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Impact of Micro Finance on Decision Making Empowerment - A study of Self Help Group Members in Kodaikanal, Dindigul District, Tamil Nadu, India

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A B S T R A C T

Empowerment is a multi-dimensional social process that helps people gain control over their own lives communities and in their society, by acting on issues that they define as important. Empowerment occurs within sociological, psychological economic spheres and at various levels, such as individual, group and community. Empowering women puts the spotlight on education and employment which are an essential element to sustainable development. One of the powerful approaches to women empowerment and entrepreneurship is the formation of Self Help Groups (SHGs) especially among women"s SHG is conceived as a sustainable people"s institution that provides the poor women with space and support necessary for them to take effective steps towards achieving greater control of their lives.

Key words: Empowerment, Women, decision making

1. INTRODUCTION

Micro Finance is emerging as a powerful instrument for poverty alleviation in the new economy. In India, micro finance scene is dominated by Self Help Groups (SHGs) – Bank Linkage Programme, aimed at providing a cost effective mechanism for providing financial services to the "unreached poor". Based on the philosophy of peer pressure and group savings as collateral substitute , the SHG programme has been successful in not only in meeting peculiar needs of the rural poor, but also in strengthening collective self-help capacities of the poor at the local level, leading to their empowerment. Micro Finance for the poor and women has received extensive recognition as a strategy for poverty reduction and for economic empowerment.

Increasingly in the last five years , there is questioning of whether micro credit is most effective approach to economic empowerment of poorest and, among them, women in particular. Development

practitioners in India and developing countries often argue that the exaggerated focus on micro finance as a solution for the poor has led to neglect by the state and public institutions in addressing employment and livelihood needs of the poor.

2. REVIEWS OF LITERATURE

Kabeer (1991)[1] Empowerment signifies increased participation in decision-making and it is this process through which people feel themselves to be capable of making decisions and the right to do so.

According to **Emma Zapata (1991)**[2] empowerment is power within and can be expressed in different ways, such as a chance to negotiate as a group, to share power, to get the support of other organisations, to look for outside support, all building up power in positive way.

According to **Sankar Chatter Jee (1993)**[3], empowerment through group strategy is multi faced process which encompasses many aspects enhancing awareness increasing the access to resources economic and socials. An equally component is the mobilization and organization of women into groups. The group strategy provides the required basis for solidarity strengths and collective action among the women. Empowerment is also linked to issues of social justice and equality.

Sakunthala Narashimhan[4], The author focuses on the positive aspects of the empowerment such as economic, social, political and psychological empowerment and the author concludes that to empower women with hope and enthusiasm in the inner layers of their psyche (mind) and thousands of women, irrespective of the educational achievements or economic status, women show their determination as useful and productive citizens who are eager to contribute their mite to the national effort.

Mayoux, (1993)[5] has identified three „paradigms“ on micro-finance and gender. The „financial self-sustainability paradigm“, currently dominant within most donor agencies and USAID, World Bank, UNDP, etc. assumes that increasing women“s access to micro-finance services will lead to individual economic empowerment, well-being and social and political empowerment.

Punithavathy Pandian and Eswaran (2005)[6] argued that the economic empowerment of poor women is the only way for poverty eradication. Because increased access to financial resources enables poor women to increase their employment and income in the petty business that has local demand and also based on local resources.

Microfinance, according to Otero (1997)[7] is the provision of financial services to low-income poor and very poor self-employed people. These financial services, according to Ledgerwood (1997) generally include savings and credit but also include other financial services such as insurance and payment services.

K.K.Kundu, K.S.Suhag, U.K.Pandy and Kusum Jain (2001)[8] in their article, "sustainable Micro Financing through SHGs in Gurgaon district (Haryana)", pointed out that through SHGs the poor had developed courage and confidence and served as decision makers SHGs inculcated the habit of savings among women.

3. STATEMENT OF THE PROBLEM

In India, 93 per cent of all workers are self employed. Women constitute more than half of this workforce. More than 96 per cent of women workers are self employed. Self employed workers are those who earn a living through their own small business or through their own labour. Unlike workers in the organised sector, they do not obtain a regular salary. These workers are characterised by insecure employment, low incomes, lack of capital assets, lack of access to institutional support and social security benefits, leading to an extreme level of poverty. The women generally vendors, home based workers such weavers, garment makers, food processors and craft people, manual labour and service providers such as agricultural labourers, construction workers, rag pickers domestic workers and cart-pullers.

