the shopping goods and is very much resembled to the shopping mall trolley.

The section of the basket is trapezium when observed from the top. The basket is made from wire of 6mm gauge and 3mm gauge.

The side nearer to operator = 24" in width The side nearer to operator = 12" in height The opposite side = 15" in width

The opposite side = 8" in height

The length of entire basket in horizontal plane is 24"

g.Wheels

Wheels of 6" diameter and 2" thick are used at the base for transportation of trolley structure from one point to another. Two wheels are on the rear shaft which are motorized and two front wheels are freely rotating which makes the motion of trolley free and easy.

6. Project Photos

Figure 2. Gearbox.

Figure 3. Bush.

Figure 4. Front wheels and Battery.

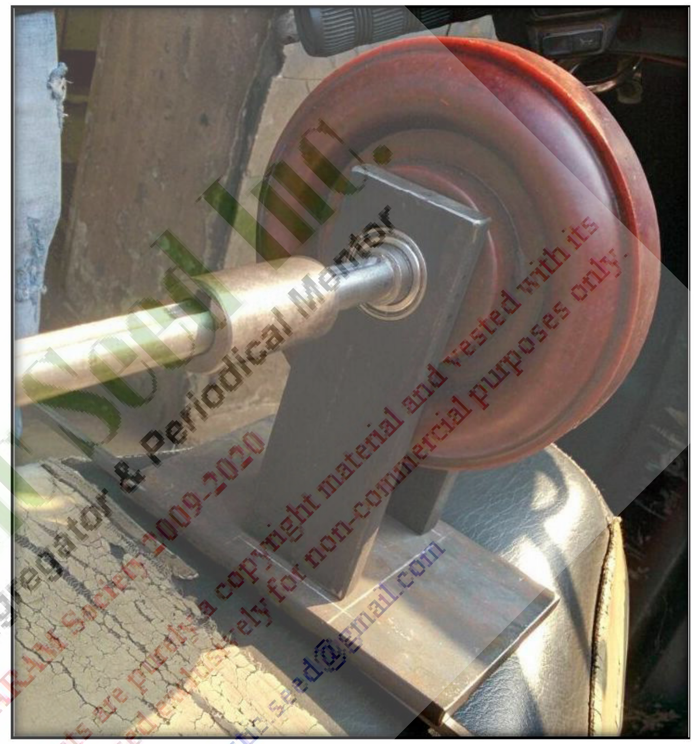

Figure 5. Rear Wheel with shaft, bush and keyway.

Figure 6. Base.

Figure 7. Trolley Sub Assembly.

7. Conclusion

The trolley has been successfully designed and fabricated. Functioning of the same has been confirmed by loading conditions and found working as per requirements. Automation of wheel has been developed successfully and tested to reduce the human effort at the handle of the trolley for giving appropriate direction. The same working model of trolley is being developed with more creative modifications in future as per the required market conditions.

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Design and Analysis of Flywheel for Different Geometries and Materials

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Abstract

Flywheel is a mechanical device used to store energy and utilize it whenever it required. Flywheels find its application in number of fields ranging from IC engine of 2-wheeler to more powerful jet engines. Increase in Kinetic Energy of flywheel is the most critical factor for the design engineers. The literature survey shows that flywheel can be redesign for mass optimization which results light weight and Increase in storage capacity. In this project work, an attempt is made to redesign the existing flywheel in terms of its geometry and different materials. Different cross sections of the flywheel are designed using 3D designing software Solidworks 2015. Finite Element analysis is used to calculate the Maximum Rotational speed the flywheel and the amount of Kinetic energy stored at that speed. The results shows that flywheel with Triangular cross sectional geometry and made of S-glass epoxy composite material stores highest Kinetic Energy per unit mass compare to all other combination of Geometries and materials. This New design of flywheel saves weight by 65.252kg compared to existing designs.

Keywords: Finite Element Analysis, Flywheel, Solidworks, S-glass Epoxy

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1. Introduction

A flywheel is an inertial energy-storage device. It absorbs mechanical energy and serves as a reservoir, storing energy during the period when the supply of energy is more than the requirement and releases it during the period when the requirement of energy is more than the supply. The main function of a flywheel is to smoothen out variations in the speed of a shaft caused by torque fluctuations. Generally used materials for manufacturing of flywheels are Steel, Cast Iron, Aluminum Alloy, and Titanium. Cast iron is most preferred because of long term durability and its design can be easily modified by avoiding cost of complete replacement. Internal combustion engines with one or two cylinders are a typical example. Piston compressors, punch presses, rock crushers etc. are the other systems that have flywheel. Rating of Flywheel Kinetic Energy is defined interns of Energy Density.

The Energy Density is defined as the Energy per unit mass,

Where, ω = Angular velocity of the flywheel, σ = Specific strength of a material , ρ = Density of the material.

2. Selection and Dimensions of Flywheel

Thresher machine is used in agriculture sector to separate the comb from grain. Flywheels used in Thresher Machine are made of single solid disk cast iron material and is selected in this project work. Specifications are mentioned in the Table no 1.

Table 1. Flywheel Dimensions

Mass of Flywheel (m)	72kg
Outer Diameter (D_o)	500mm
Inner Diameter (D_i)	50mm
Thickness (t)	50mm
RPM	750

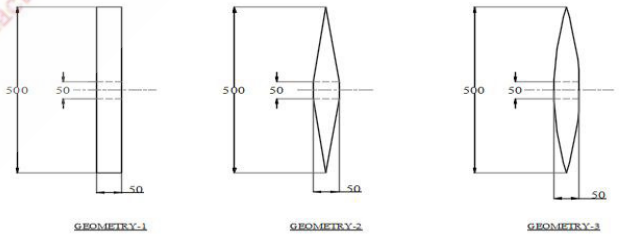

Figure 1. Different Cross sectional Flywheels.

3. Design of Flywheel Geometries

Single solid disk flywheels made of rectangular cross section is considered. Variation in cross section of the flywheel will results

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in variation of Maximum rotational speed and kinetic energy storage capacity. In this project work existing rectangular cross section flywheel designs are compared with different cross sectional are of flywheels. The redesign of flywheel is done by changing the cross-section and reducing the material by keeping outer diameter, inner diameter and thickness to be constant. Three Different geometries are considered for design and analysis.

4. 3D Modelling of Different Geometries of Flywheel

Designing and modeling of flywheel is done using SOLIDWORKS 2015. Solidworks is a solid modeler that makes use of parametric feature-based approach for creating models and assemblies. The following figures show the present as well as re-designed geometries of flywheel.

ANSYS Workbench, one can generate 3D models, FEA models, perform analysis and generate results of analysis.

5. Material Selection

Flywheels Kinetic Energy is Depends upon the mass Moment of inertia of the Cross section which intern depends on the material of flywheel. Hence selection of Material to enhance the rotational speed and kinetic energy of the existing system is a critical task for the engineers. Different composite materials are short listed depending upon the Energy storage capacity of the materials. Weighted Residual Method (WRM) is used to find the best materials out of the number of shorted one. S-glass epoxy stands at the top to full fill all the requirement of flywheel. It has good inner strength and variety in surface textures. It is cost effective and corrosion resistant. In this project work S- Glass Epoxy Flywheel is compared with Existing Cast Iron ASTM – 30 Flywheel.

Table 2. Flywheel Material Properties

Material	Young's Modulus E, GPa	Poisson' s Ratio,	Density , kg/m^3	Yield Strength, y MPa
Cast Iron ASTM-30	101	0.23	7510	260
S- Glass Epoxy	90	0.33	2190	190

6. Theoretical Calculation

For Flywheel Geometry 1 made of Cast Iron

1. Angular Velocity,

<eq problem in MS Word>

2. Mass Moment of Inertia, $I = {}^1/_2\ mr^2 = {}^1/_2 * 72.992 * (0.250)^2 = 2.281\ kg - m^2$

3. Maximum Kinetic Energy, $KE = {}^1/_2\ I\omega^2 = 760.14$ KJ

7. Finite Element Analysis using ANSYS

Finite Element Method & Analysis is used to find the maximum Speed the flywheel can rotate without any failure and Amount of kinetic energy the flywheel can store at that maximum speed. Static structural analysis is used to find the Maximum Rotation speed and Explicit Dynamics is used to calculate the amount of kinetic Energy in the flywheel.

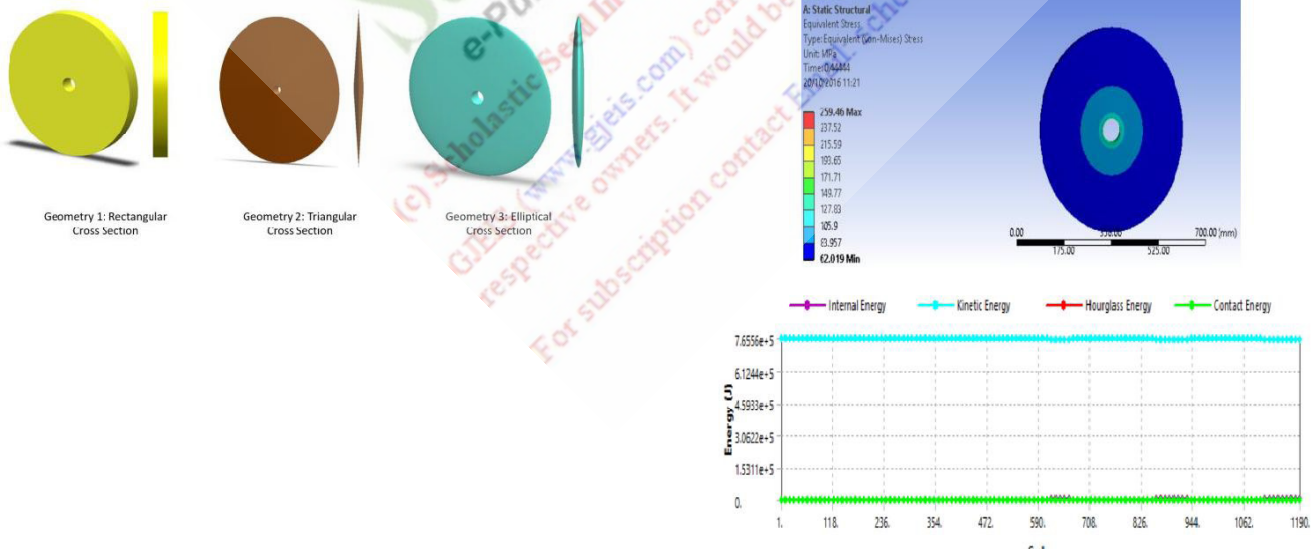

Figure 2. Different Cross sectional Flywheel Models.

ANSYS is a Computer Aided Finite Element Modeling (FEM) and Finite Element Analysis (FEA) tool developed by ANSYS Inc. In the Graphical User Interface (GUI) of

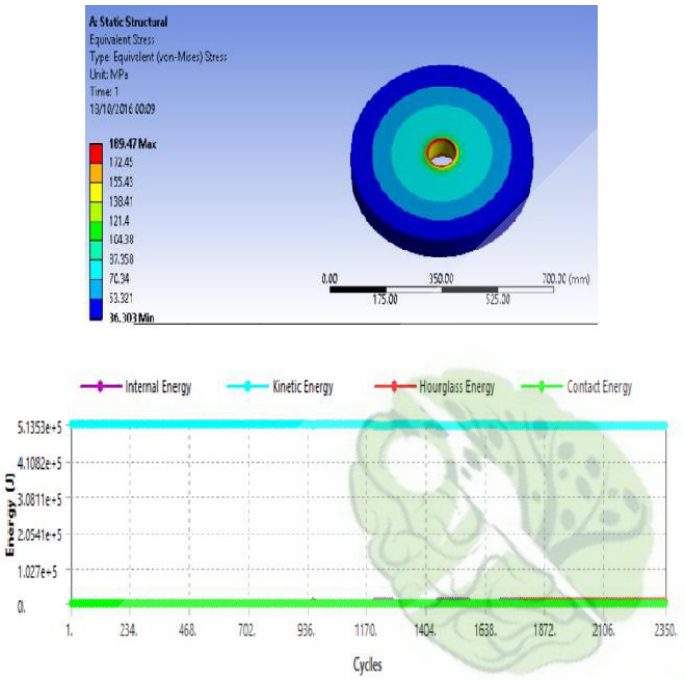

Figure 3. Stress distribution and KE of Geometry 1 with Cast Iron.

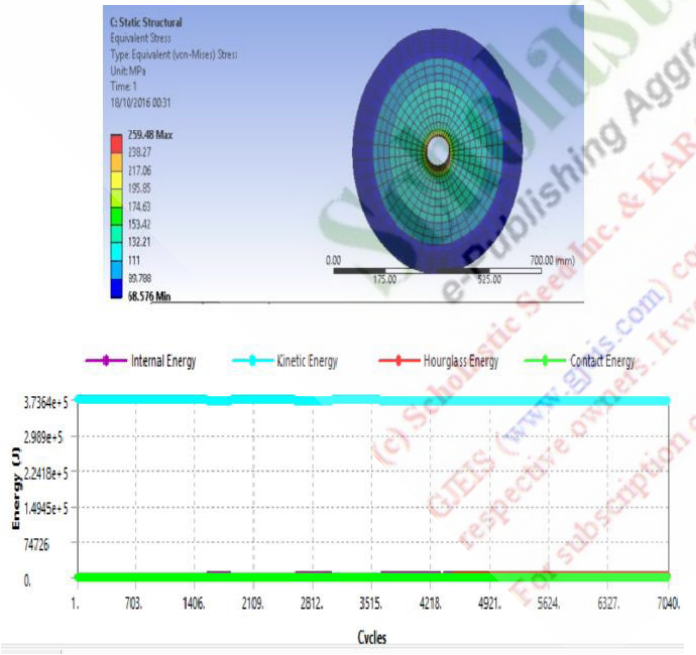

Figure 4. Stress distribution and KE of Geometry 1 with S-Glass Epoxy.

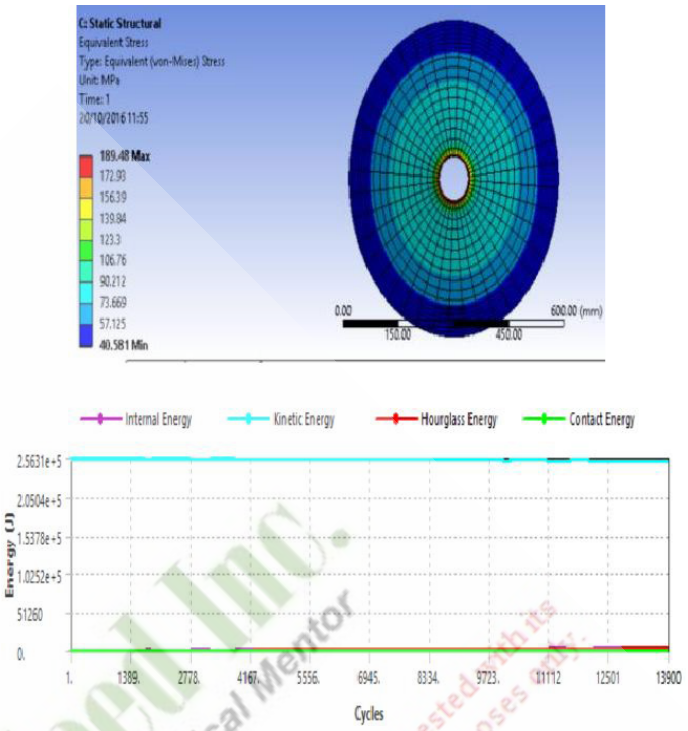

Figure 5. Stress distribution and KE of Geometry 2 with Cast Iron.

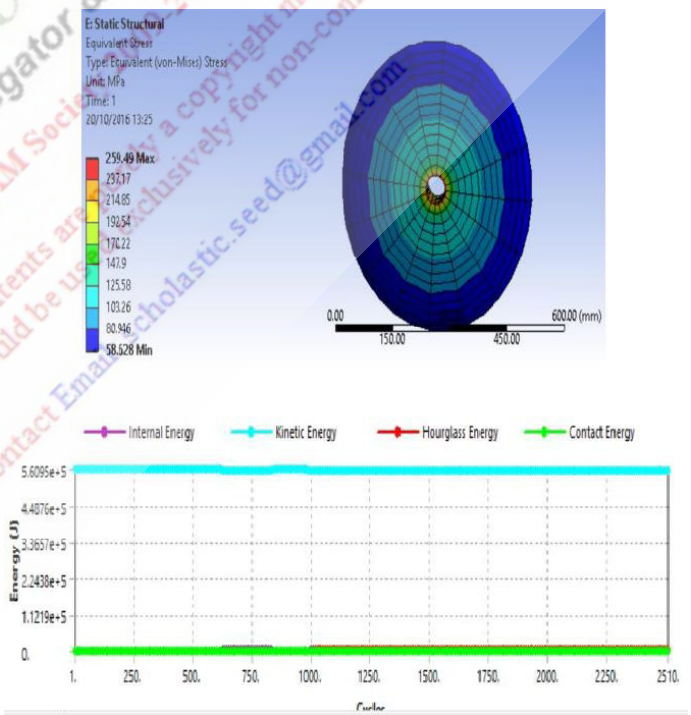

Figure 6. Stress distribution and KE of Geometry 2 with S-Glass Epoxy.

Table 3. Result table of ANSYS Simulation

Geometry	Material	Mass (kg)	Speed (RPM)	Stress (MPa)	Kinetic Energy (KJ)	Kinetic Energy perkg (KJ/kg)
1	Cast Iron	72.9	779	259.4	766	10.49
	ASTM 30	92	6	6		
	S-Glass	21.2	118	189.4	514	24.14
	Epoxy	85	24	7		
2	Cast Iron	26.5	115	259.4	374	14.09
	ASTM 30	43	43	8		
	S-Glass	7.74	177	189.4	256	33.07
	Epoxy		04	8		
3	Cast Iron	50.2	901	259.4	561	11.17
	ASTM 30	44	8	9		
	S-Glass	14.6	137	189.4	379	25.87
	Epoxy	52	43	9		

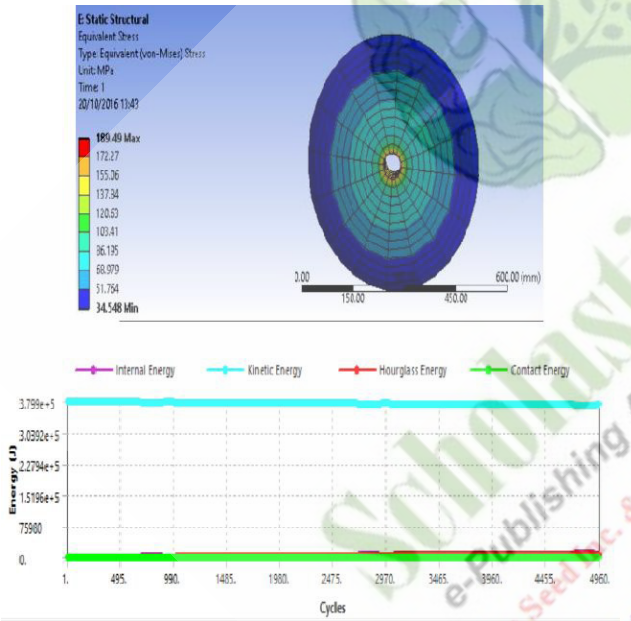

Figure 7. Stress distribution and KE of Geometry 3 with Cast Iron.

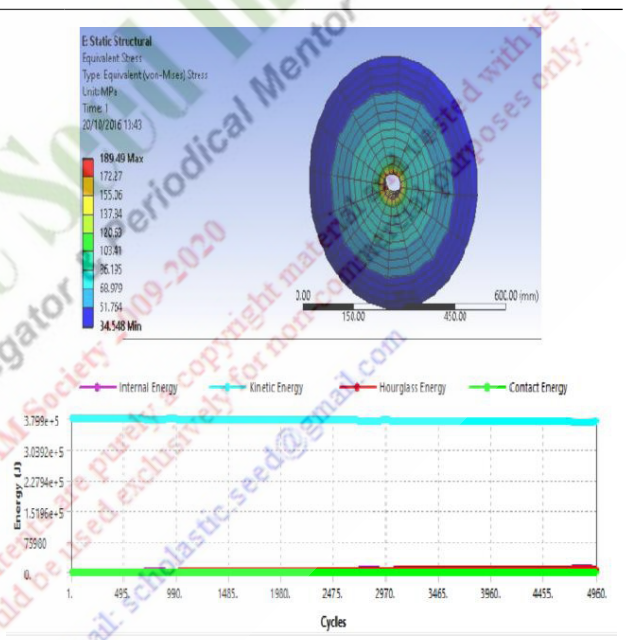

Figure 8. Stress distribution and KE of Geometry 3 with S-Glass Epoxy.

8. Result and Conclusion

The results shows that flywheel with Triangular cross sectional geometry and made of S-glass epoxy composite material stores highest Kinetic Energy per unit mass compare to all other combination of Geometry and material. We can observe that the mass is going on decreasing from present geometry to modified geometry thus increasing flywheels maximum rotational speed, and hence maximum Kinetic Energy to corresponding rotational speed. This New design of flywheel saves weight by 65.252kg compared to existing design of flywheel made of Cast iron ASTM 30.

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Design and Fabrication of Solar Powered Water Dispenser

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Abstract

In water dispensers available in today's market have a compressor for cooling water and heating element to heat the water along with a lot of other secondary devices. Use of these hefty devices make this water dispenser heavy, bulky and consumes more power. Its compressor releases cfc which are very handy in ozone layer depletion. Our aim is to eliminate these limitations from the conventional water dispenser. We will create a potential difference using solar isolation to achieve the temperature difference.

Keywords: Peltier Effect Thermocouple, Refrigeration, Solar Powered Water Dispenser

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1. Introduction

In the water dispensers available in today's market have a compressor for cooling of water and a heating element to heat the water along with a lot of other secondary devices. Conventional refrigeration is the process of removing heat from an enclosed space, or from a substance, and rejecting it elsewhere for the primary purpose of lowering the temperature of the enclosed space or substance and then maintaining that lower temperature. Cooling is the natural or artificial process by which heat is dissipated. Cold is the absence of heat, hence in order to decrease temperature, one removes heat, rather than adding satisfy the Second Law of Thermodynamics, some form of work must be performed. This work is traditionally done mechanically but can also be done by other means..

Innovation in the field of Refrigeration lies in the fact that what we are doing to reduce or eliminate the excretion of CFCs used in coils and compressors. Efforts are being made to develop an electric field refrigeration unit (as electricity is more convenient) and in the future, we can envision a flat-panel refrigerator with no coils and compressors, but solid polymer with appropriate heat exchangers. Researchers are working with ferroelectric polymers that exhibit temperature changes at room temperature under an electrical field. These polar polymers include poly (vinylidene fluoride-trifluorethylene) and poly (vinylidene fluoride-trifluoroethylene)-chlorofluoroethylene.

Water dispenser is a kind of Peltier works on the Seebeck Effect also known Device/Thermoelectric Device available in the market which as Thermoelectric Effect. Tiisthermoelmecatdrie coeffftewcot states that if a temperature difference is n created across a suitable arrangement dissimilar semiconductors (p-type & n then the free electrons available in n-type -ytype) connected side by side on a common platform semiconductor and free holes available in p-type semiconductor will diffuse from hot side towards the Cold side. This diffusion of charge carriers from hot side to cold side create a voltage difference due to which an electricity flow ets established. The arrangement we are talking about is very small in size and thus creates a very tiny amount of electricity but if we arrange a large number of such arrangements between two plates one of which is colder comparatively than the other plate which is hotter. In this case all those small modules will combine to generate a considerable amount of electricity. Any such arrangement with a large number of modules connected together is called Peltier Device. 5.1 Thermoelectric Cooling In theory if a device creates a potential difference when both sides of the device is It means it should create a subjected to different temperature then it should work vice-versa. We connect the pelt device to a battery temperature difference across its both panels when s. Now we can use this property and its internal construction supports this theory in all aspect of the device to cool Water below its normal temperature or heat it up above its normal temperature.

2. Design and Methodology

With the peltier effect thermocouple causes a temperature difference between the junctions of the different materials Phenomenon that is potential difference applied across a in the thermocouple. Since the hot junction can be placed outside of an insulated area, and the cold junction can be placed inside the region, the Peltier effect can be used to cool this reverse Seebeck effect or Peltier effect. region (or an object).

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According to the requirement our main aim is to cool water using this previous chapter is Prepared according to the calculation done. For calculation theory and A highly updated design which is explained in formulae from different branches like thermodynamics, heat and mass transfer, fluid mechanics is applied. Methods from electronic circuit theory are also applied. This mixed use of theory make this project more of mechatronics field. Different parts used in the solar panel water dispenser are explained below

2.1 Peltier Cooler Module

The heat-sink side of the TEC gets very hot, so it is necessary to have a fan and/or some sort of radiator to dissipate this heat. Otherwise, the entire TEC would begin to heat up, and pieces would fuse together. Normal Peltier elements are roughly a few centimeters thick and a few millimeters or centimeters on a side. To obtain greater cooling abilities, the individual elements are connected in stacks, or they can be connected in some combination of series and parallel electrical connections. According to our requirement four modules are used to cool the water tank of size 500 rnl. All four peltier modules are contact with the heating arranged in such a way that all are connected in parallel on four side of the water tank Cli is in contact with the wall of cooling tank whereas .long surface of peltier, heating side is in tank. Heating is done by the exhaust air from fan which is at high temperature from normal.

2.2 Water Tank

There are total of three tank used in the solar power water dispenser. These are cooling water tank, heating water tank and reservoir tank. Material used in making these tanks is aluminum because aluminium is best available conductor of heat in market. And at the same time it's easily moldable and light. Capacity of cooling water tank and heating water tank is 500m1 both and the reservoir tank has capacity of lilt altogether as it have to compensate water requirement of both heating water tank and cooling water tank. By working model point of view reservoir tank is placed at some height above the other two tank develop head so that water flow between these tank under pressure.

2.3 Solar Panel

Main aim of this project is to provide clean fuel energy that is why solar energy is used by attaching a solar panel which will convert solar energy into clean electric energy. We are using a detachable solar panel which is used to charge the battery. Solar panel as per the calculation and in project point of view is taken of smaller dimension in comparison to which Can be used in real application. In the model presented, dimension of solar panel required ts 5sqleet. As per the experimental result a pair solar panel will take around 4 hours to charge the battery which is of 12 volt, 7.2 Ah. ery is connected to solar panel to charge the battery so we are using rechargeable In this nese batteries could be charged within 4 hours. Since batteries supply Direct

2.4 Transformer

As battery articled works on 1 volt 7.2 Ah, it is required to decrease the n current intensity. For which a step down transformer is used *step do ii transformer is a connection to decrease th between battery and i ar er device. We e using step down transformer because it is required the amount pelt of mains supply as sunlight current. As we also provided the method of charging battery by t is not available in evening required which therefore stepping down of current is is further fulfilled by transformer.

2.5 Rectifier

As the current supply from battery to transformer is still A.0 which is not our requirement because peltier cooling effect on different side of surface is only achieved when D.0 is supplied. For this requirement an A.0 to Derter between transformer and pettier cooler modules .0 conv i.e. rectifier is attached.

2.6 Base Material

This whole setup requires a base which mentioned elements of solar power water dispenser condition of electric shock and provided with components are firmly fixed by using a glue solution is used to hold the assembly of above . Material chose is wood as to prevent any better earthing. On this base different It

2.7 Dispensing tap

Cooling water tank and heating water tank is provided with dispensing tap through water pipe. Both taps have colour indication on it i.e. blue colour for cool water and red colour for hot water.

3. Specifications

Metal Used: Aluminium

Insulating material: PUF capacity of Peltier Device-60 Watt ,/ &
Peltier Peltiers used- 4 fan's power---1 0 Watts/fan fans Used-.4
Volume of Hot Chamber-340 ml

4. Dimensions of Hot Chamber

Length---6.2 cm Width-----3.6 cm Height-15.3 cm Thickness =2.4 mm

Volume of Cold Chamber= 340 ml

5. Dimensions of Cold Chamber

Length-6.2 cm
Width=3.6 cm
Height=15.3 cm
Thickness=2.4 mm
Time for Cooling-30 minutes
Time for Heating-30 minutes
Degrees cooled=l5°C

6. Power Supply

2 Rechargeable Batteries
Rating: 12 Volt, 7.2 Ah
Solar Panel Capacity=50 Watt Solar Panel Dimension-5 sq.feet

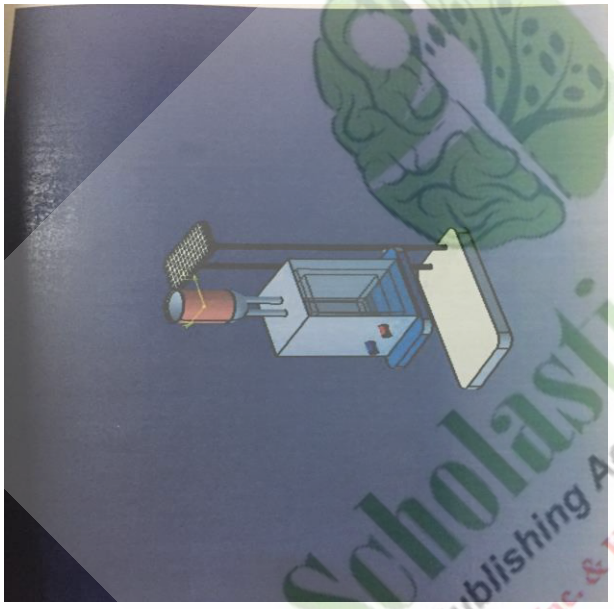


Figure 1. Preliminary Design.

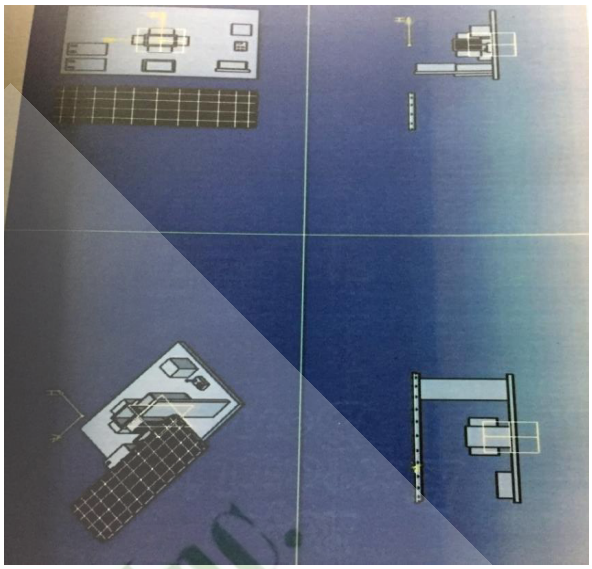


Figure 2. Updated Design Multi View.

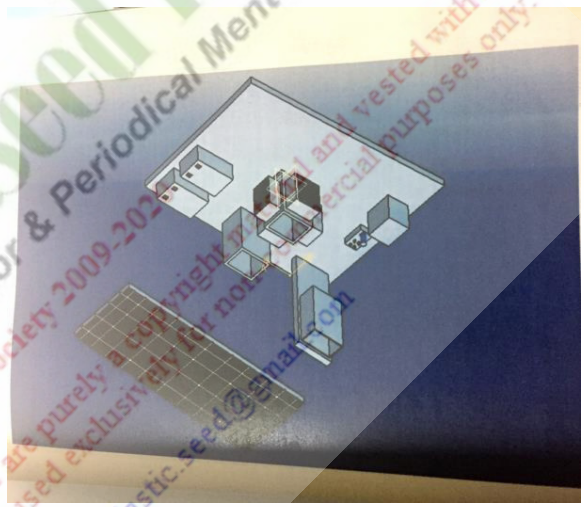


Figure 3. Updated Design- Isometric View.

7. Calculations

Time taken by the system to cool the water= 30 minuets= 1800 seconds

Work done on the system= 60×30×60×4J=432000J Entropy generated in the system=m×c×lnTf/Ti+Q/T0 Inideal condition entropy generation is 0

So m×c×lnTf/Ti+Q/T0=0 M×4182×ln293/308+432000+m×4182×15/308=0

the value of m from the above equation We got m=3.412 kg

Since Second law efficiency in most of the cases is found to be 10% of the ideal

So. mass that can be cooled is -1 x 3.412kg = .3412kg. = 341.2 ml

8. Dimensions of the cooling Chamber

mass of water to be Cooled by the Peltier --- 341.2ml we know 1 m^3 = 1000L

So, Volume of container = 3.412x 10-4 m^3

cross sectional Area of Aluminum Container Available =3.6x6.2 cm^2

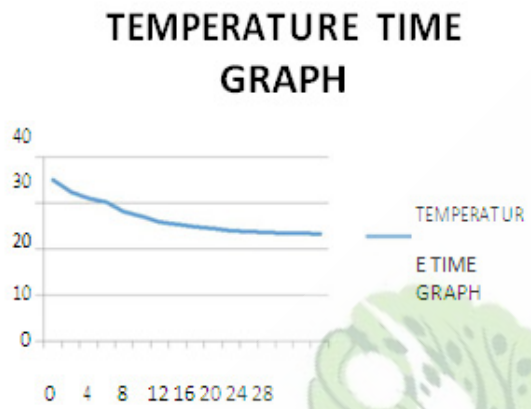
so height of container Height will be 15.28 cm.

9. Capacity of Heating Coil

Dimensions of heating chamber=15.28x3.6x6.2 cm^2 Time taken=1800 sec

Temp difference=150c
Capacity of heating coil= .3412 x 4180 x 15 1800
Time taken for heating the box is 720 sec

10. Results and Discussion



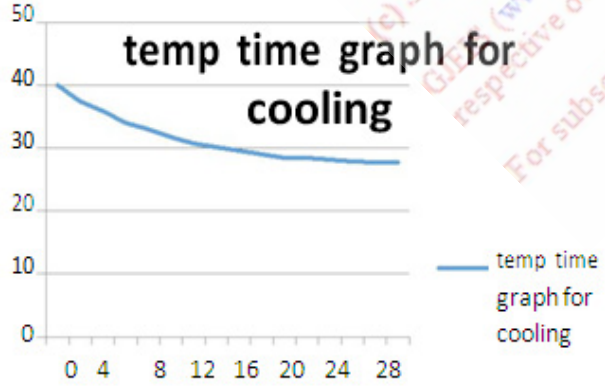
TEMPERATURE-TIME GRAPH FOR COOLING OF 40°C WATER

Time (min)	0	2	4	6	8	10	12	14
Temperature(c)	40	37.4	35.9	34	33	31.7	30.7	30.1
	16	18	20	22	24	26	28	30
	29.6	29	28.5	28.4	28.1	27.9	27.8	27.7

With the peltier effect thermocouple causes a temperature difference between the junctions of the different materials .Due to this Phenomenon the potential difference applied across a in the thermocouple and a potential difference exist using solar isolation to achieve the temperature difference.

Expected fall in temperature= 150c Actual fall in temperature= 120c

Actual time taken for cooling upto this temperature is 30 minutes



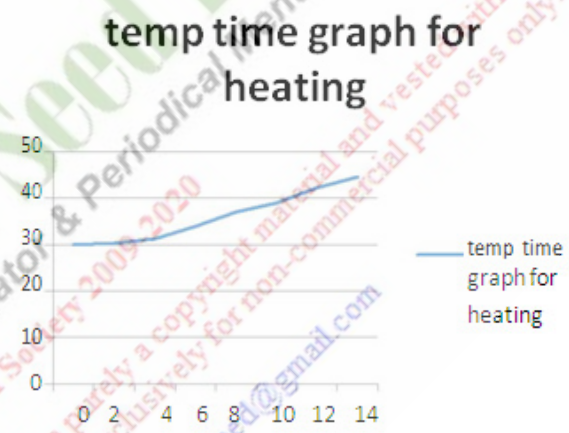
TEMPERATURE-TIME GRAPH FOR COOLING OF 50°C WATER

Time (min)	0	2	4	6	8	10	12	14
Temperature(c)	35	32.3	31.1	30.1	28.1	27	25.8	25.3
	16	18	20	22	24	26	28	30
	24.8	24.4	24	23.7	23.5	23.4	23.4	23.3

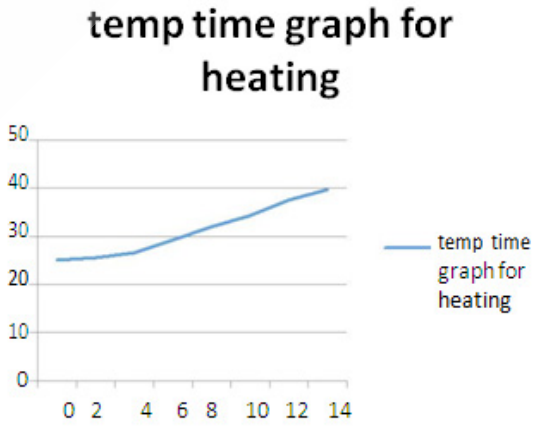
IN HEATING CHAMBER

Expected rise in temperature= 150c
Actual rise in temperature=140c
Expected time taken for heating= 12 min
Actual time for heating= 14 min

Time (min)	0	2	4	6	8	1	12	14
Temperatur e(c)	30	30.4	31.3	34	37	39	42.2	44.4



Time(min)	0	2	4	6
Temperature(c)	25	25.6	26.6	29.2
	8	10	12	14
	32	34.3	37.5	39.7



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A Review of the Advancements in Geothermal Heating and Cooling System

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Abstract

The increasing demand for energy and the depleting fossil fuels have fuelled explorations in new frontiers of Renewable Energy Technology. Geothermal Heating and Cooling is a new advancement in HVAC industry of India. It uses earth's heat for space heating and cooling with the use of Heat Pump systems, saving up to 51% electricity consumption in HVAC, and reduced CO2 emissions. The main prospects of Geothermal Energy are longer equipment life and lower operating costs. This paper reviews the recent advancements in Geothermal Heating and Cooling System.