One of the powerful approaches to women empowerment and entrepreneurship is the formation of Self Help Groups (SHGs) especially among women‟s SHG is conceived as a sustainable people‟s institution that provides the poor women with space and support necessary for them to take effective steps towards achieving greater control of their lives. Also create awareness about health and hygiene, sanitation and cleanliness, environmental protection, importance of education and better response to development schemes. Through SHGs they are provided credit and extension support for various production oriented and income generating activities. Also Micro finance for the poor and women has received extensive recognition as a strategy for poverty reduction and for economic empowerment.

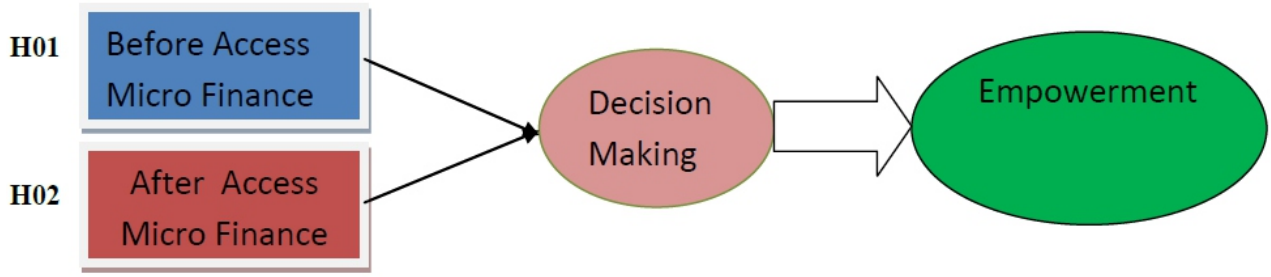
The impact of microfinance in Kodikanal is a subject worthy of serious examination for a number of reasons. In kodaikanal there are ample opportunities for entrepreneurial development. Most of the women here are poor and earn for livelihood through self employed activities. If they are supported financially by affordable schemes like Micro Finance to sustain their life, they can concentrate more on their employment activities and slowly they could become an better entrepreneur.

Against this backdrop, the present study has been carried out to assess the impact of micro-finance on socio-economic status of women.

4. OBJECTIVES

- To analyse whether there is any significant difference before and after access of micro finance with regard to decision making empowerment

5. RESEARCH MODEL



6. METHODOLOGY

The present study depends on both Primary and Secondary data. Primary data is based on the survey method. To facilitate the survey, Interview schedule was constructed as optional type as well as in Likert‟s five point scale. The optional type is aimed at information search and other details of the respondents. The likerts five point scale is applied to seek the opinion of the respondents regarding opinion, satisfaction and expectations. Interview schedule was used to know the perceptions of the respondents regarding their socio economic details, empowerment factors, micro finance provision.

Survey is conducted among the Self Help Group Members in Kodaikanal, Dindigul District, Tamil Nadu, India. The Stratified Random sampling technique adopted. The selection process is given below

This study was intended to analyse the role of SHGs in the promotion and development of the women members. For the purpose of analysis, the study was designed with a comprehensive profile.
Kodaikannal is divided into

- Kodaikannal Municipality and
- Kodaikannal Union

In Kodaikannal Municipality, we have

- Wards : 24

In Kodaikannal Union we have,

- Panchayat Union : 01
- Town Panchayats : 01
- Panchayats : 15
- Firrkas : 03
- Villages : 16
- Hamlets : 81

Table 1shows the details relating to total no. of SHGs in Kodaikannal Municipality