Keywords: Air Handling Unit [AHU], Cooling, Geothermal, Heat Pump, Ground Loop, Ground Sources Heat Pump system [GSPH's], Heating

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1. Introduction

Previously the air conditioning system was considered as the symbol of luxury. Now as the world is growing faster it has become a necessity of the day. Residential and commercial sector contributes to over 30% of total electricity consumption[1]. Out of this, HVAC system consumes 64% of electricity. As the need for HVAC increases, so does the demand for energy. Hence fossil fuels are used on large scale to meet this requirement, increasing CO2 and particulate matter emissions, resulting in global warming. This has paved the way for renewable energy sources and the feasibility of "Geothermal Heating and cooling" [2].

The name Geothermal is derived from the words 'Geo' means earth and 'Thermal' means heat. The earth's heat is produced by gravitational collapse and radioactive decay of isotopes. The soil provides a stable temperature at approximate 6-8 m in range of 16-29 °C all year round[1]. The geothermal system is also called 'Geothermal heat pump system [GHP's], Ground source heat pump system [GSPH's] or Geo-exchange system, working on the basic heat pump principle of stable earth temperature to provide heating and cooling. Ground loops are used to connect the ground and the space for heating or cooling applications.

2. Components of GSPH'S

2.1 Geothermal Earth Connection System

Geothermal earth connection system connects the space to be cooled or heated with the earth using Copper (high thermal conductivity) or High Density Polyethylene [HDPE] pipes. The thermal conductivity of Copper is 380 W/mK whereas the thermal conductivity of HDPE pipes is 0.42 - 0.51W/mK. The diameter of pipe ranges from 29 mm to 38 mm[10].

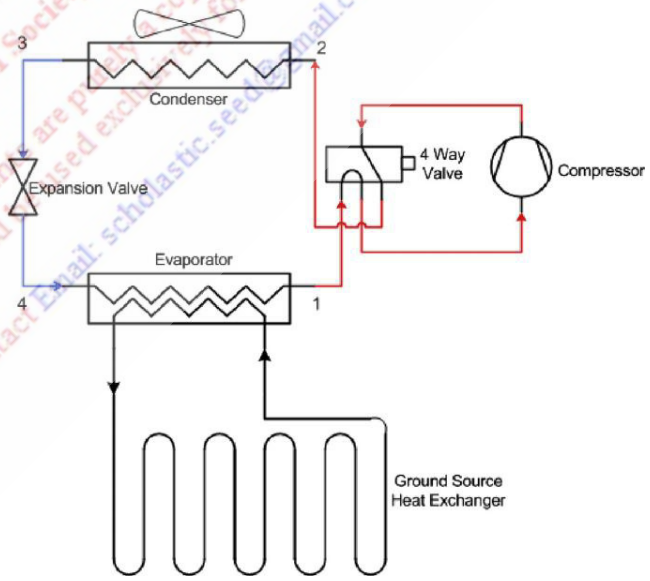

Figure 1. Schematic diagram of geothermal heating and cooling system.

As the length of the pipe increases the overall efficiency of the system also increases, with the required length of pipe depending primarily on geographical and building character.

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There are two type GSPH's system

1) Open loop

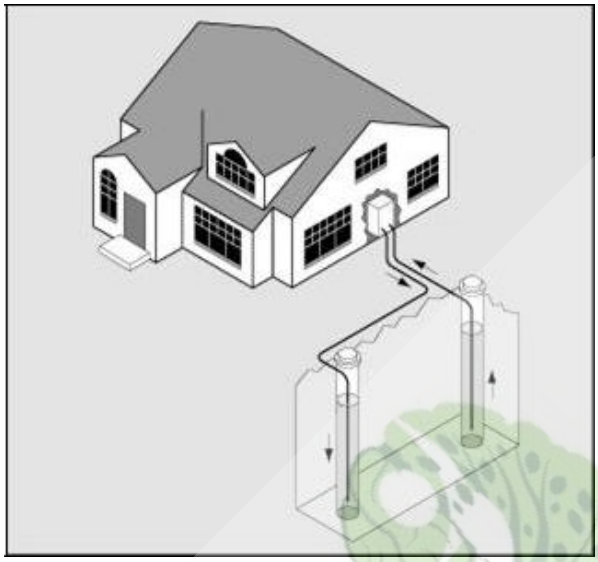


Figure 2. Open loop system-Schematic.

There are two wells one for taking the water and another for leaning the water. The water is injected from the 1st well to extract or reject heat as per the requirement and then ejected into 2nd well. The water requirement is 5.67-7.57 lpm per ton[3].

The main drawback of this system is the quality of water, affecting the component life, and escalating maintenance costs. Also the local environment regulation may be restrictive.

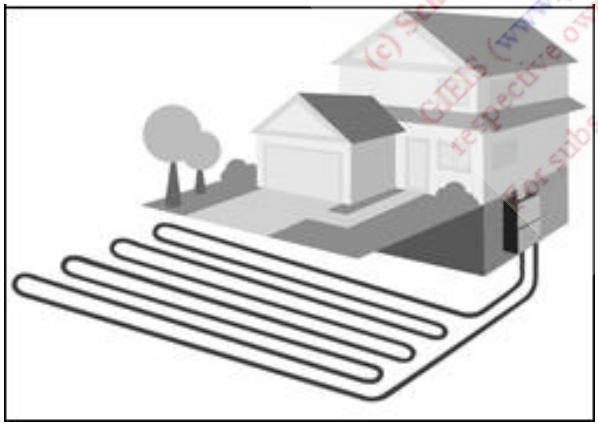
2) Closed loop:

In closed loop system, water is re-circulated through the coil forming a closed loop. The quality of water can be regulated and antifreeze mixture (eg. Methyl alcohol) can be added to avoid freezing.

Closed loop system is further classified into

i. Horizontal loop:

Horizontal loop are normally at 1-2m depth[8].



If the available land is more than horizontal loop can be use. After installation of this system we can't used this land for other use, hence capital in tie in this system.

Also the soil temperature varies from the length to length and no constant temperature.

Horizontal loop required approximate 232 m^2 /ton of area, but are easy to installed and less costly[9].

ii. Vertical loop:

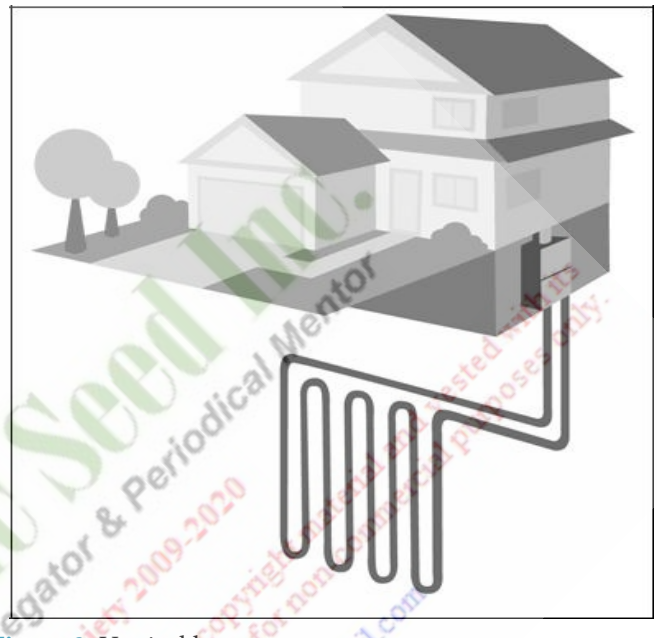


Figure 3. Vertical loop system.

Holes are drilled in the earth. The space between two bore holes at least 5-6metre apart. This type of system required 23-27 m^2/ton of area[9]. The cost of installation, being a function of tube depth and geology of the location, is more than the horizontal.

The advantages of vertical loop are lesser space requirement, lesser variations due of temperature and thermal properties of soil and greater efficiency[10].

2.2 Geothermal Heat Pump System

The heat pump system consists of a compressor, condenser, expansion valve and evaporator and is governed by the Second Law of Thermodynamics. It raises the temperature of vapour by isentropic compression[6]. Cooling effect is produced by expanding the compressed vapour in the expansion valve and lowering its temperature. In summer it acts as a refrigerator. The heat pump does not generate heat but transfer heat from lower temperature to higher temperature.

Heat pump converts 1KW of electricity into 3KW of useful work[11]. Hence COP of a heat pump is greater than a refrigerator. A heat pump has an average life +20 years[7].

2.3 Geothermal Heat Distribution System

It consists of a Air Handling unit [AHU].This supply the required temperature air to the space whose temperature is to be maintained. Ducts are provided to supply the required air[8].

2.4 Working of Geothermal Heat Pump System

i) Heating mode

In winter when heating is required in the room, the water in the ground loop absorbs the heat of earth and thus the temperature of water in the pipe increases.

The expanded vapour refrigerant is circulated within the heat conductive copper pipes and because the refrigerant absorbs the heat from ground loop water, its temperature increases. This vapour refrigerant is further sent to the compressor where it is compressed to high pressure and temperature. The hot refrigerant vapour is passed from the copper coil in Air Handling Unit (AHU). The cold air from the house is blown over this copper coil using a fan or a blower, absorbing heat from the hot vapour refrigerant and heating the room.

ii) Cooling mode

In cooling mode, the operational reversal of heating mode occurs. The water in the loop rejects its heat to the earth and temperature of water decreases. The hot refrigerant from the compressor reject its heat to ground water and the vapour refrigerant temperature decreases. After this the refrigerant vapour is expanded in the expansion valve, further reducing its temperature. This cold refrigerant then circulated in copper coil of AHU.

The hot air from the room is passed over the cold refrigerant coil, where the hot air rejects heat. Now this cold air is supplied to the room. The hot refrigerant is sent back to the compressor, where it is compressed to high temperature and pressure, and the whole cycle repeats.

Also with heating and cooling of space, we can get hot water by installing desuperheater in the system.

3. Comparison

From the figure it is observed that 51% of energy is free and also the energy required for heating and air conditioning, water heating has also reduced.

4. Advantages

The heat pump has higher efficiency and also this system does not depend on outside temperature, as in case of traditional HVAC system[12].

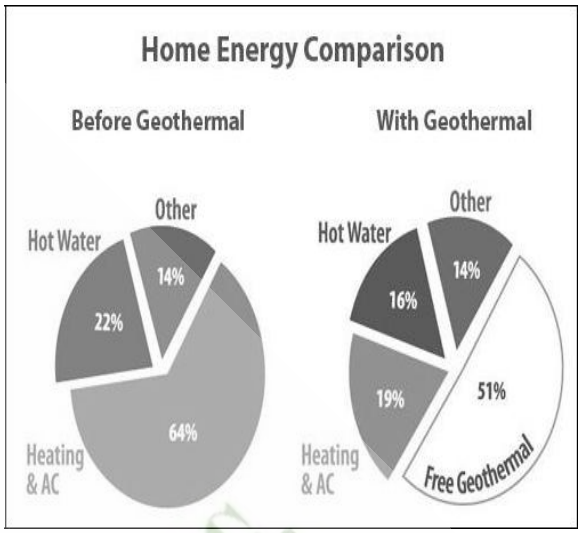


Figure 4. Energy savings by GSHP's.

Lower maintenance and operating costs, as heat pump system is installed within the house, protecting it from harsh weather and climate conditions[12]. Also it requires 50% lesser power The Ministry of New and Renewable Energy (MNRE), New Delhi in a move to boost use of renewable sources and reduce Carbon footprint, is providing loans, concessions in tax credits and many more incentives.

Water conservation is 100% due to the replacement of chiller with ground loops[13] and also low cost of water heating Geothermal heating and cooling is an eco-friendly as large amount of CO_2 is saved

5. Future Scope

The growth of this technology is slower than the other RES technology due to high cost of installation and limited knowledge of geothermal technology and its means of harvesting[14].

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Investigation and Minimization of Barriers for Effective Implementation of ERP System in Indian Industries

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SECTION I

Demographic Details

Name: (Optional) _____

Name & Place of Company: _____

Designation: _____

(Please tick (>) against the appropriate option)

-Age (year) < 25 ☐ 26-35 ☐ 36-50 ☐ > 50 ☐

-Income (m) < 50,000 ☐ 50,000 -1,00,000 ☐ > 1,00,000 ☐

-Educational Qualf Graduate ☐ Post Graduate ☐ Others ☐

-Occupation Business ☐ Service Professional ☐

-Marital Status Married ☐ Unmarried ☐

-Family size Two ☐ Three ☐ Four ☐ > 4 ☐

-No. of children Nil ☐ One ☐ Two ☐ > 2 ☐

SECTION – II

1] Rank the following from 1 to 4 nos. in planning the implementation in order of importance to you. (Pl. give 1 to the most important one and then 2, 3…..)

	Rank
a) What to implement?	☐
b) When to implement?	☐
c) Where to implement?	☐
d) How to implement?	☐

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2] Do you see barriers in effectively implementing the ERP system?

YES NO

If yes, what are the barriers in effective implementation of the system?

3] Which one of the following six barriers has been identified in your industry during the implementation of ERP system?

a) Project Management

b) Top Management Commitment

c) Change Management

d) Technology Factors

e) Cultural Factors

f) Human Factors

SECTION - III

DETAILED QUESTIONNAIRE SURVEY FOR THE ABOVE SIX FACTORS for the effective implementation of ERP system:

Use the 5 Point Likert Scale. 1 – Strongly Agree, 2 – Agree, 3 – Neutral, 4 – Disagree, 5 - Strongly DA

Please tick mark (√) on the suitable option.

1) PM (Project Management):-

PM encompasses the effective project team, project planning and preparation and the right selection of the implementation partner / consultant for the project.

Q.1. Whether "Project Management" is essential aspect of ERP implementation process?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.2. Does the project team should consist of the best people in the organization?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.3. Whether the project team should have a mix of consultants and internal staff?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 4. Whether hiring of consultants helps in improving technical skills for design and implementation of ERP system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.5. Whether planning issues are the major barriers to employ ERP systems effectively?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.6. Whether an ERP implementation may be very risky if it is undertaken without full preparation and/or a detailed feasibility study?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.7. Is it necessary to assess and analyse the preparedness of an organization before initiating the project?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.8. Whether the consultants are required in helping the users in data preparation and assisting in project planning and monitoring?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

2) TMS (Top Management Support):-

It includes the top management commitment, post implementation evaluation and the external - internal issues or problems.

Q.9. Whether the Top Management Support is necessary?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.10. Whether the allocation of valuable organizational resources by the top management is essential?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.11. Whether the setting of strategic direction by the top management is essential?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.12. Whether the continuous support and monitoring of implementation process by top management is essential?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 13. Whether the Fit-gap analysis is necessary for post implementation evaluation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 14. Whether the external and internal issues or problems in an organizations effect on the implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

3] CM (Change Management):-

Change management is about the organizational changes, shift (change) from legacy to ERP system and BPR (Business Process Reengineering) - CM for business process strategy.

Q. 15. Do you run the Change Management programme in your organization for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 16. What are the changes that have taken place during this change management program?

1.
2.
3.

Q. 17. If already implemented the ERP system in your organization, what were the changes you made during the implementation process?

1.
2.
3.

Q. 18. What change you did suggest for the implementation of ERP system in your organization?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.19. Whether the Change management is regarded as one of the most important factors for the successful ERP implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 20. Whether the successful change management requires a selection of the qualified internal employees as project members for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 21. Whether constantly changing environment significantly affects the overall efficiency and so also the competitiveness of enterprises?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 22. Whether the degree of fit between the organization and the ERP systems is very critical for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 23. Whether the success in change management requires the selection of employees excellent in capability and communication skill within the organization in early stages for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 24. Whether the shift (change) from legacy system to ERP system is useful for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 25. Whether the family business legacy system is suitable for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 26. Whether the organization focuses on business process reengineering (BPR) as change management strategy prior to implementing ERP system for effective implementation?

If yes, what is the change management strategy?

_____

_____

If no, whether there is need of change of organizational process for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 27. Whether good CM strategy leads to effective implementation of ERP system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 28. Whether as part of change management efforts, users should be involved in design & implementation of business processes and the ERP system for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 29. Do you think that if the input to CM is organizational change management strategy then output to CM will be an effective implementation of ERP system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

4] TFs (Technology Factors):-

Technology factors in ERP implementation is about hardware, software, human resources, data management and the Information System IS/ Information Technology IT of the organization. These TFs are applicable for both MNCs and Domestic (National) Companies' systems.

Q. 30. In order to use ERP software, whether the computer hardware structure has to be upgraded to Pentium 4 (P4s) with large capacities, which are compatible with ERP software for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 31. Whether also the number of PCs has to be increased to appreciably reduce paper work, and improve faster flow of information and quick decision making processes for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 32. Whether the suitable networking is required for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 33. Whether the intranet facilities within the different departments of an organization are important for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 34. Whether good bandwidth of internet is essential for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 35. Whether the critical issue in ERP implementation is how to bridge the gap between the ERP system and an organization's business processes by customizing either the system, or the business processes of the organization, or both?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 36. Whether the customized software is required for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 37. Whether the organizations' should be willing to change the business to fit the software with minimal customization for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 38. Whether the selection / development of the software are important for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 39. Whether Enterprise integration software, when implemented correctly, can be used to streamline companies' business processes?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 40. Whether it is crucial that software developers pay attention to factors of user diversity, such as age and cognitive abilities, as these substantially contribute to increased effectivity, efficiency, and satisfaction and which will eventually yield in substantially more productive and competitive companies?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 41. Whether the software modifications should be avoided as far as possible to reduce errors and to take advantage of newer versions and releases for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 42. Whether the trend of the human resources of an organization is to give fool proof training about computer system for its effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 43. Whether there is allocation of human resources for training in computer literacy for its effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 44. Whether one of the biggest challenges faced by the implementation team of a new computer system is to acquire data from existing catalogues managed by legacy software applications still in execution?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 45. Whether there should be a plan for migrating and cleaning up data for an effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 46. Whether the correct analysis of data management reveals the effective performance of organization during the ERP implementation process?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 47. Whether Information technology and systems have tremendous impact on the productivity of both manufacturing and service organizations?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 48. Whether the IS/IT Department in an organization play an important role for the effective implementation of ERP system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 49. With the change in the Indian economy and consequent changes in the business environment, whether there is a need to understand how different factors have influenced information system (IS) deployment in Indian firms?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 50. Do your MNC have all the technology factors which are used for effective implementation of ERP system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 51. What type of systems your MNC have?

1.
2.

Q. 52. What type of systems your Domestic (National) company have?

1.
2.

Q. 53. Are those people who are in Domestic Company, are comfortable in working with ERP system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

5] CFs (Cultural Factors):-

The cultural factors are about the organizational culture, national culture and managing cultural change.

Q. 54. Whether the organizational culture entails about Learning and development culture for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 55. Whether the organizational culture entails about participative decision making culture and power sharing culture for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 56. Whether the organizational culture entails about support and collaboration culture; and tolerance of conflicts and risk culture for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 57. Whether the training process is one main vehicle for the dissemination of the organizational culture for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 58. Whether a culture with shared values and common goal is conducive to success?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 59. Whether the National culture (Government / Corporate policies) has significant impact on the effective implementation process?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 60. Whether Indian organizations have encountered organizational and cultural problems during the adoption and implementation of new IT in general for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 61. Whether managing culture / cultural change pave the way for effective implementation of ERP system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 62. Are there many approaches for managing the cultural change for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

6] HFs (Human Factors):-

HFs is those wherein human resources planning, training and communication are taken into account.

Q. 63. Whether human factors are critical to the success of ERP projects?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 64. Whether the impacts and the outcomes of the usage of ERP, therefore, should be investigated from different perspectives?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 65. Whether human factor influences success about ERP's performance significantly?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 66. Whether human factors that contribute to efficient and effective decision making in the complex ERP system implementations are insufficiently understood in an organization?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 67. Whether Human factors can have a pivotal role in enabling the success and adoption of ERP implementation in manufacturing industries?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q.68. Whether effective implementation is because of human resources planning factor rather than that of technical factors?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 69. Is it important to identify the human capital that will be required in order to meet the deadlines identified in the project?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 70. Whether ERP implementation process requires vast amount of human resources for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 71. Whether the training of ERP system is must for all the employees of various departments of an organization for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 72. Whether training processes might not only explain system use but also illustrate the ability of the ERPs to enhance job performance for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 73. Whether the computer literacy for IT and business people to be included in the training for effective implementation?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 74. Do the most vendors offer class room training prior to ERP rollout for effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 75. Whether effective enterprise communication is critical to an effective ERP implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Q. 76. Whether the communications between the departments help determine defects in ERP designing and effective implementation of the system?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

If yes, what are the defects observed in ERP designing and effective implementation?

_____

_____

_____

_____

Thanks for your kind co-operation and for sparing the valuable time for questionnaire.

THANK YOU

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Voltage Stability Enhancement of Fixed Speed Wind Energy Conversion System

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Abstract

Fixed speed wind energy conversion systems based on squirrel cage induction generator (SCIG) has a significant existence in wind energy technology. Availability of reactive power is obligatory for the reliable and stable performance of the power system. Insufficient reactive power has navigated to voltage collapses and has been a foremost source of various recent major power outages universally. This paper exhibits the simulation results of a grid integrated wind farm with and without reactive power compensation by capacitor banks and static synchronous compensator (STATCOM) to achieve voltage stability improvement during startup, normal operation, symmetrical and unsymmetrical fault conditions. The effect of reactive power compensation on voltage profile is compared.

Keywords: FACTS, Reactive Power, Startup, SCIG, Symmetrical Fault, Unsymmetrical Fault, Voltage Stability, Wind Energy Conversion System (WEC)

1. Introduction

Penetration of wind energy in the power systems generates numerous technical and economic challenges that is required to be addressed for satisfactory integration with wind energy conversion system. Variable wind velocity results in fluctuations of output power generated by wind turbines. The fluctuating power output becomes a challenge with increased contribution of wind energy in modern electrical power systems. Significant power variations lead to voltage and frequency deviations from nominal values that can cause actuation of protective relays that may lead to disconnection of the wind energy conversion system from the grid. Wind energy conversion system coupled to weak grid such as distribution network in rural area, are sensitive to supply disturbances[1].

With the increase in wind energy penetration, the interaction between the grid and the wind farms generating electricity becomes more and more critical. Today, wind energy converters not only offer power plant capabilities similar to conventional resources but may exceed their performance in various aspects. The characteristics of the different types of wind generating systems used in wind turbines start to affect the behavior of the power system differently. Increasing penetration of wind energy conversion system (WECS) in the conventional power system has put tremendous challenge to the power systems operators as well as planners to ensure reliable and secure grid operation[2].

The squirrel-cage induction generator propositions various advantages of high efficiency, a quickly damped short-circuit current, reliability, economy and sparsity of related apparatus for control, regulation, and protection. It demands a large quantity of reactive power, which can only be satisfied by the charging current of the power system with difficulty, because of the conditions to be met[3].

2. Reactive Power Capability of SCIG

Reactive power is mandatory for the stable and reliable operation of the power system. It is essential for the flow of active power from generator to the load centers and maintains bus voltage within the desired limits.Grid utilities need extended reactive power provide capability not solely throughout fault conditions, however additionally in steady-state operation[4].

Availability of adequate reactive power is essential for the stable operation of electrical power system. The induction generator is a constant speed wind energy system which draws reactive power from the electrical power grid. The amount of reactive power Q extrated by an induction generator changes with the active stator P_s or the slip. The generator draws reactive power of around one third of the net power when it is not supplying any real power. The reactive power is associated with the magnetising inductance L_m of the induction generator. The reactive power demand increases with the stator real power being delivered to

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the power grid. This rise is primarily caused by the significant rotor current flowing in the stator and rotor leakage inductances L_{ls} and L_{lr}. SCIG based wind turbines are not able to provide reactive power support themselves and equipped with static sources like capacitor banks or dynamic reactive power sources like SVCs or STATCOM. In comparison with SVC, the STATCOM gives a higher support to the transient margin which can determined by calculations as well as simulations[5-7]. Reactive power is central to voltage instability analysis. Shortage or excess of reactive power causes voltage instability and any rise in power demand may lead to voltage collapse.

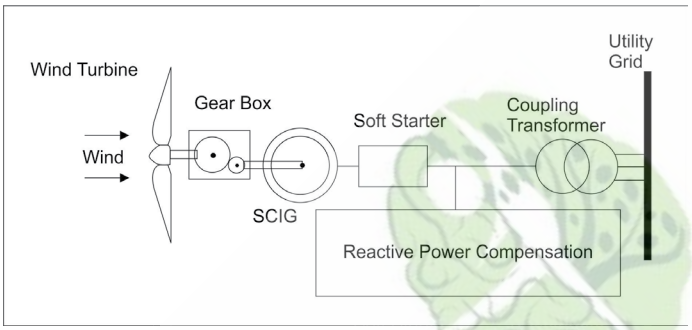

Figure 1. SCIG connected to grid.

3. Modeling of SCIG Wind Energy Conversion System

The induction generator space vector model is has three sets of equations for voltage, flux and motion[8,9].

Voltage Equations:

$$\overline{v_s} = R_s \overline{i_s} + \frac{d}{dt}\overline{\lambda_s} + j\omega\overline{\lambda_s} \quad (1)$$

$$\overline{v_r} = R_r \overline{i_r} + \frac{d}{dt}\overline{\lambda_r} + j(\omega - \omega_r)\overline{\lambda_r} \quad (2)$$

$\overline{v_s}$ and $\overline{v_r}$ are stator & rotor voltage vectors(V) ,
$\overline{i_s}$ and $\overline{i_r}$ are stator and rotor currents(A),
$\overline{\lambda_s}$ and $\overline{\lambda_r}$ are stator and rotor flux linkage(Wb),
R_s and R_r are stator and rotor winding resistances(A)
ω rotating speed of arbitrary reference frame and(rad/s)
ω_r rotor electrical angular speed(rad/s)

Flux linkage equations:

$$\overline{\lambda_s} = (L_{ls} + L_m)\overline{i_s} + L_m\overline{i_r} = L_s\overline{i_s} + L_m\overline{i_r} \quad (3)$$

$$\overline{\lambda_r} = (L_{lr} + L_m)\overline{i_r} + L_m\overline{i_s} = L_r\overline{i_r} + L_m\overline{i_s} \quad (4)$$

Where L_{ls}- stator leakage inductance, Llr- rotor leakage inductance, $L_s=L_{ls}+L_m$ - stator self inductance (H) and $L_r=L_{lr}+L_m$ is rotor self-inductance (H),

Motion Equations:

$$J\frac{d\omega_m}{dt} = T_e - T_m \quad (5)$$

$$T_e = \frac{3P}{2}\mathrm{Re}(j\overline{\lambda_s}\overline{i_s}) = -\frac{3P}{2}\mathrm{Re}(j\overline{\lambda_r}\overline{i_r}) \quad (6)$$

Where J-Moment of inertia (kgm^2), P- No. of pole pairs, Tm-mechanical torque from generator shaft(N-m), T_e- electromagnetic torque & ω_m is rotor mechanical speed.

Fig 2 shows the space-vector equivalent circuit of SCIG in arbitrary reference frame which can easily nbe transformed into other reference frames.

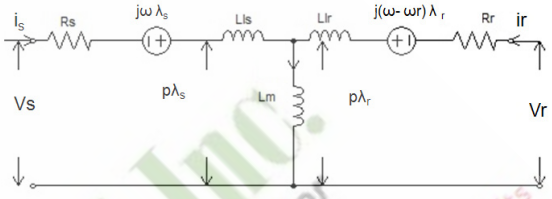

Figure. 2 space-vector equivalent circuit of SCIG in arbitrary reference frame

d-q reference model of IG can be derived from space vetcor model by resolving the vectors along d and q axis. The simulation model of induction generator is based on d-q reference frame model.

4. SCIG based Windfarm System Description

Fig 3 depicts the simulation model of SCIG based wind farm under study. A squirrel cage induction generator is fed by drive train system. The drive train system is composed of has low speed shaft, gearbox and high speed shaft that is directly coupled to SCIG rotor. The three phase stator winding of SCIG is integrated to the grid via coupling transformer[10].

The simulation model consists of SCIG based wind farm that includes six 1.5-MW wind energy converters. The wind farm connected to a 25-kV distribution system injects power to a 120-kV grid via a 30-km 25-kV feeder. The 9-MW wind farm is composed by six 1.5 MW wind energy converters. In the given system wind energy converters use squirrel-cage induction generators those run on nearly constant speed. The stator winding is coupled to the 60 Hz grid and the rotor is driven by a rotor of wind turbine with variable pitch mechanism. The pitch angle is regulated for controlling the output power of SCIG at the rated value for winds higher than the rated speed (9 m/s). For generating the active power the SCIG speed needs to be above the synchronous speed. The range of speed varies between 1 pu at no load and 1.005 pu at full load. Every wind energy converter

has a protection system that monitors voltage, current and speed of the machine. Squirrel cage induction generator requires reactive power which is being supplied by capacitor banks. Each wind energy converter is equipped with capacitor bank of the rating of 350 KVAR. Balance reactive power needed to regulate the 25-kV voltage at 1 pu is supplied by a 3-MVar STATCOM of 3% droop setting. The Wind energy converter is wind controlled[11,12].

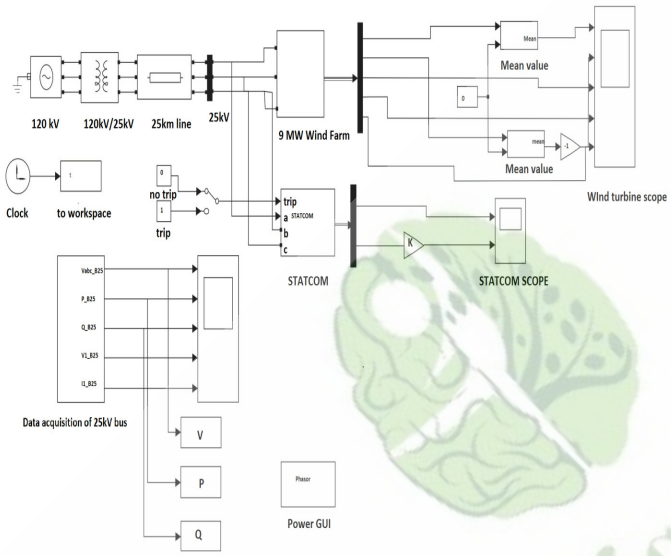

Figure 3. Wind farm with Squirrel Cage Induction Generator integrated with Grid.

In Pitch Control, during normal operation the pitch angle is set at optimal value to capture maximum power. When wind speed is higher than the rated value, blades are turned out of the wind direction to reduce the captured power[8]. The system under consideration is analyzed during startup as well as normal steady state condition. The system is subjected to symmetrical fault & unsymmetrical faults at one of the wind turbine terminals and effect of reactive power compensation by capacitor banks & STATCOM on voltage profile is at grid has been obtained.

5. Simulation Results

Case I : SCIG connected to grid start up with and without support of Reactive power Q by Capacitor Bank & STATCOM:

The dynamic performance of a SCIG based wind energy conversion system during startup verifies that SCIG draws large reactive power due to high inrush current and torque oscillations. The voltage profile is significantly affected by reactive power. As per the simulation results depicted in fig.4 the voltage profile without reactive power support is very poor which can be improved by the connected capacitor banks of suitable rating. The voltage profile at grid can further be improved by STATCOM.

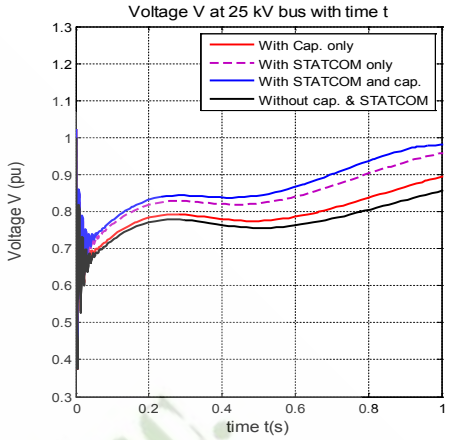

Figure 4. Simulation result for startup with & without Reactive Power Support.

Case II: SCIG connected to grid under normal condition with and without support of Reactive power Q by Capacitor Bank & STATCOM:

The simulation results shown in fig 5 depict variation in voltage at 25 kV grid with and without support of reactive power under normal condition. The effect of reactive power support by capacitor bank alone and with STATCOM has been shown in the fig. 5.

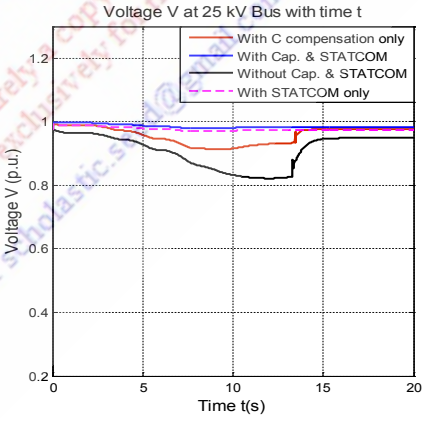

Figure 5. Simulation result for normal operation with & without Reactive Power Support.

Case III : SCIG connected to grid under the condition of symmetrical fault LLLG with & without support of Reactive power Q:

The simulation results shown in fig 6 depict variation in voltage with and without support of reactive power under the condition of symmetrical LLLG fault at the grid. The p.u. voltage at 25 kV bus is improved with the support of reactive power

by capacitor bank which can further be improved by STATCOM under fault condition.

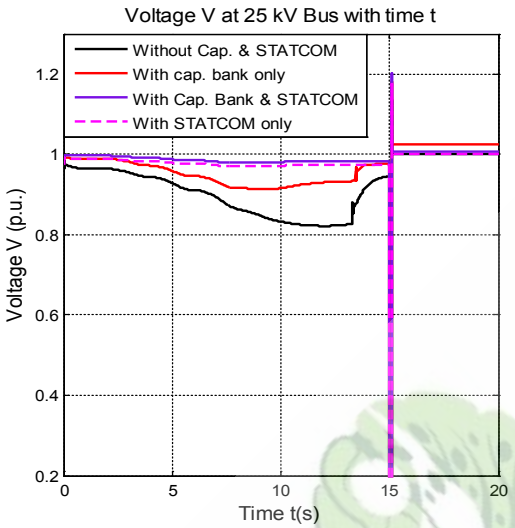

Figure 6. Simulation result for symmetrical fault (LLLG) with & without Reactive Power Support.

Case IV: SCIG connected to grid under the condition of LLG with & without Reactive Power Support

The simulation results shown in fig 7 depict variation in voltage with and without support of reactive power under the condition of unsymmetrical LLG fault at the grid. The capacitor bank and STATCOM provide significant support of reactive power in stabilizing the voltage under fault condition.

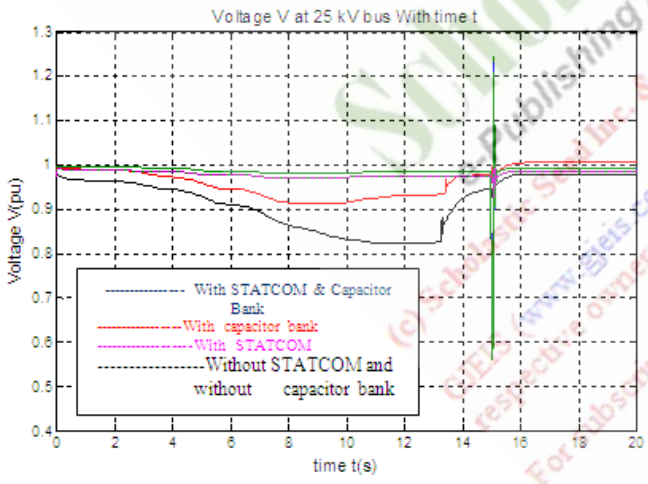

Figure 7. Simulation result for unsymmetrical fault (LLG) with and without support of Reactive Power Q.