TABLE 1 Total no. of SHGs in Kodaikanal Municipality

TOTAL NO. OF SHGS IN KODAIKANNAL MUNICIPALITY									
S.NO	WARD NO	DMI	G.TRUST	MMS	SMILE	CHANARD	KODAI KURUNJI	MUNICIPALITY	TOTAL
1	1	5	5	5	1	2		8	26
2	2		6		5	5		8	24
3	3	8	2		5	7		4	26
4	4	10	6	2	6	8	1	5	38
5	5	5		1	3	5	4	2	20
6	6		1	4	1	6		2	14
7	7	1		1	2	7		1	12
8	8	1	1	2	2	5		3	14
9	9	2	15	1	2	12	4	4	40
10	10	18	16	1	2	18			55
11	11	5	2	1	1	3			12
12	12	6	1	2	2	10			21
13	13	5	1	1	4	9		1	21
14	14	3	2	7	5	5		6	28
15	15	6	1	8	2	14		6	37
16	16	7	5			1		5	18
17	17		16	4	1	1		2	24
18	18	5	18	2	3	4		6	38
19	19	8	17	2	2	1		2	32
20	20	2	2	2		1		1	8
21	21	8	6	2	3	2			21
22	22	3	11	7	1				22
23	23	14	1	8	3	4		1	31
24	24	2		13	1	18			34
	TOTAL	124	135	76	57	148	9	67	616

Table 2 shows the details relating to total no. of SHGs in Kodaikannal Panchayats

TABLE 2 Total no of SHG's in Kodaikanal Panchayat

TOTAL NO OF SHG'S IN KODAIKANAL PANCHAYAT'S														
S. No	PANCHAYAT'S	DMI	G. TRUST	MMS	CHANARD	SMILE	RWDM	8 AID ACTION	KALAN JIAM	KODAI KURUNJI	CO- OPERATIVE BANK KUZHU	VANA KUZHU	KODAI THEND RAL	TOTAL
1	VILPATTY	70	47	22	10	10				21		2		182
2	ADUKKAM	3	24	3		2						3		35
3	KAMANURE	18					32		4					54
4	K.C.PATTY						19							19
5	KOOKAL	19	11											30
6	KUMBARAIURE	5												5
7	MANNAMANURE	31	19								10	4		64
8	POOLATHURE	29							4					33
9	PERIURE						21							21
10	THANDIKUDI	19		1			16							36
11	POOMBARAI	12	16											28
12	POONDI	7	1											8
13	VADAKAVUNJI	4	14	2	4			3		4			1	32
14	PACHALURE				4		4							8
15	VELLAKEVI				1									1
16	PANNAIKADU	20					25		18					63
	TOTAL	237	132	28	19	12	117	3	26	25	10	9	1	619

Selection of panchayat - The Union-wise and panchayat-wise details of the Self Help Groups are maintained systematically by the taluk administration. The details regarding thrift, loans, and the number of NHGs, which are updated monthly was collected. As the number of SHGs is definite, the population can be known. Hence, the researcher resorted to Random Sampling Technique. In Kodaikanal, 1225 self help groups are functioning. These self help groups were stratified (wards and panchayats) and on basis of stratification sample, respondent groups were selected.

There are 24 wards in Kodaikannal Municipality and 132 wards in Kodaikannal Union. Each ward is given equal weightage. Out of these SHGs, 1 SHG from each ward is selected as sample. So, totally 120 SHGs were selected. (i.e. 10% of the total population). The researcher contacted the sample SHGs and

requested the SHGs to conduct a survey with the required number of members. On the recommendation of the animator 450 members were selected (four from each group) and the survey was conducted among them. Incomplete responses were rejected and Thus, sampling was done scientifically and survey was carried out according to the research norms without prejudice and bias.

7. TOOLS USED FOR ANALYSIS

To analyse, the objectives framed, percentage, Mean Standard deviation and t test are used.

8. ANALYSIS OF THE STUDY

The analysis consists of two parts- I Profile of the sample respondents and II their empowerment level due to their decision making.

I) PROFILE OF THE RESPONDENTS

Table 3

Sl.No	Particulars	Classification	No of Respondents	Percentage
1	Age	Below 30	61	14
		30-40	266	59
		Above 40	123	27
		Total	**450**	**100**
2	Marital Status	Married	370	82
		Divorce	48	11
		Widow	32	7
		Total	**450**	**100**
3	Educational qualification	Illiterat	175	39
		e Literate	275	61
		Total	**450**	**100**
4	Nativity	Rural	307	68
		Urban	143	32
		Total	**450**	**100**
5	Occupation	Agriculturist	188	42
		Self Employed	71	16
		Salary Earner	55	12
		Petty Business	12	3
		Artisans	14	3
		Housewife	83	18
		Vegetable Vendor	12	3
		Others	15	3
		Total	**450**	**100**

II. ANALYSIS OF THE STUDY

Empowerment regard to Decision making - Before access to Micro Finance

The empowerment of the members regarding the decision making process before access to the micro Finance study has been made and the gathered details are presented in the following table.