Case V: : SCIG connected to grid under the condition of LG with & without Reactive Power Support

The simulation results shown in fig 8 shows the voltage profile when wind turbine is subjected to LG fault at its terminal.

The voltage stability improves with reactive power support by capacitor bank & STATCOM.

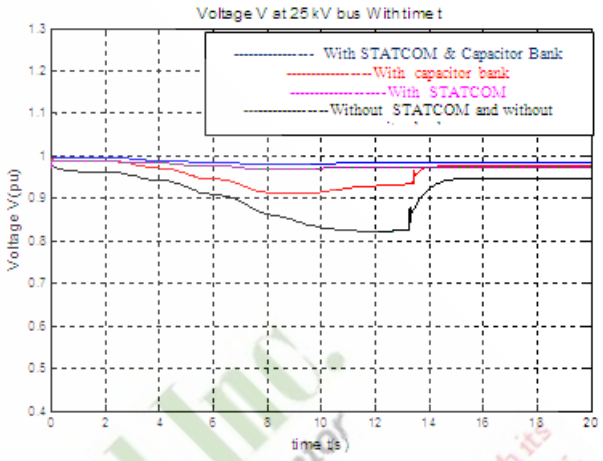

Figure 8. Simulation result for unsymmetrical fault (LG) with and without support of Reactive power Q.

6. Result and Conclusion

From the simulation results it can be concluded that reactive power is fundamental to voltage instability analysis. Shortage or surplus of reactive power causes voltage instability either locally or globally and any increase in power demand may result in voltage collapse. Grid code requires wind farms connected to power grid to ride-through grid faults and supply real & reactive power support for grid-voltage recovery. The problem of startup of SCIG based wind energy conversion system connected to grid is more critical in the severe cold weather conditions. The results obtained through simulation signify that capacitor bank & STATCOM stabilize the voltage at the time of startup by reactive power supplying capability. The voltage stability is also improved under normal steady state condition and under the conditions of symmetrical & unsymmetrical ground faults.

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M Commerce: Experiencing the Phygital Retail

Edited by: Punita Duhan, Anurag Singh

Call for Chapters

Proposal submission deadline: **February 28, 2017**

1. Introduction

Emergence and evolution of information technologies paved way for the online transactions, termed as e-commerce. E-commerce was soon rechristened as wired e-commerce due to the rapid rise of mobile phone and other handheld devices facilitating access to internet while on the go and this led to the coining of the term m-commerce, the wireless avatar of e-commerce. Term Mobile commerce or simply m-commerce has been attributed to the collection of location based commercial services that are delivered by various internet enabled handheld devices such as mobile phones, tablets and palmtop devices. Though, essentially, both-e-commerce and m-commerce- are similar as the transactions are electronic in nature and are facilitated by internet but the element of mobility is one big differentiator between the two. Now, it has become difficult for the people to imagine e-commerce without the mobility dimension appended to it. In today's online business environment, m-commerce is growing as next stage of e-commerce. Further, M-commerce has opened up new vistas for marketing the products, for targeting the customers at multiple points, for offering customized services using location-based features and for enabling enhanced shopping and service experiences. It also offers opportunities for services that are more efficient and more user-friendly. The marketers may also offer new approaches, apps, and in-store solutions for enhanced customer engagement after researching the needs, roles and use contexts of the customers. Marketers have already started talking about mobile conversion funnel besides desktop conversion funnel. It is quite interesting to note that in mature markets, shape of the funnel is different and has higher purchase conversion rate.

Accordingly, editors' objective, while proposing this book, is to consolidate the contemporary academic and business research. The book is a sincere endeavor to present the up to date research related to m-commerce to various stakeholders in a comprehensive manner and to give them some ideas for future research avenues. Some of the broad areas this book aims to cater are analysis of preconditions leading to such stupendous growth of m-commerce, dimensions of m-commerce, newer mobile technologies, emerging business models, frameworks and trends, novel services and approaches to provide consistent customer experiences, emerging payment mechanisms and platforms and other ongoing developments in this rapidly expanding area to various stakeholders.

Target Group

The book targets professionals, researchers and scholars working in the domain of M-commerce, E-commerce, Mobile banking, Digital payments, mobile apps, Cashless economy, Digitalization etc.

Proposed Areas of Study:

- M-commerce: Meaning, Evolution and Growth
- Paradigm shifts in M-commerce
- M-commerce and Digitization
- New business models in M-commerce
- Emerging Trends and practices in M-commerce
- Mobile Apps
- Mobile Payments
- Applications of M-commerce
- Future of mobile commerce
- Impediments in M-commerce
- M-commerce versus E-commerce
- Future of M-commerce
- Legal and policy framework related to M-commerce
- M-commerce: A fleeting obsession or a permanent fixture
- Mobile Banking
- Advantages of M-commerce
- Driving forces of M-commerce
- M-commerce: A boon or bane
- Mobile Organizations : Myth or Reality

*Author for correspondence

- M-commerce and demonetization
- M-commerce: Crusader for "Phygital" retail
- M-commerce and cashless economies
- M-commerce and financial inclusion of marginalized sections

Please note: Tentative topics given above are only indicative and not exhaustive.

Submission Guidelines

Interested researchers, practitioners, authors and contributors are invited to submit on or before **February 28, 2017**, a chapter proposal of up to 500 words clearly explaining the objectives, issues, concerns and outcomes of his or her proposed chapter on **mcommercesubmissions@gmail.com**. Authors will be notified by **March 05, 2017** about the status of their proposals and will be sent detailed chapter guidelines. Full chapters are expected to be submitted by **March 31, 2017**. Contributing authors must consult the guidelines for manuscript submissions prior to final submission. All submitted chapters will be subjected to a double-blind review. Contributors may also be requested to serve as reviewers for this project.

However, if author(s) has/ have ready full chapters with them, they are encouraged to submit both proposal and chapter simultaneously. Expected length of the chapter is 6,000-8,000 words excluding abstract and references. Chapter should be in 11 Point font, Times New Roman, 1.5 line spacing and default margins. Style of referencing should be APA.

Note: There are no submission or acceptance fees.

About the Publisher

Apple Academic Press, Inc., is an independent international publisher focusing on academic and professional books, dedicated to publishing cutting-edge, informative books written and edited by internationally renowned experts in their fields. Apple Academic Press is committed to publishing quality books in the field of science, hospitality, tourism and management. Apple Academic Press has partnered with CRC Press, a member of the **Taylor & Francis Group**, for marketing and distribution worldwide.

Important Dates:

February 28, 2017: Proposal Submission Deadline

March 05, 2017: Notification of Acceptance

March 31, 2017: Full Chapter Submission

April 30, 2017: Review Results Returned

May 31, 2017: Final Chapter Submission

Proposals may be submitted at **mcommercesubmissions@gmail.com**

All inquiries may be addressed to the editors at:

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Book Review

E-Book on Outcome Based Education (OBE)

Dr. P. H. Waghodekar, Adviser (HR) IBS, MIT, Aurangabad.

Monday, February 27, 2017

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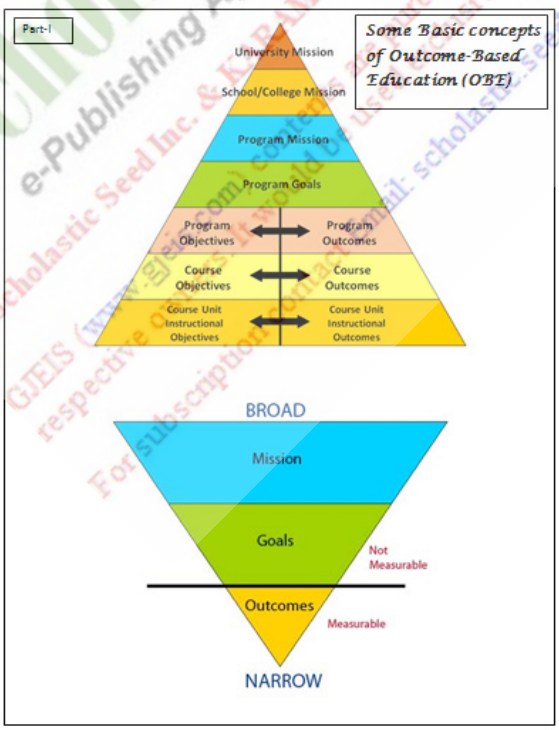


*Author for correspondence

Part-II; A Case Study: MMU

Focus and Benefits of OBE

OBE addresses the following key questions:

•What do we want the students to have or be able to do?

•How can we best help students achieve it?

•How will we know whether they students have achieved it?

•How do we close the loop for further improvement (Continuous Quality Improvement (CQI))?

Benefits of OBE:

1. **More directed & coherent curriculum.**
2. **Graduates will be more "relevant" to industry & other stakeholders (more well rounded graduates)**
3. **Continuous Quality Improvement (CQI) is in place.**

Vision and Mission of MMU

Vision of the University

To be a premier university that propagates the generation and dissemination of knowledge in cutting edge technologies

Mission of the University

1.To deliver quality academic programmes based on state-of-the-art R&D.

2.To attract and nurture quality minds who will contribute towards the global knowledge economy

3.To inculcate a strong research culture within a dynamic, efficient and effective team of academic and support staff

4.To be financially self-sustaining via education and the commercialisation of R&D products and services.

Expectations on Students under OBE – the Outcomes

- Students are expected to be able to do more challenging tasks other than memorize and reproduce what was taught.
- Students should be able to: write project proposals, complete projects, analyze case studies, give case presentations, show their abilities to think, question, research, and make decisions based on the findings.
- Be more creative, able to analyze and synthesize information.
- Able to plan and organize tasks, able to work in a team as a community or in entrepreneurial service teams to propose solutions to problems and market their solutions.

Vision and Mission of FOE

Vision of the Faculty

To be a leading engineering faculty for creation, preservation and dissemination of knowledge, training of knowledge workers for nation building, and providing continuous technical support for the ICT industry in Malaysia.

Mission of the Faculty

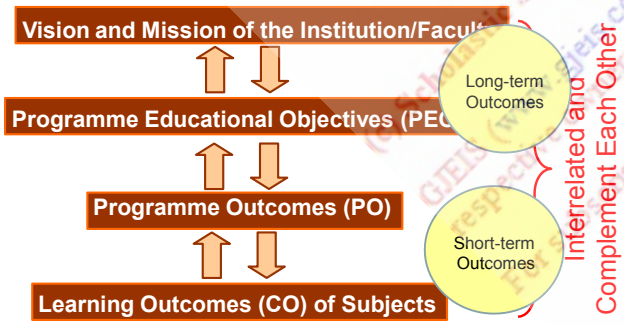
1.To produce multi-skilled graduates who are able to spearhead nation-building in the Information Age.

2.To provide opportunities and resources for academic and researchers to carry out the state-of-the-art research and development work.

3.To support the growth of nationwide ICT industry through provision of continuous professional development of knowledge.

Outcomes in OBE

A Model Hierarchy of Outcomes



Program Educational Objectives for B.Eng Electronics Majoring in Microwave & Comm.

Programme Educational Objectives (PEO) are **long term goals (5 years or more after graduation)** describing expected achievements of graduates in their career.

PEO of B.Eng. (Hons) Electronics Majoring in Microwave and Communications

•To develop highly competent engineers specialising in the area of microwave and communications technologies in support of the related industry.

•To produce innovative technical leaders that are able to contribute towards the advancement of microwave and communications technologies.

PEOs and Vision and Mission of MMU and FOE

Example of how PEOs are linked to the Vision and Mission

Vision of the Faculty	Mission of the Faculty	Programme Educational Objectives (PEOs)
To be a leading engineering faculty for creation, preservation and dissemination of knowledge, training of knowledge workers for nation building, and providing continuous technical support for the ICT industry in Malaysia	1. To produce multi-skilled graduates who are able to spearhead nation- building in the Information Age 2. To provide opportunities and resources for academic and researchers to carry out the state-of-the-art research and development work 3. To support the growth of nationwide ICT industry through provision of continuous professional development of knowledge	1.To develop highly competent engineers specialising in the area of microwave and communications technologies in support of the related industry. *-Related to M1,M2 & M3* 2.To produce innovative technical leaders that are able to contribute towards the advancement of microwave and communications technologies. *-Related to M1 & M3*

Outcome-Based Education

Example of how POs are linked to the PEOs

Programme Educational Objectives (PEOs)	Description of how POs (Programme Outcomes) are linked to the PEOs
1. To produce all-rounded engineers in the telecommunications technologies in support of the emerging ICT industry **2. To develop capable technical leaders who are able to spearhead the advancement of telecommunications in the country.**	**1. Ability to acquire and apply fundamental principles of science and engineering.** *-The graduates have firm fundamental knowledge and therefore can easily understand and adapt to any change in the technology* *-This will ensure that the graduates will be of high caliber equipped with the fundamental technical principles of science and engineering so that they can lead, facilitate and support the development of engineering practices in the industries in Malaysia* *-Related to PEO 1*
	2. Capability to communicate effectively *-Communication and networking skills are enhanced through presentations, exchanging ideas and arguing with solid rational* *-To be a good leader, effective communication is a must* *-Related to PEOs 1 and 2*

Program Outcomes for B.Eng Electronics Majoring in Microwave & Comm.

Programme Outcomes (PO) are **short term outcomes (at the point of graduation)** describing what students are expected to know and be able to perform.

POs of B.Eng. (Hons) Electronics Majoring in Microwave and Communications

1.Ability to acquire and apply fundamental principles of science and engineering.

2.Capability to communicate effectively.

3.Acquisition of technical competence in specialized areas of engineering discipline.

4.Ability to identify, formulate and model problems and find engineering solutions based on a systems approach.

5. Ability to conduct investigation and research on engineering problems in a chosen field of study.

Outcome-Based Education

Example of how the course subjects contribute towards POs

Programme Outcome	Descriptions
Ability to acquire and apply fundamental principles of science and engineering	- Core subjects on Mathematics (Engineering Mathematics I to IV), Circuit Theory, Electronics (I to III), Computer & Program Design, Field Theory, Digital Logic Design, Instrumentation & Measurement Techniques, Introduction to Machines, Algorithm & Data Structure, Microprocessor Systems & Interfacing, Circuits and Signals, Electromagnetic Theory, Control Theory, Communication Networks, Electromagnetic Interference, Introduction to Power Systems. - Basic concepts and theories and their relation to actual engineering systems are applied and extended in Final Year Projects and Industrial Training. - Extensive laboratory experiments to provide in-depth practical knowledge and hands-on experience to students.

Program Outcomes for B.Eng Electronics Majoring in Microwave & Comm.

POs Cont…

6.Understanding of the importance of sustainability and cost-effectiveness in design and development of engineering solutions.

7.Understanding and commitment to professional and ethical responsibilities.

8.Ability to work effectively as an individual, and as a member/leader in a team.

9.Ability to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurial skills.

10.Awareness of the social, cultural, global and environmental responsibilities as an engineer.

11.Capability and enthusiasm for self-improvement through continuous professional development and life-long learning.

Outcome-Based Education

Learning Outcomes (LO) of subjects are statements of a learning achievement on completion of the subject.

LOs of EEN1036 Digital Logic Design:

1.Describe the differences between analog and digital systems, and their respective advantages and disadvantages.

2.Apply positional notations, number systems and computer codes in digital systems.

3.Apply algebraic methods based on Boolean algebra and truth table to analyse logic circuits.

4.Apply minimisation methods such as Karnaugh maps and Quine-McCluskey tabular method to simplify switching functions.

5.Apply the concepts of sequential logic and memory devices in digital systems.

6.Design modular combinational circuits using encoders, decoders, multiplexers and demultiplexers.

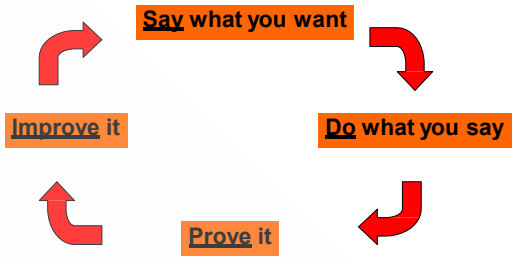
Outcome-Based Education

Course to Program Outcomes Matrix for Courses under the **Electronic Engineering Majoring in Microwave and Communications**

CODE	SUBJECT	CONTRIBUTION TO PROGRAMME OUTCOMES (PO)										
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
ENGINEERING SUBJECTS												
EEM1016	Engineering Mathematics I	80	10	0	10	0	0	0	0	0	0	0
EEM1026	Engineering Mathematics II	80	10	0	10	0	0	0	0	0	0	0
EEM2036	Engineering Mathematics III	80	10	0	10	0	0	0	0	0	0	0
EEM2046	Engineering Mathematics IV	80	10	0	10	0	0	0	0	0	0	0
EEM3066	Random Processes and Queueing Theory	0	5	45	45	0	0	0	5	0	0	0
ECT1016	Circuit Theory	60	10	10	10	0	0	0	10	0	0	0
ECT1026	Field Theory	60	10	10	10	0	0	0	10	0	0	0
ECT2036	Circuits and Signals	50	10	10	10	0	10	0	10	0	0	0
EEN1016	Electronics I	60	10	10	5	0	10	0	5	0	0	0
EEN1036	Digital Logic Design	50	10	10	15	0	5	0	10	0	0	0
EEN1046	Electronics III	50	10	10	10	0	10	0	10	0	0	0
EEN3096	Communications Electronics	30	10	25	15	10	0	0	10	0	0	0
ECP1016	Computer and Program Design	10	10	10	20	0	20	0	10	0	0	20
ECP1026	Algorithm and Data Structure	40	5	15	10	10	10	5	0	0	0	5

Outcome-Based Education

Continuous Quality Improvement (CQI)



Outcome-Based Education

Example of Assessment Methods for Program Outcome 2: Capability to Communicate Effectively

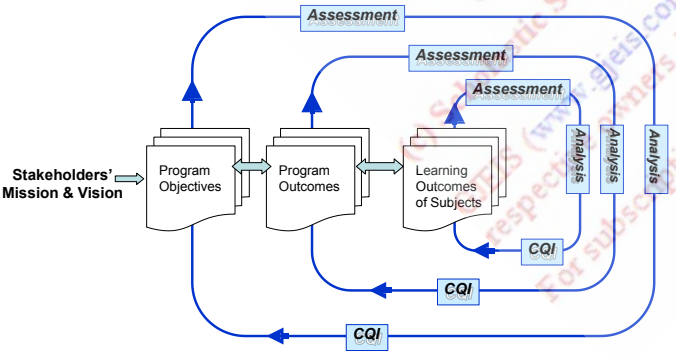
Performance Criteria	Subjects	Assessment Methods
• Present and document ideas and experimental results properly documented in a specified format, and supported with evidence. The document must contain explanation with sufficient detail, with minimum grammatical and spelling errors.	• All Subjects- Lab Experiments, FYP, ITP, Mini Projects	• Coursework and exam • presentation of Final Year Project and Industrial Tr • Lab Reports
• Use multimedia content in oral and visual communication	• EPT4046 Final Year Project, EPT4066 Industrial Training • Mini Project • Other Seminars, and • Meetings	• Presentation of Final Year Project, Industrial Traini
• Respond to audience's questions correctly and confidently	• EPT4046 Final Year Project, EPT4066 Industrial Training, • EPT3016 Mini Project, • other seminars and • meetings	• Presentation of Final Year Project, Industrial Traini

04/01/2012

Roles of Lecturers

- Review PEOs, POs, course structures and syllabi.
- Teach the relevant engineering, maths, and other relevant subjects.
- Conduct relevant tutorials and laboratory practical sessions.
- Give appropriate guide on assignments and projects.
- Conduct empirical measurements of POs.
- Prepare the required documentation.
- Assure EAC and public on the standard of our graduates.
- Obtain and maintain accreditation from EAC through Continuous Quality Improvement (CQI).