Table 4 : Empowerment regard to Decision making - Before access to Micro Finance

Decision making Empowerment	Mean	Std. Deviation
Going to job	3.02	1.059
Managing household expenditure	2.65	0.622
Going to health care	2.74	0.526
Purchase of household items	2.71	0.546
Family Budgeting	2.69	0.570
Education / career / marriage of children	2.72	0.524
Decision regarding recreation/entertainment	2.68	0.574
Saving, Borrowing and Investment	2.27	0.653

Source: Computed from Primary data

Table 2 explains that Decision making Empowerment (Before access to micro credit). The mean value for Going to job variable is 3.02 and standard deviation is 1.059, for Managing Household expenditure variable is 2.65 and standard deviation is 0.622, for Going to health care factor is 2.74 and standard deviation is 0.526, for Purchase of household factor is 2.71 and standard deviation is 0.546, for Family Budgeting factor is 2.69 and standard deviation is 0.570, for Education / career / marriage of children is 2.72 and standard deviation is 0.524, for Decision regarding recreation/entertainment factor is 2.68 and standard deviation is 0.574 and for Saving, Borrowing and Investment factor is 2.27 and standard deviation is 0.653.

Empowerment regard to Decision making - After access to Micro credit

The empowerment of the members regarding the decision making process after access to the micro credit study has been made and the gathered details are presented in the following table.

Table 5 Empowerment regard to Decision making - After access to Micro credit

Decision making Empowerment	Mean	Std. Deviation
Going to job	3.86	1.269
Managing household expenditure	3.86	0.547
Going to health care	3.78	0.594
Purchase of household items	3.89	0.535
Family Budgeting	3.92	0.534
Education / career / marriage of children	3.88	0.551
Decision regarding recreation/entertainment	3.86	0.577
Saving, Borrowing and Investment	4.03	0.537

Source: Computed from Primary data

From the above table it is found that the mean value for the factor Going to job is 3.86 and standard deviation 1.269, for Managing Household expenditure is 3.86 and standard deviation 0.547, for Going to health care is 3.78 and standard deviation 0.594, for Purchase of household items is 3.89 and standard deviation 0.535, for Family Budgeting is 3.92 and standard deviation 0.534, for Education / career / marriage of children is 3.88 and standard deviation is 0.551, for Decision regarding recreation/entertainment is 3.86 and standard deviation 0.577 and for Saving, Borrowing and Investment is 4.03 and standard deviation 0.537.

Null Hypothesis

There is no significant difference between mean ranks towards various empowerment before joining in SHGs.

Table 6 Friedman test for significant difference between mean ranks towards various Empowerment before joining in SHGs

Empowerment before joining SHGs	Mean Rank	Chi-Square value	P value
Economic Empowerment	**2.88**	776.318	< 0.001**
Social Empowerment	**1.49**		
Decision making Empowerment	**4.09**		
Familial / Interpersonal Empowerment	**3.75**		
Psychological Empowerment	**2.80**		

Note: ** Denotes significant at 1per cent level

Since P value is less than 0.01, the null hypothesis is rejected at 1 percent level of significance with regard to all dimensions of empowerment. Hence it is concluded that there is significant difference between mean ranks towards the empowerment before joining in SHGs. Based on mean rank Decision making empowerment (4.09) is high, followed by Familial empowerment (3.75), **Economic empowerment (2.88),** Psychological empowerment (2.80) and Social empowerment (1.49).

Null Hypothesis

There is no significant difference between mean ranks towards the Empowerment after joining in SHGs.

Table 7 . Friedman test for significant difference between mean ranks towards the Empowerment after joining SHGs

Empowerment after joining SHGs	Mean Rank	Chi-Square value	P value
Economic Empowerment	2.53	385.364	< 0.001**
Social Empowerment	3.46		
Decision making Empowerment	3.53		
Familial / Interpersonal Empowerment	1.99		
Psychological Empowerment	3.49		

Note: ** Denotes significant at 1per cent level

Since P value is less than 0.01, the null hypothesis is rejected at 1 percent level of significance with regard to all dimensions of empowerment. Hence it is concluded that there is significant difference between mean ranks towards the empowerment after joining SHGs. Based on mean rank, Decision making empowerment (3.53) is high, followed by Psychological empowerment (3.49), Social empowerment (3.46), **Economic empowerment (2.53)** and Familial empowerment (1.99).

SUGGESTION AND CONCLUSION

Empowerment process starts with the very beginning of group formation. Gradually the members of the groups become aware about various social and technical related activities through the group. Initially, they learn and gather information from each other by experience sharing during group meetings. They take the opportunity to participate in capacity building programme whenever they are exposed to such environment. In addition we recognize the fact that economic, social, political and psychological empowerment are the basic components which plays an important role in mobilizing women to become economically strong by providing training and employment opportunities. As a result women are gaining empowerment through their earnings and also they realize their full potential and self-esteem.

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Single Server Feedback Markovian Queueing System With Impatient Customers And Two Types Of Vacations

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A B S T R A C T

We consider an M/M/1 queue with two types of vacations and Bernoulli feedback simultaneously. During both vacations, the customers become impatient. That is whenever a customer arrives at the system it activates an 'impatience timer'. If the customer's service has not been completed before the customer's timer expire, the customer leaves the queue and never return. The stationary probability distribution of the system studied by probability generating function technique and some performance measures are also derived.

Keywords: Markovian Queue, Vacations, Feedbacks, Impatient Customers.

1. INTRODUCTION

Consider a system operating as an M/M/1 queue. In recent years, the study of vacation queues has a great effect on the queueing theory. Queueing system with server vacations have been extensively studied from 1970's onwards by various researchers. This system is applied in various fields such as computer system, communication networks etc..The appication of vacation model is available in the survey paper of Doshi[8], Wu and Takagi[23] and Tian and Zhang[24].

Waiting for service is usually an unpleasent experience and represents the loss of valuable resources, which translates into psychoogical as well as economic cost of waiting. The concept of waiting server with server vacation was first introduced by Boxma *etal*. [3]. There is now growing interest in the analysis of queueing systems with impatience customers. Laxmi and Jyothsna have discussed lot about the impatient customers in [25]. Queueing system with impatience customers reflects in many real life queueing system, particularly when dealing with human behaviour. Customers impatience has been

dealt with in the queueing literature mainly in the context of customers abandoning the queue due to either a long wait alread experienced or a long wait anticipated upon arrival.

Altman and Yechiali [1] have discussed briefly about the impatience customers with single and multiple working vacations. They have also discussed the *M/M/*∞ queueing model with impatient customers and vacations in [2]. Gang et al.[11] have extended [2] with impatience customers and working vacations. They have derived the probability geneating function of number of customers in the system and calculated values of key performances. Goswami[5] and Ammar[19] have discussed about two differentiated vacations. In [18], Padmavathi et al. have discussed impatience customers with vacation and a waiting server in their paper. In [26], Yue et al. analysed Markovian queueing systems with impatient customers and a variant of multiple vacation policy.

One more feature which has been widely studied in queueing systems is feedback. The concept of Bernoulli feedback is widely applied in computer time sharing and telecommunications systems. Tackas [21] was the first to study feedback queueing model. Further studies on the queue length, the total sojourn time and waiting time are provided by Disney et al. [6], [7]. Fontana and Berzova [10] have extended some results obtained for the *M/G/1* model with Bernoulli feedback to a more general feedback with priorities.

Disney et al.[7] have given an overview of literature concerning Bernoulli feedback studies. Queues with feedback exhibit interesting and some what unexpected behaviour. However, such problems are widely studied. One may refer to Falin [9], Kumar et al. [15], Ke and Chang [13], Kumar et al. [16] and Li Tao et al. [12].

The remaining part of the paper is organised as follows: In section 2, we describe the model description. We develop the probabaility generating functions of the steady state probabilities and solving the differential equations, we get a closed form expressions of the mean system size when it is in different states in section 3, 4 and 5, respectively. We also obtain expression for other performance measures in section 6.