Outcome-Based Education



Roles of Students

- Know the required Programme Outcomes and Programme Objectives (available at the FOE website).
- For each course, review the Learning Outcomes (available at the FOE website/uploaded in MMLS) at the beginning of each trimester. This gives you an idea of the knowledge and skills expected from a particular course.
- Be more proactive in the learning process to acquire the Learning Outcomes of subjects.
- Demonstrate through the assessment methods that the required skills and knowledge have been acquired.
- Attain the Programme Outcomes and Programme Objectives as a whole during the entire programme.
- Give constructive feedbacks on the programme/course/academic staff to obtain accreditation through active participation in Online Teaching Evaluation, Academic Advisory System, dialog sessions with Dean,

04/01/2012

Part-III: A Sample Collection of Vision and Mission Statements

Vision (***Where we want to be) and Mission (What are we) statements***

The vision statement is concerned with what one can visualize after say 20-30 years, a long range planning, whereas. Mission statement is about short range planning mostly limited to the duration of a program. Mission statement needs to clearly bring out 3-5 measureable outcomes (M1 – M5) that are further closely interwoven with Program Education Outcomes (PEO: may be 10-15) that dictate Course/Learning Outcomes.

1. AICTE

Vision

"To be a world class organization leading technological and socio-economic development of the Country by enhancing the global competitiveness of technical manpower and by ensuring high quality technical education to all sections of the society".

Mission

- A true facilitator and an objective regulator
- Transparent governance and her accountability approach towards the society.
- Planned and coordinated development of Technical Education in the Country by ensuring world-class standards of Institutions through accreditation.
- Facilitating world-class Technical Education through:
- Emphasis on developing high quality Institutions, academic excellence and innovative research and development programmes;
- Networking of Institutions for optimum resource utilization;
- Dissemination of knowledge;
- Technology forecasting and global manpower planning;
- Promoting industry-Institution interaction for developing new products, services, and patents;
- Inculcating entrepreneurship;
- Encouraging indigenous technology;
- Focusing on non-formal education;
- Providing affordable education to all.
- Making Indian Technical Education globally acceptable.
- To be a forward-looking organization that has an efficient, flexible and empowered manpower, sensitive to stakeholders' expectations.

2. MSBTE: VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological & environmental challenges.

MSBTE: MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental changes.

3. Delhi Top Pvt. Engineering College

Vision

To develop centre of excellence for value based engineering education and research comparable with the best in the world through state-of-the-art technology, continuous learning and strategic partnership with the industry.

Mission

To provide quality technical human capital to the industry and society by establishing center of excellence of engineering education research.

To provide a superior, student centered learning environment which emphasizes close faculty student interaction and experiential education in order to prepare graduates who excel in their chosen profession, are qualified to pursue advanced degrees and posses the technical knowledge, critical thinking skills, creativity and ethical values which are needed for leadership in developing and applying technology for the betterment of society and sustaining the world environment.

4. BAMU Aurangabad

Vision-Mission

Vision: Dr. Babasaheb Ambedkar Marathwada University, Aurangabad is committed to create opportunities for quality higher education, intellectual reflection and spiritual enrichment and to raise moral and ethical standards. In his golden

jubilee year, the University has instituted Gautam Buddha Study Center to encourage and promote study and research on Gautam Buddha's philosophy and its social relevance in the 21st century. **Mission:** Our University is committed to create an intellectual environment in a spirit of critical insights and rational enquiry. Therefore, the Gautam Buddha Study Center is dedicated to intensive study of Buddhist philosophy to instill in students a holistic development of Personality -Body, Mind and Soul to meet the challenges of 21st Century.

Objectives

1) To disseminate knowledge of Buddha's philosophy.
2) To promote consciousness rising of the finer sensibilities of life
3) To create scholars capable of critical analysis of thought in research.
4) To encourage ecumenism amongst the various school of Buddhist thoughts.
5) To undertake the interfaith dialogue to promote amity and harmony amongst the people.

5. Dr. BA University, Lonere

Dr. Babasaheb Ambedkar Technological University, Lonere-Raigad

VISION

The University is committed to becoming a leading 'Center of Excellence' in the field of Engineering, Technology and Science as a seat of learning with a national character and international outlook.

MISSION

The University is committed to provide quality technical education, research and development services to meet the needs of industry, business, service sector and the society, at large.

6. Harvard

HARVARD John A. Paulson School of Engineering and Applied Sciences

Mission – Who we are

The SEAS HR office strives to develop and deliver innovative human resource programs and services designed to support the mission of SEAS and Harvard University. Our core services and competencies include recruitment and staffing, diversity, employee and labor relations, compensation, performance management, employee development, HR information management, and regulatory compliance. Our goal is to be the most effective, accountable, and engaged HR team possible.

Vision – Where we want to be

We seek to deliver superior customer service to the entire SEAS community with the goal of attracting, developing, motivating, and retaining a diverse workforce in a supportive work environment.

7. Malaysian University (MMU

Vision and Mission of MMU

Vision of the University

To be a premier university that propagates the generation and dissemination of knowledge in cutting edge technologies

Mission of the University

1.To deliver quality academic programmes based on state-of-the-art R&D.

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3.To inculcate a strong research culture within a dynamic, efficient and effective team of academic and support staff

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Biographical Note

Outstanding Achievement and Contribution to the field of Management and Computer Education

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Prof. Hoda joined Bharati Vidyapeeth, Pune, on 01.09.1997 as a Lecturer at BVIMR, New Delhi and now he is working as a Professor in **Computer Science & Director at Bharati Vidyapeeth's Institute of Computer Applications & Management (BVICAM)**, New Delhi (affiliated to GGSIP University, Delhi), since **1st April, 2002**. He has over twenty two years of experience in academics in different capacities. Prior to joining the academics, he has initially worked with corporate as Software Engineer. He is an expert member of many board level committees of **DST, CSIR** and **MHRD**. He is the Chairman of Technical Committee of NCPUL, MHRD, Govt. of India, New Delhi. He is the member of the **Court of the GGSIP University**. He has been a member of **Board of Management** of GGSIP University for two terms, 2011-2012 and 2006-2007. He is member of **Academic Council (AC)** of GGSIP University, New Delhi, for last 10 consecutive terms from 2006. He is also working as the **Co-ordinator cum Convener** for MCA Programme of GGSIP University, New Delhi, since last eleven years from 2004. During last eleven years, as the Chairman of Syllabus re-structuring committee of MCA Programme of GGSIP University, he has steered the revision of MCA curriculum thrice, which is considered as one of the best curriculum for MCA Programme in the country. As member of different Boards, Committees and Task Forces, he has facilitated to more than a dozen of other Universities for restructuring of their IT and Computer Science programmes, both at UG and PG levels, as well as innovating and re-aligning their teaching learning practices in line with the requirements of IT industry in 21st Century.

Prof. Hoda has recently been re-elected as National Chairman, Systems and Architecture Division, Computer Society of India (CSI) for the year 2015-2017. Prof. Hoda was elected unopposed as the **Chairman**, Indian Society for Technical Education **(ISTE)**, Delhi Section for 2012 - 2014. He has also been ***Secretary – cum – Treasurer***, ISTE, Delhi Section, for 2009 - 2011. He is a member of **IEEE Executive Committee**, Delhi Section for last six consecutive years. He was also the Regional Students' Co-ordinator (Region-1), CSI, for 2011 - 2013. He was elected un-opposed as **Chairman,** Computer Society of India (CSI), Delhi Chapter for the year 2009-2010. He has also served as **Vice Chairman** for the year 2008-2009, as **Hony. Secretary** for two consecutive terms; 2006-2008 and 2005-2006. He was appointed as the **Returning Officer** for IETE Delhi Centre Elections 2012 – 2014. He has also served as the **Returning Officer** for IETE Delhi Centre Elections 2008 – 2010 and member, Board of Scrutinizers for 2010 – 2012 & 2014 - 2016.

He has published over **60 Papers** at both National and International levels, including SCI and ISI publications. He has delivered over **100 Invited Talks, Key Note Addresses** at different academic and corporate forums on various emerging issues in the field of Information Technology and Innovations in Teaching Learning System. He has organized and conducted over **60** National Level Management Development and Quality Improvement Programmes for working executives in the industry and academia. He is the **Editor-in-Chief** of the International Journal; **'BIJIT' - BVICAM's International Journal of Information Technology,** having ISSN 0973 – 5658, which is an indexed and refereed Journal, including at **INSPEC (UK)** and **Google Scholar (USA)**. He has edited more than 15 volumes of Conference Proceedings, as Editor, having ISSN and ISBN serials, indexed at **ISI, SCOPUS, DBLP**, etc. He has co-authored two books; one entitled **"Handbook of MCA"** for U. P. Technical University and a reference book on **Mathematical Modelling, Optimization and Their Applications** published by Narosa International. Another book entitled **"The Foundation Course in Artificial Intelligence"** is under process.

*Author for correspondence

He is a Senior Member of **IEEE (USA)**, Member of **ACM (USA), Fellow** of Institution of Electronics and Telecommunication Engineers **(IETE)**, **Senior Life Member** of Computer Society of India **(CSI)**, Life Member of Indian Society of Technical Education **(ISTE),** Member of Indian Science Congress Association **(ISCA)** and National HRD Network **(NHRD)**. He was awarded **Outstanding Achievement Award – 2000** by Management Studies and Promotion Institute, New Delhi for his outstanding achievement and contribution to the field of Management and Computer Education.

Prof. Hoda holds MCA degree from Aligarh Muslim University (AMU), Aligarh and Doctorate in Information System Audit in Computer Science. His current areas of research are Information System Audit, Software Engineering, Computer Networks, Artificial Intelligence, Fuzzy Logic, Information Security, Information & Communication Technologies (ICT) and Innovative 21st Century Teaching Learning Pedagogics.

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Biographical Note

Has Long Been Committed to Enhancing the Development of Higher Education and Research in Hong Kong

Professor Benjamin Wan-Sang Wah
Professor of Computer Science and Engineering,
The Chinese University of Hong Kong
(852) 3943 7446
Email. bwah@cuhk.edu.hk.
Facsimile. (852) 2603 6022.

Professor Benjamin Wah is the Provost and Wei Lun Professor of Computer Science and Engineering at the Chinese University of Hong Kong. Professor Wah is the Franklin W. Woeltge Emeritus Professor of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign, and is a prominent computer scientist, with expertise in non-linear programming, multimedia signal processing and artificial intelligence. He is a fellow of the Institute of Electrical and Electronics Engineers (IEEE), the Association for Computing Machinery (ACM), and the American Association for the Advancement of Science (AAAS) and has served as the President of IEEE Computer Society. Professor Wah has received numerous international honours and awards for his distinguished academic and professional achievements. Among these are the Distinguished Alumni Award in Computer Science of the University of California, Berkeley, the W. Wallace McDowell Award, the Tsutomu Kanai Award and the Richard E. Merwin Distinguished Service Award of the IEEE Computer Society.

In 1998-99, Professor Wah was Professor of Computer Science and Engineering at CUHK, and in that year received an Exemplary Teaching Award. His bonds with the University continued afterwards as he served in the capacity of Adjunct Professor in the Department from 1999 to 2003.

Professor Wah has also long been committed to enhancing the development of higher education and research in Hong Kong. He was a member of the Research Grants Council of the University Grants Committee in Hong Kong between 2005 and 2009, and served as the Chairman of its Engineering Panel between 2006 and 2009. He was re-appointed as member of the RGC in October 2011 and appointed as Chairman of the RGC in January 2013. He was appointed as ex-officio member of the Advisory Committee on Innovation and Technology of the HKSAR Government in the capacity as the Chairman of the Research Grants Council in 2015. He is currently member of various UGC Sub-Committees, including Strategy Sub-Committee and Research Group. He also serves on the Innovation and Technology Advisory Committee of the Hong Kong Trade Development Council.

Born and brought up in Hong Kong, Professor Wah graduated from Queen Elizabeth School and pursued further studies in the US. He received his BS and MS in Electrical Engineering and Computer Science from Columbia University, and his MS in Computer Science and PhD in Engineering from the University of California, Berkeley. He began teaching in Purdue University in 1979, and later joined the University of Illinois at Urbana-Champaign in 1985. He also served as Director of the Advanced Digital Sciences Centre established by the University of Illinois in Singapore in 2009, with funding from the Singapore government's Agency for Science, Technology and Research.

*Author for correspondence

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Great Enterprise Contribution to Society

Ambab, founded in April, is a leading Internet and mobility engineering company headquartered at Mumbai. Ambab also launched 'Pretr', a B2C discovery app that helps consumers to identify and search products in stores around them.

Ambab is a leading Internet and mobility engineering company headquartered at Mumbai, with offices across Hyderabad, Delhi, London and New York City. We at Ambab are a team of 140+ smart, talented, and yet humble engineers, designers and product architects who are excited about businesses to operate web scale.

We build cutting edge products for web, mobile, and really anything on the internet. As a business builder, Ambab partners with the best entrepreneurs, enterprise globally to build there digital footprints from scratch. Ambab helps them ramp on-demand extending Omni channel technology, go to market operations, content marketing and deep business analytic at every step.

Engineering of complicated problems begins at the product design level. Great products are built using the best blend of people, process and platform. With over decade long experience, Ambab is well equipped to engineer the right products for every business needs.

*Author for correspondence

DOI: 10.18311/gjeis/2017/15883

Great Enterprise Contribution to Society

IBM SPSS

http://www.ibm.com/analytics/in/en/technology/spss http://www.ibm.com/analytics/in/en/technology/spss
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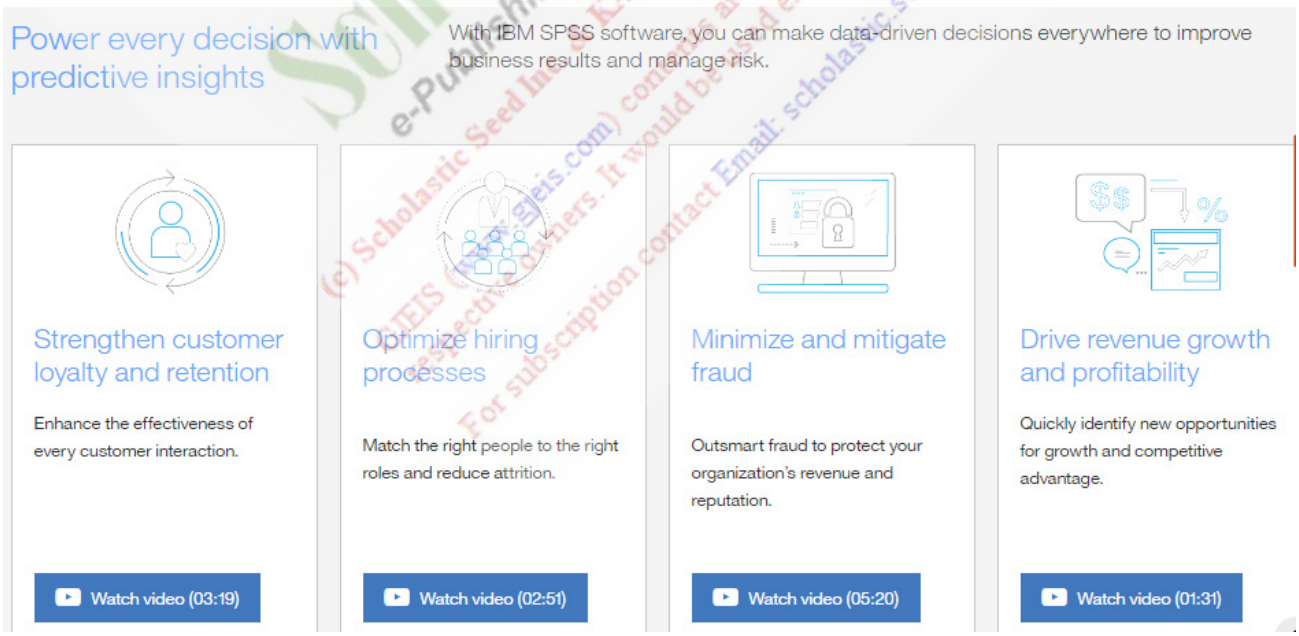
What if you could get deeper, more meaningful insights from your data and predict what is likely to happen next? IBM SPSS predictive analytics software offers advanced techniques in an easy-to-use package to help you find new opportunities, improve efficiency and minimize risk.



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Statistical analysis and reporting

Address the entire analytical process: planning, data collection, analysis, reporting, and deployment.

Predictive modeling and data mining

Use powerful model-building, evaluation, and automation capabilities.

Decision management and deployment

Activate your analytics with advanced model management and analytic decision management on prem, on cloud or as hybrid.