2. MODEL DESCRIPTION AND ANALYSIS

We consider an *M/M/1* queueing system with impatient customers and two vacations. Customers arrive according to a Poisson process at rate λ. The service is provided by a single server, who serves the customer on FCFS basis. The service time follows an exponential distribution with a service rate μ.

After each service, the customer may, independent of the remaining stochastic behaviour of the system, return to the queue with probability $\delta(0 < \delta < 1)$ or depart from the system with probability $1 - \delta$.

When the server finishes service and finds the system empty, he does not leave for vacation and he stays ideal for a random period and then he leaves the system with rate α. If the server finds a customer at a vacation completion, the server returns to serve a customer immediately. Otherwise the server will take another vacation with rate γ_1. After the completion of second vacation, if there is no customer, the server returns to first vacation with rate γ_2. If he found customer arrives after completion of second vacation, immediately he start serving the customer.

During the vacations, the customers become impatient. That is whenever a customer arrives at the system it activates an 'imapatience timer' T, which is exponentially distributded with parameters ζ_1, ζ_2 respectively. If the customer's service has not been completed before the customer's timer expire, the customer leaves the queue and never return. We can find, at any time *t*, the system can be completely described by the following two random variables: L(t) and S(t), where L(t) represents the number of customers in the system at time *t*, *S(t)* speaks the state of server at time *t*, which is defined as follows: S(t) = 0 denotes that the server is busy or idle at time *t*, for *k = 1,2, S(t) = k* , denotes that the server is in *k*th vacation. Then $\{(S(t), L(t)), t \geq 0\}$ is a continuous time Markov chain that has state space

$$\Omega = \{(s, j), s = 0,1,2, j \geq 0\}$$

We define the following steady-state probabilities:

P_{sj} = The probability that there are j customers in the system when the service station is in the state s

We establish the steady-state equations for our model in the next section.

2.1. STEADY STATE ANALYSIS

The steady-state equations for , and are given by

$$(\lambda + \alpha)P_{00} = \mu\delta P_{01} \quad (1)$$

$$(\lambda + \mu\delta)P_{0n} = \lambda P_{0n-1} + \mu\delta P_{0n+1} + \gamma_1 P_{1n} + \gamma_2 P_{2n} \quad (2)$$

$$(\lambda + \gamma_1)P_{10} = \alpha P_{00} + \zeta_1 P_{11} + \gamma_2 P_{20} \quad (3)$$

$$(\lambda + \gamma_1 + n\zeta_1)P_{1n} = \lambda P_{1n-1} + (n+1)\zeta_1 P_{1n+1} \quad (4)$$

$$(\lambda + \gamma_2)P_{20} = \zeta_2 P_{21} + \gamma_1 P_{10} \quad (5)$$

$$(\lambda + \gamma_2 + n\zeta_2)P_{2n} = \lambda P_{2n-1} + (n+1)\zeta_2 P_{2n+1} \quad (6)$$

Let $P_s(z) = \sum_{j=0}^{\infty} P_{sj} z^j, |z| \leq 1$ and $s = 0,1,2$ be the generating function for the probability P_s, then by (1) - (6) and some habitual algebraic manipulations, we get

$$[\lambda(1-z) + \mu\delta(1-\tfrac{1}{z})]P_0(z) = \gamma_1 P_1 z + \gamma_2 P_2(z) - [\alpha - \mu\delta(1-\tfrac{1}{z})]P_{00} - \gamma_1 P_{10} - \gamma_2 P_{20} \quad (7)$$

$$(z-1)\zeta_1 P_1'(z) + [\lambda(1-z) + \gamma_1]P_1(z) = \alpha P_{00} + \gamma_2 P_{20} \quad (8)$$

$$(z-1)\zeta_2 P_2'(z) + [\lambda(1-z) + \gamma_2]P_2(z) = \gamma_1 P_{10} \quad (9)$$

2.2. SOLUTION OF DIFFERENTIAL EQUATIONS

Equation (8) can be written as

$$P_1'(z) - \left[\frac{\lambda}{\zeta_1} + \frac{\gamma_1}{\zeta_1(1-z)}\right]P_1(z) = -\left[\frac{\alpha P_{00} + \gamma_2 P_{20}}{\zeta_1(1-z)}\right] \quad (10)$$