Big data analytics

Analyze big data to gain predictive insights and build effective business strategies.

DOI: 10.18311/gjeis/2017/15884

Great Enterprise Contribution to Society

SAP SE (NYSE: SAP) today introduced the latest advances to SAP S/4HANA Cloud and shared its innovation road map for the industry's next-generation, leading-edge cloud enterprise resource planning (ERP) suite.

With a new architecture of in-memory technology in combination with contextual analytics, digital assistant capabilities, machine learning and the award-winning SAP Fiori user experience, SAP S/4HANA Cloud enables customers to instantly adjust and adopt business processes and models and act on real-time insight and advice. The announcement was made at SAP Capital Markets Day at the New York Stock Exchange, where SAP executives showcased a combination of strategy and innovation.

The ERP offering from SAP provides enterprise-ready functionality for digital business in industry and line-of-business functions, with faster deployment, time to value and lower entry costs of cloud delivery. Industry research firm IDC predicts that the software-as-a-service (SaaS) business applications market will grow 17 percent annually to $103.9B in 2020 from $47.4B in 2015.*

"Decades ago, SAP invented and became the leader in first-generation ERP," said Darren Roos, president of SAP S/4HANA Cloud. "Later, we were early to build first-generation cloud ERP along with other new cloud vendors. While many cloud ERP vendors remain on this early architecture, SAP did not stop there, and invested in innovating the next generation of cloud ERP. SAP S/4HANA Cloud encompasses the latest architecture and technology innovations, along with SAP's proven set of business management expertise to usher in a true new generation of intelligent ERP in the cloud."

Intelligent, Immediate, Integrated

Thanks to the SAP HANA platform, SAP can help companies to get a real-time view of their business, with the assurance that SAP is managing their digital core and offering superior integration with SAP's full portfolio, including SAP SuccessFactors solutions for human capital management, SAP Ariba solutions for procurement, SAP Hybris solutions for customer engagement and commerce, Concur solutions for travel and expense management, and SAP Fieldglass solutions for services procurement and external workforce management.

*Author for correspondence

The latest release of SAP S/4HANA Cloud enables customers to carry out their digital transformation faster and to make business processes more efficient through increased transparency, automation and quality. Different solutions in the cloud ERP suite include:

- SAP S/4HANA Professional Services Cloud, delivering end-to-end project management
- SAP S/4HANA Finance Cloud, an easy-to-use modern finance solution that includes procurement and order management capabilities, and supports large enterprises and subsidiaries
- SAP S/4HANA Enterprise Management Cloud, combining professional services and finance capabilities for comprehensive real-time business management

"As a purpose-driven business with an ambitious strategy, we realized we needed a best-in-class ERP solution to support our growth," said Bob Barton, chief financial officer of MOD Pizza, the pioneer of the "fast casual" pizza segment with over 200 locations and over 4,000 MOD Squaders system-wide. Named America's fastest-growing chain restaurant by research and consulting firm Technomic, MOD Pizza had 220 percent growth in 2015. "MOD prides itself on its commitment to employees and customers, and SAP S/4HANA Cloud gives us a stable, scalable platform to help us manage our business and our people cohesively, with real-time access to reliable, actionable information."

Road Map for Innovation

SAP also outlined the road map for future cloud ERP innovation. The quarterly updates planned by SAP include setup wizards that will grow increasingly intelligent with machine learning and artificial intelligence; prepopulated, easy-to-adjust settings; and additional cloud-to-cloud integration and external application programming interfaces (APIs) to integrate with other applications and legacy systems. In addition, SAP detailed plans for including blockchain digital ledger capabilities and Internet of Things capabilities that will support broader global, digital business models, as well as plans for partners to build localization and industry vertical extensions.

For more information on SAP S/4HANA Cloud, see here.

For more SAP news, visit the SAP News Center. Follow SAP on Twitter at @sapnews and join the dialog at the hashtags #S4HANA and #CapitalMarketsDay.

About SAP

As market leader in enterprise application software, SAP (NYSE: SAP) helps companies of all sizes and industries run better. From back office to the boardroom, warehouse to the storefront, desktop to a mobile device – SAP software empowers people and organizations to work together more efficiently and use business insight more effectively to stay ahead of the competition. SAP applications and services enable more than 345,000 business and public sector customers to operate profitably, adapt continuously, and grow sustainably. For more information, visit www.sap.com.

Note to editors:

To preview and download broadcast-standard stock footage and press photos digitally, please visit www.sap.com/photos. On this platform, you can find high resolution material for your media channels. To view video stories on diverse topics, visit www.sap-tv.com. From this site, you can embed videos into your own Web pages, share video via email links, and subscribe to RSS feeds from SAP TV.

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** IDC, Worldwide and Regional Public IT Cloud Services Forecast, 2016-2020, Doc # US40739016, Dec. 2016.*

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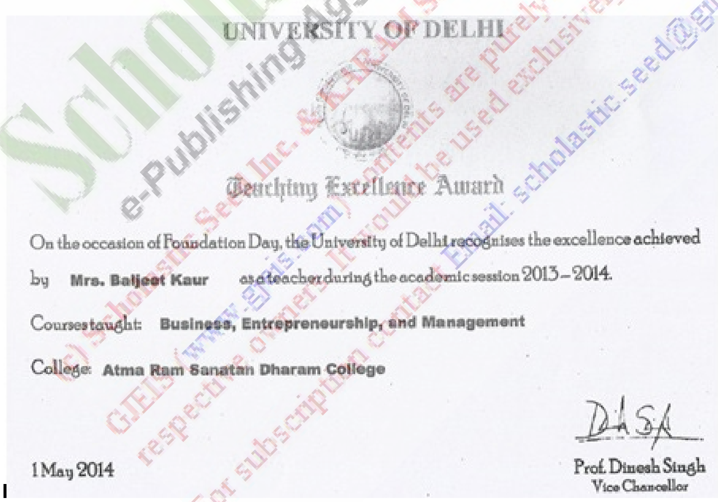
Great Enterprise Contribution to Society

*Author for correspondence

DOI: 10.18311/gjeis/2017/15886

Award

Mrs. Baljeet Kaur, Assistant Professor, Department of Commerce received the prestigious Teaching Excellence Award from the Honourable Vice Chancellor, University of Delhi in the Academic session 2013-2014 for the foundation course , "Business, Entrepreneurship and Management" under FYUP.



UNIVERSITY OF DELHI

Teaching Excellence Award

On the occasion of Foundation Day, the University of Delhi recognises the excellence achieved by **Mrs. Baljeet Kaur** as a teacher during the academic session 2013 – 2014.

Courses taught: **Business, Entrepreneurship, and Management**

College: **Atma Ram Sanatan Dharam College**

1 May 2014

Prof. Dinesh Singh
Vice Chancellor

*Author for correspondence

Best Professor of HRM National Award by Times Ascent

DOI: 10.18311/gjeis/2017/15888

Award

Write Up

Dr. Lokinder Kumar Tyagi, Professor & Deputy Director, Amity University, NOIDA has been conferred with the National Level Award of Best Professor in Human Resource Management. This award has been given by the Times Ascent and World HRD Congress, governed by Global Advisory Council which guides the strategic intent of the congress to its logical success. Dr. Lokinder Kumar Tyagi **(PhD, M.Phil, MBA, PGDPM)** currently working for Amity University, Noida as Professor and Dy. Director. Worked as Dean Student Welfare & Associate Professor, BVIMR, New Delhi has 27+ Years of Industry & Academic experience with Reputed Educational Institutions/Universities like, Bharati Vidyapeeth Univesity, Delhi University, AIMA, IP University etc. He has been conferred with "**International VIFA-2016 as Distinguished Faculty Award-2016**" by Hon'ble Mr Justice T.N. Vallinayagam of Tamilnadu & Prof. Matthew Hibberd of University of Stirling, on 9th September, 2016 in Chennai, (2) "**Teacher Excellence Award-2014" by Prof. Yeshpal, Padam Vibushan** in Sept.2014 and (3) "**Efficient Teacher Award-2014" by Mrs. Meenakshi, Mayor East Delhi** in BVIMR on 24th December, 2014 .

He is **Member of Board of Studies (BOS)** under Faculty of Management Studies, and PhD Guide, Bharati Vidyapeeth University, Pune. As Chairman of Training & Development Cell Dr. Tyagi has **successfully organized & conducted 69 MDPs/ SDPs/FDPs/International Seminars/NMGs.** He has a publication of 05 books, **60 Research Papers in International & National Journal of repute and** 07 Management Articles to his credit.

Dr. Tyagi has been associated as Executive Member/Advisory Board Member with 08 Organizations, Institutions, B-Schools. One PhD Degree has been awarded under his supervision in Bharati Vidyapeeth University.

The **Best Professors in Human Resources Management** is intensely researched. Our research cell consists of Post Graduates in History & Management with over 7 years research experience posts their studies. It is an iconic job of the research cell to produce a shortlist of Individuals who are doing extraordinary work and track the record of their achievements. The shortlist is then reviewed by a Jury comprising of senior professionals from across the globe.

The Jury which consists of senior leaders, researchers and academicians includes some prominent names as below:

Dr. Arun Arora, Ex President and CEO, The Economic Times; Chairman, Edvance Pre-schools Pvt. Ltd. & Emeritus Chairman - World HRD Congress

- Dr. Harish Mehta, Chairman & MD - Onward Technologies Ltd.; Emeritus Chairman - World HRD Congress & Founder Member – NASSCOM
- Professor Tom Hilton, Global Chairman, Asia Pacific HRM Congress
- Jack Jones, Global Chairman, World HRD Congress
- Jonathan Peters, Global Chairman, Stars of the Industry Group
- Prof. Indira Parikh, Ex Dean of IIM Ahmedabad & President – Antardisha (Directions from Within)
- Dr. R L Bhatia, Founder, World CSR Day and World Sustainability
- Nina E. Woodard, President & Chief "N" Sights Officer , Nina E. Woodard & Associates, a division of NDPendence, Inc

On behalf of the committee, the **Best Professor in Human Resources Management** citation was presented to Dr. Lokinder Kumar Tyagi, on 15th February, 2017 in Hotel Taj, Mumbai.

The event is a not – for – profit making activity and expects to break even. Each Recipient takes care of their travel; accommodation & Incidental costs. There is no financial liability on any winner. Regarding registration a free / gratis pass for award ceremony was given to specially invitee Dr. LK Tyagi only. The entire Event is organized for a Professional cause and is not for profit.

*Author for correspondence

4th International Conference on E-Commerce

ICoEC 2017

18-20 SEPTEMBER 2017. PUTRAJAYA, MALAYSIA

For more information, please visit:
www.icoec.my

"Empowering the Digital Economy: Opportunities and Challenges"

Important Dates

Submission Deadline	31 Mar 2017
Notification of Acceptance	30 Apr 2017
Deadline for Revised Paper	31 May 2017

Theme and Tracks

The theme of this conference is "Empowering the Digital Economy: Opportunities and Challenges". Conference papers will be invited through the "Call for Papers" related to numerous E-commerce areas. Scopes of paper include, but are not limited to the following topics:

- E-commerce, digital business and digital economy
- Digital crime, IS security and privacy
- Enterprise system (Enterprise resource planning (ERP), Supply chain management (SCM), Customer relationship management (CRM), Knowledge management (KM))
- Big data and Internet of things
- Social media analytics and business practices
- IT governance, risk management, control and auditing
- Technology and science application
- Information systems (Accounting, Management, Business, Health etc.)
- Others

Fees

	LOCAL	INTERNATIONAL
PRESENTER/PARTICIPANT	RM 1,890.00	USD 500.00
EARLY BIRD (pay before 31st June 2017)	RM 1,600.00	USD 400.00

Fee includes conference admission, conference kits, lunches and refreshments.

Publications

Accepted papers will be published in the conference proceedings and Scopus Journal. The proceedings will be available in the ICoEC Digital Library which can be accessed online, and will also be available in hard copy after the conference. The proceedings will be sent to ISI Thomson and Scopus for indexing.

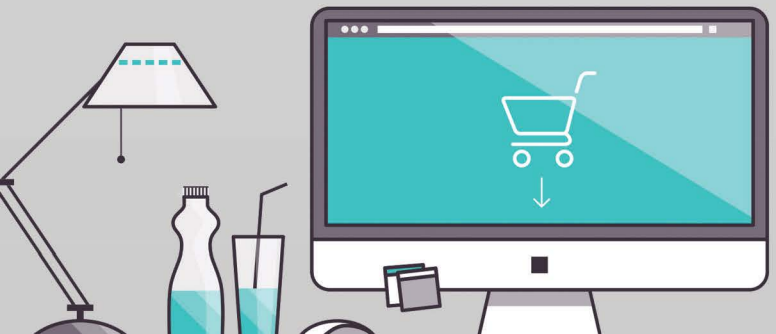
Journal: Extended version of the accepted paper will be published in one of the following journals*:

- International Journal of Business Information Systems (IJBIS)
- Journal of Electronic Commerce in Organizations (JECO)
- Journal of Internet Banking and Commerce (JIBC)
- Journal of Telecommunication, Electronic and Computer Engineering (JTEC)
- Asian Academy of Management Journal (AAMJ)
- International Journal of Digital Accounting Research (IJDAR)
- International Journal of Accounting Information Systems (IJAIS)
- International Journal of Supply Chain Management (IJSCM)

**Before submission, papers need to be formatted as per the journal requirements. Authors need to further develop their papers (e.g. adding in any other findings, expanding in some areas and drilling deeper into others, to justify a good journal publication) and to submit their papers for possible publication in the journal. Papers will undergo the journal's peer review process.*

Best PAPER AWARD will be conferred

SCOPUS JOURNAL PUBLICATION OPPORTUNITY



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CALL FOR PAPERS

Deadline: 1 June 2017

Conference website: www.ieem.org

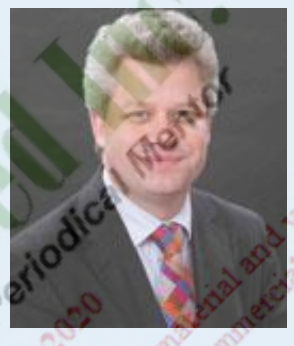
The IEEE International Conference on Industrial Engineering and Engineering Management (IEEM) is the leading international forum to disseminate, to all branches of industries, information on the most recent and relevant research, theories and practices in IEEM. All submissions are subjected to rigorous review before an acceptance decision is made. This conference has been hosted by leading universities in Asia and has been attended by around 500 participants from 50 countries each time.

This year's **IEEM2017** will be held in **Singapore** from **10-13 December**. Within the sunny island city one can expect to find a wide variety of cuisines and attractions that blend together different cultures to serve up a "Uniquely Singapore" experience.

TOPICS

- Data and Analytics
- Decision Analysis and Methods
- E-Business and E-Commerce
- Engineering Economy and Cost Analysis
- Engineering Education and Training
- Healthcare Systems and Management
- Human Factors
- Information Processing and Engineering
- Intelligent Systems
- Manufacturing Systems
- Operations Research
- Production Planning and Control
- Project Management
- Quality Control and Management
- Reliability and Maintenance Engineering
- Safety, Security and Risk Management
- Service Innovation and Management
- Supply Chain Management
- Systems Modeling and Simulation
- Technology and Knowledge Management

KEYNOTE SPEAKERS



Andy NEELY
University of Cambridge
United Kingdom

Benjamin W. WAH
The Chinese University of Hong Kong
Hong Kong SAR

Publication

All submissions (in full paper) will be peer reviewed. Accepted papers will be published in an IEEE conference proceeding.

Important Dates
Paper Submission Deadline: **1 Jun 2017**
Notification of Acceptance: **1 Aug 2017**
Final Paper & Copyright Transfer Due: **1 Sep 2017**
Author Registration Deadline: **1 Sep 2017**
Conference: **10-13 Dec 2017**

IEEM2017 Conference Updates
Please save this URL for your personal reference: www.ieem.org

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STRATEGIZING TOWARDS A DIGITAL FUTURE

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About the Conference

PM Narendra Modi's shock and awe demonetization announcement on Nov. 8, accompanied by his pitch to go digital, makes deeper analysis on the digital ecosystem inevitable. While narrower interpretations of digital aggressiveness policy might liken it to using less cash ostensibly to eliminate corruption, the forest of digital expansiveness, however, goes far beyond.

The industrial information architecture designed for world created post Industrial Revolution is increasingly being dismantled. Internet and the accompanying digital revolution challenge this substructure significantly on account of advances in internet and telecommunications. Knowledge dominates both production and consumption substantially at the cusp of a new order of information and knowledge access, control and transfer.

Furthermore, the digital shift has upset the time-honored equilibrium of power between private corporations, civil society and governments. Access to information ceases to be the preserve of the state, yet neither the corporation nor the wide body of non-profit, nongovernmental organizations and pressure groups can claim exclusive control. Implications notwithstanding, there is uncertainty whether the forces digitalization fortify decentralized order of information production and exchange or conversely craft a new order of information feudalism. Nonetheless, the emerging order is not technological determinism but an outcome of consumer, citizen and producer behavior reaching a tipping point facilitated by digital tools. If in more ways than one, the traditional substructures of information reflected elitist form of socio-economic discourse, sharing based production models (Wikipedia), open innovation models (P&G, IBM), user driven innovations (Google Maps, Lego Toy) and other online business models (Intuit, Amazon, E-bay) present a bottom up reaction in business thinking.

Digital technologies serve as engines of cultural innovation. Their influence stems from the virtualization of group networks and social identities like Facebook and extends to the digital convergence of textual and audio-visual media. The growth and adoption of electronic commerce gets inter-wined with the development and strengthening of intellectual property legislations. The global nature of internet is evident in the fact that while service providers are located in industrialized world, the benefits diffuse across developed and emerging countries alike. Digital expansiveness suggests strong movement towards the spread of greater competition, increased availability of choice, spirit which liberates from the lock-ins, controls that threaten to take the market into a monopoly and like. For India to emerge as a hub for the new generation digitally underpinned firms, recognition that there are subtle shifts in the way we produce and consume is imperative.

Despite uncertainty over future trends, it would be apt to explore the directions the global society, economy and polity might negotiate in the coming years. We invite you to join us in attempting to harness the unfamiliar terrain of the knowledge ecosystem.

Theme: STRATEGIZING TOWARDS A DIGITAL FUTURE

Tracks

DECODING DIGITAL BUSINESS LANDSCAPE

It is just not existing brick and mortar business shifting their distribution online but whole set of transformations in the way the relationships across the business ecosystem are redefined and reassessed. Topics can included theoretical contexualisation of digital phenomena, changing industry dynamics, characterizing digital goods, identification of digital drivers, etc.

DIGITAL BUSINESS MODELS, DESIGN & PRODUCT DEVELOPMENT

Given the transformative and disruptive nature of knowledge as means of production, there are multifarious vistas for emergence of new business models and product design. Proposals can encompass underlying drivers of digital industries, emergent technologies, new economies of the horizon, disruptions to existing business models, redefined user roles, revenue and financial model and competition dynamics among others.

INNOVATION COMPASS IN THE DIGITAL UNIVERSE

As couple of leading scholars put it, every business is a knowledge business. Given the increasing role of knowledge, information, creativity, culture, etc. in business, the track seeks to explore these dimensions. Further it also explores the challenges and sustainability of these models. It seeks to trace cost benefit anchors of innovation, explore intellectual property rights and its roles, emergent organizational structures, spillovers among others.

DIGITAL EXTERNALITIES

Digitalization might seem manna from heaven yet it is littered with ever-expanding unintended consequences. Issues like privacy, cyber-security, generativity, digital sweatshops, piracy, knockoffs among others.

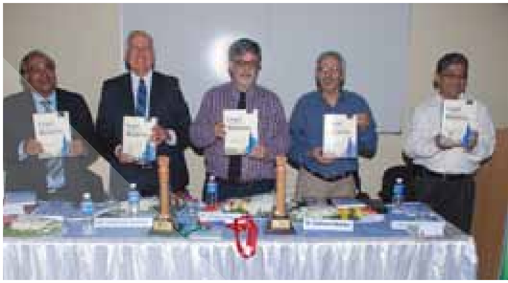
SOCIAL & POLITICAL FACE OF THE DIGITAL

Digital disruption encompasses its effects on the political and social dimensions of the system. The track attempts to decode these effects. We aim to work towards constructing digital contract, understand state role in information flows, social media narratives, digital diplomacy, public services delivery, cashless society among others.

SECTORAL & FUNCTIONAL CASE STUDIES USER STORIES, WHITE PAPERS & EXPERIENCES

We invite participants to submit case studies, use stories, white papers and experiences with respect to digital impact across various sectors and functional domains. They could include impact in terms of production, operations, marketing, finance, innovation, organizational restructuring, consumer behavior, intellectual property among others. Proposals are invited of experiences across industries.

Snapshots from earlier international conferences



Conference Paper Submission & Review

- Upload an abstract of your research contribution (around 800 words) at the conference website **(http://iba.ac.in/9th-iba-international-conference/)** on or before February 28, 2017. If you face any difficulty, contact us at **ibaconf@ibaintl.org**
- Shortlisted proposals will be informed by March 3, 2017.
- Submission guidelines are given at our website listed above.
- All proposals will be reviewed for originality, clarity, relevance besides testing for plagiarism.

Invited Sessions / Workshops / Panels

- To facilitate wider communication among researchers, we invite proposals from researchers/scholars to organize sessions/ workshops/panels.
- Details of the same are available at our website **(http://iba.ac.in/9th-iba-international-conference/)**.
- Proposals for the same can be mailed to **ibaconf@iba.ac.in** on or before Feb 28, 2017.

Publication of Papers

- Selected papers will be considered for publication in the half-yearly journal 3-D- IBA Journal of Management and Leadership
- CD-ROM proceedings of all accepted papers will be provided to all registered participants.

Conference Awards

Best Paper Award	₹20,000/-
Best Doctoral Paper	₹12,000/-
Best Student Paper	₹8,000/-

Accommodation

The participants will have to make their own arrangements for their stay. Pick up and drop facility will be provided from select points in the city to the conference venue.

Important Dates

Last date for submission of abstract	February 28, 2017
Last date for submission of full papers	March 3, 2017
Last date for registration for the conference (Early Bird)	March 10, 2017
Last date for registration for the conference (Regular)	March 23, 2017

Registration

Participants can register themselves at the conference website.

	Registration on or before March 10, 2017 (Early Bird)	Registration after March 10, 2017 (Regular)
For Faculty Members	₹1,500	₹1,800
For Full time Doctoral Students / Research Scholars / Students	₹400	₹600
For Industry Delegates	₹2,000	₹2,500

Note: All institutions/individuals who are members of industry bodies like CII, BCIC, FKCII, BMA, AIMA, AIMS etc will get a discount of 20% on registration fees.

The conference registration fees will include the conference kit, lunch, refreshments and dinner. Registration fees will be **per participant and not per paper.** If the co-authors want to participate, they have to register separately.

Registration details are available on our website.

The conference participants will have to send the demand draft drawn in favor of **'Arihant Education and Research Foundation' payable at Bangalore** along with the registration form. At least one author has to register for the conference to be eligible for the inclusion of the paper in the conference proceedings and programme.

The registration can also be done through Online Banking/NEFT. The details are as follows.

Account Detail For NEFT/RTGS

Name of The Bank	:	AXIS Bank
Branch Name	:	J.P. Nagar, Bangalore
Branch Address	:	Gound Floor, No. 6/A, J.P. Nagar, 3rd Phase, Bannerghatta Main Road Bangalore 560 076
Account Number	:	333010100008099
Account Name	:	Arihant Education & Research Foundation
IFSC Code	:	UTIB0000333
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About IBA

Indus Business Academy (IBA - formerly Indian Business Academy) has been Ranked **'28th'** All India by Competition Success Review (CSR) – GHRDC B-School Survey 2016, **'49th'** All India by Business India Best B-School Survey 2016, **'52nd'** Best B-School by Outlook All India B-School Survey in 2016, and **'56th'** All India by Times of India B-School Survey 2016.

IBA's founding mission was to bring excellence in Teaching, Training, Corporate Networking and in Placements. At IBA, students are groomed, not just as managers but as holistic individuals. It ensures emergence of positively charged individuals, ready to contribute to the growth of corporations and the welfare of the society.

'IBA' stands for three success mantras viz. Inspiration, Breakthrough and Achievement. At IBA, these three success mantras are represented by success formula viz. **Success = Inspiration X Breakthrough X Achievement (S = I X B X A).** Students of IBA imbibe these fundamental values and this has led to their success in various walks of life at the national and global levels. Learning at IBA is rooted in the 3 D model of Discussion, Dialogue and Discourse facilitating the development of Creative, Enlightened and Organic (CEO) leaders.

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Internationally Accredited by IACBE – IBA, Bangalore is the 19th among the 33 B-Schools (Out of 5000+ B-Schools in India) to get an International Accreditation.

Awarded as the 'Most Innovative Institute' in India by AIMS (Association of Indian Management Schools) in 2016.

Honoured with the 'The Academy of Success' award at the World Business Conclave 2016, Hong Kong: "Celebrating Asia-Pacific's Success Story".

Listed among 100 Fastest growing Private Institutes in Asia by WCRC Survey (Process Advised & Evaluated by KPMG).

Conference Venue:

Indus Business Academy

Lakshmipura, Thataguni Post, Kanakapura Main Road, Bengaluru 560 062

Conference Contacts:

Prof. Prashant Kulkarni, Conference Co-Chair, IBA, Bangalore

• E-mail:ibaconf@ibaintl.org • Phone: 080-26083756

Social Media Footprint:

Website : http://iba.ac.in/9th-iba-international-conference/

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Approved by AICTE Ministry of HRD Govt. of India

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IBA Bangalore is the first and the only Indian Business school to become a member of the Council for Higher Education Accreditation (CHEA) International Quality Group, formed to bring together high quality institutions involved in the international accreditation and support services of the world.

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www.iba.ac.in I www.ibasoapbox.wordpress.com

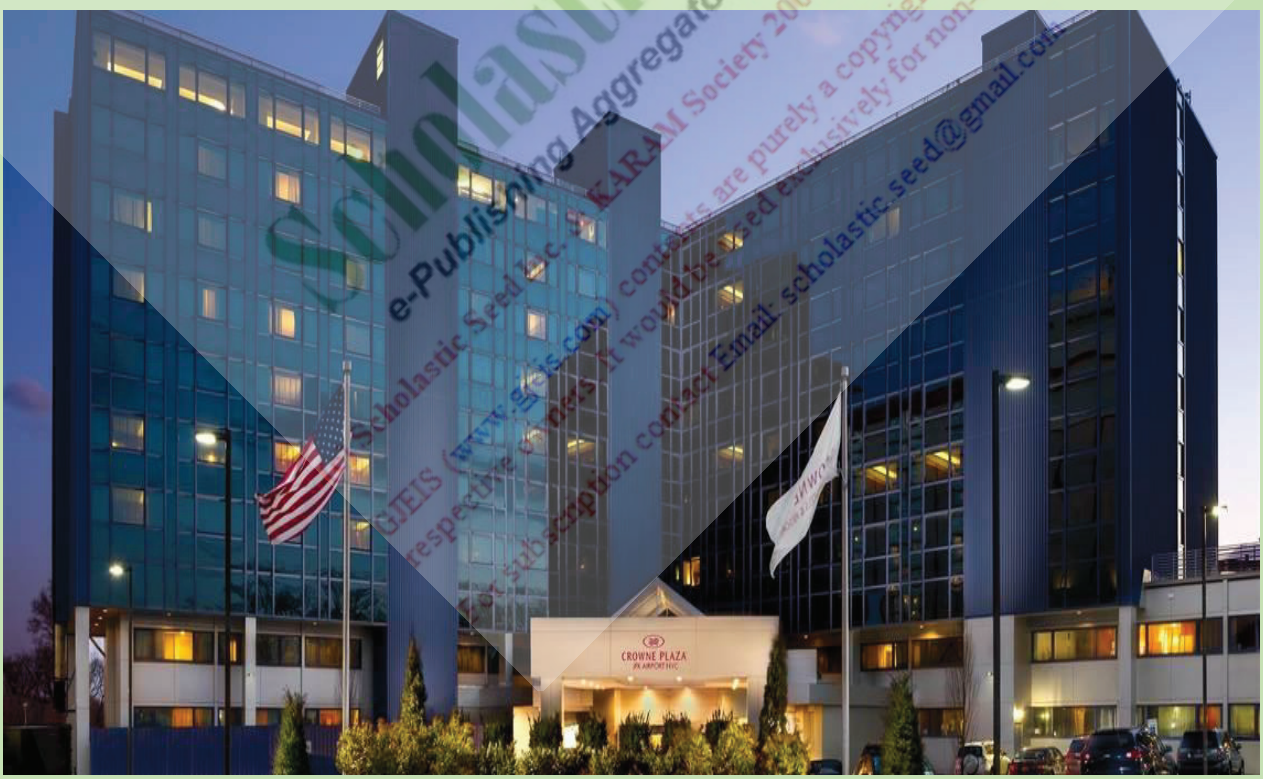
www.facebook.com/IBABlr

Academy of Business and Retail Management (ABRM)
London, United Kingdom

Presents

2017 ABRM 6th International Conference on Business & Economic Development (ICBED), New York-USA

Venue:
Crown Plaza JFK Airport
138-10 135th Avenue, Jamaica, New York 11436



Welcome Message from the Conference Chair

We are keen to foster a spirit of intellectual enquiry, one that draws on the wisdom of the past, yet equally encourages fresh thinking. It is our earnest wish that during the course of our conference new and purposeful relationships will be forged that will prove beneficial to all concerned.

This conference organized by ABRM seeks elucidate a wealth of issues in all aspects of business management, health and social care sciences, management education, teaching and learning methodologies and many more. Contributions should therefore be of interest to scholars, practitioners and researchers in management in both developed and developing countries targeting a worldwide readership. We are particularly interested in thought provoking research which capture and articulate the ways in which management thinking will have to be changed or customized to be effective and efficient in this new environment.

We believe that 2017 ABRM International Academic Conference on Business & Economic Development (ICBED) shall provide you opportunities to disseminate your research, learn from other researchers and network with other like-minded scholars.

We look forward to meeting you in New York in April 2017.

Dr. P. R. Datta
Academy of Business and Retail Management, London, United Kingdom

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Dr. P. R. Datta, Academy of Business and Retail Management, London, United Kingdom

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International Conference on Business & Economic Development (ICBED), 10-11th April 2017, New York, USA

Invitation

You are invited to participate in the '2016 ABRM International Academic Conference' organized by the Academy of Business and Retail Management (ABRM), New York-USA, during **Monday 10th and Tuesday 11th April 2017**

TRACKS FOR ICBED-2017

ICBED-2017 offers various tracks which include: The Finance, Accounting and Organisational structure, The Growth and Economic Development, the Globalisation and International Trade, Education and teaching for the Life Long Learning Sector, The HRM, Marketing & Information Technology, Health and Social care Management, Science and Engineering

Authors are invited to submit their original research papers, case study, review, work in progress, reports, abstract, students' papers or research proposals within the broad scope of each conference. Author's submission will be published in both the conference proceeding under **The Business & Management Review** (Printed copy) and online. ABRM utilises **double blind review** process for all submitted papers.

Contributions are invited in the areas including but not limited to:

- Innovation in retailing, ethical produce procurement and development
- Customer satisfaction, customer loyalty and retention strategies
- Customer Relationships marketing (CRM)
- Management and retail marketing
- Business management
- Business policies, strategies, and performance
- Innovation and product development, Business strategies
- Marketing management and strategies
- Consumer behaviour, Customer relationship management
- Public relations and retail communication
- Human Resources Management Practices and policies
- Information technology, Management Information Systems
- Globalisation, regional integration, international business, cross cultural management
- Multinational Corporations, transfer pricing, export and economic growth
- Trade and economic liberalisation
- Health and social care management, regulating in a changing health and social care sector
- Governance practices in health care sector
- Teaching and learning for life long learning sector
- The future of business education, assessment methods and techniques
- the structure and curricula of current and future business education
- Cross cultural issues in education, use of technology in teaching and learning
- Emotional intelligence in teaching

Authors may consider the above listed areas; however if they wish to develop a special session around a specific topic, the information is available in the call for submissions document. Individuals may also register and attend the conference as a participant without submitting or presenting any work.

Fee Details

Category	Indian Authors Per Paper	Foreign Authors
Academicians/ Corporate Executive	2500 INR	150 USD
Research Scholar/ Students(UG,PG)	2000 INR	100 USD
Listener/Participants	1000 INR	50 USD

- Maximum three authors in one research paper.
- (All three must be students then fee is 2000 INR else 2500 INR).
- If More than three authors, each author will be added with additional 500 INR.

Payment Options

- Online Payment using net banking NEFT or IMPS.
- Payment Gateway
- www.conferenceinfo.org/payment
- Direct Deposit in the bank account which will be provided in acceptance letter
- Foreign Authors can transfer Through Paypal/wire transfer/western money

The registration fee includes:

- Participation of one registered person in the conference.
- Publishing of full papers in one the associated Journals
- Publishing of full papers in the International Conference proceeding with ISBN number
- Conference Kit
- Hardcopy of certificates for both international journal publication and conference presentation.
- Tea and Lunch during the Conference.
- All papers the published papers will get DOI

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5th International Conference on Recent Development in Engineering,Science,Management and Humanities(ICRESMH-2017)

Venue:-

Indian Federation of United Nations Associations (IFUNA), C-6, Qutab Institutional Area, New Delhi, India

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INDIACom-2017

The Organizing Committee
of
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on
Computing for Sustainable Global Development
Cordially invite you to the

Inaugural Function

on 01st March, 2017; the Wednesday at 5:30 p.m. (sharp)
at
The Auditorium
Bharati Vidyapeeth Educational Complex
A-4, Paschim Vihar, Adjacent to Paschim Vihar (East) Metro Station, Rohtak Road
National Highway No.: 10; New Delhi – 110063, Tel.: +91-11-25275055; 09899997263

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Dy. Minister, Ministry of Communications & IT
Islamic Republic of Afghanistan

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Dept. of Electronic Technology,
University of Malaga, (SPAIN)

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King Abdulaziz University, Jeddah (KSA)

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Dept. of Management Information Systems
King Abdulaziz University, Jeddah (KSA)

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Computer Science & Publishing
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Note: *Please stay with us for* ***Cultural Evening*** *at* ***07:30 P.M.*** *followed by* ***Conference Dinner*** *at* ***08:30 P.M.*** *in the Campus itself. The detailed invitation can be downloaded from the link* http://bvicam.ac.in/indiacom/latest_news.asp

DOI: 10.18311/gjeis/2017/15895

250+ college and university leaders *(deans, registrar, directors, vice chancellor, chancellor, presidents, chairmen, owners etc.)* have confirmed for EdTech Review's Higher Education Technology Conference 2017 [HETC] at **Bangalore**.

HERE'S WHAT IS GOING TO BE DISCUSSED:

Panel on **Inevitable Role of Technology in Higher Education: What Colleges and Universities Must Know** by

- **Prof. AS Kolaskar,** Vice Chancellor, Neotia University
- **Aditya Berlia,** Co-Founder, Apeejay Education Society
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- **Hemlata Chari,** Deputy Director Academic, IDOL, University of Mumbai REGISTER NOW
- Panel on **Engaging Students, Assessing and Protecting Student Data by Leveraging Technology** by
- **Dr. P. Balakrishna Shetty,** Vice Chancellor, Sri Siddhartha Academy of Higher Education, Tumkur
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- **Dr. Anand K Joshi,** Vice Chancellor at CMR University
- **Onkar Singh,** Vice Chancellor at Madan Mohan Malaviya University of Technology Gorakhpur
- **Randhir Mishra,** Director, SGBS Unnati Foundation
- **Dr. M M Bagali,** Director - International Relations, REVA University REGISTER NOW

Panel on **Trends in Higher Education Branding, Online Marketing and Enrollment** by

- **Dr. Hari Krishna Maram,** CHAIRMAN and FOUNDER-CEO IMPERIAL COLLEGE
- **Mr. Sudhakar Rao,** Director – Branding & Communication, ICFAI University
- **Mr. G. Chaitanya,** Head of Marketing, SRM University
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Last chance to confirm your registration for the HETC 2017 going to be held on **10th March 2017 at Vivanta by Taj, MG Road, Bangalore**.

CONFIRM YOUR REGISTRATION NOW

Event Website: http://events.edtechreview.in/higher-education/2017

Conference Date & Venue: 10th March 2017, Vivanta by Taj, MG Road, Bangalore

Registration: 8.00 AM onwards, **Conference:** 9 AM - 4.30 PM

Regards,
Saransh Garg
Director - Events
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*Author for correspondence