In order to solve the differential equation(10), we multiply both sides by

$$e^{-\frac{\lambda}{\zeta_1}z}(1-z)^{\frac{\gamma_1}{\zeta_1}}$$

Then, we get

$$\frac{d}{dz}\left[e^{-\frac{\lambda}{\zeta_1}z}(1-z)^{\frac{\gamma_1}{\zeta_1}}P_1(z)\right] = -\left[\frac{\alpha P_{00} + \gamma_2 P_{20}}{\zeta_1}\right] e^{-\frac{\lambda}{\zeta_1}z}(1-z)^{\frac{\gamma_1}{\zeta_1}-1} \quad (11)$$

Integrating from 0 to , we have

$$P_1(z) = \frac{e^{\frac{\lambda}{\zeta_1}z}\left\{P_{10} - \left[\frac{\alpha P_{00} + \gamma_2 P_{20}}{\zeta_1}\right]\int_0^z e^{-\frac{\lambda}{\zeta_1}s}(1-s)^{\frac{\gamma_1}{\zeta_1}-1}ds\right\}}{(1-z)^{\frac{\gamma_1}{\zeta_1}}} \quad (12)$$

Since z = 1 is the root of the denominator of the R.H.S of equation(12), we have that z = 1 must be the root of numerator of the R.H.S. Therefore we have

$$P_{10} = \left[\frac{\alpha P_{00} + \gamma_2 P_{20}}{\zeta_1}\right] C_1 \quad (13)$$

$$where C_1 = \int_0^1 e^{-\frac{\lambda}{\zeta_1}s}(1-s)^{\frac{\gamma_1}{\zeta_1}-1}ds$$

Substituting equation (13) in equation (12), we obtain

$$P_1(z) = \frac{e^{\frac{\lambda}{\zeta_1}z}}{(1-z)^{\frac{\gamma_1}{\zeta_1}}} \frac{\alpha\zeta_2}{\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2} C_1 \left[1 - \frac{1}{C_1}\int_0^z e^{-\frac{\lambda}{\zeta_1}s}(1-s)^{\frac{\gamma_1}{\zeta_1}-1}ds\right] P_{00} \quad (14)$$

Equation (9) can be written as

$$P_2'(z) - \left[\frac{\lambda}{\zeta_2} + \frac{\gamma_2}{\zeta_2(1-z)}\right] P_2(z) = -\left[\frac{\gamma_1 P_{10}}{\zeta_2(1-z)}\right] \quad (15)$$

In order to solve the differential equation (10), we multiply both sides by

$$e^{-\frac{\lambda}{\zeta_2}z}(1-z)^{\frac{\gamma_2}{\zeta_2}}$$

In a similar manner used for solving equation (8), we get

$$P_2(z) = \frac{e^{\frac{\lambda}{\zeta_2}z}\left\{P_{20} - \left[\frac{\gamma_1 P_{10}}{\zeta_2}\right]\int_0^z e^{-\frac{\lambda}{\zeta_2}s}(1-s)^{\frac{\gamma_2}{\zeta_2}-1}ds\right\}}{(1-z)^{\frac{\gamma_2}{\zeta_2}}} \quad (16)$$

Since z = 1 is the root of the denominator of the R.H.S of equation (16), we have that z = 1 must be the root of numerator of the R.H.S. Therefore we have

$$P_{20} = \left[\frac{\gamma_1 P_{10}}{\zeta_2}\right] C_2 \quad (17)$$

$$where C_2 = \int_0^1 e^{-\frac{\lambda}{\zeta_2}s}(1-s)^{\frac{\gamma_2}{\zeta_2}-1}ds$$

substituting equation (17) in equation (16), we get

$$P_2(z) = \frac{e^{\frac{\lambda}{\zeta_2}z}}{(1-z)^{\frac{\gamma_2}{\zeta_2}}} \frac{\alpha\gamma_1}{\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2} C_1 C_2 \left[1 - \frac{1}{C_2}\int_0^z e^{-\frac{\lambda}{\zeta_2}s}(1-s)^{\frac{\gamma_2}{\zeta_2}-1}ds\right] P_{00} \quad (18)$$

Equations(14) and (18) in terms of P_{00}. Therefore once P_{00} is calculated, the $P_1(z)$ and $P_2(z)$ are determined. In the next section, we derive the probabilty P_{00} and the mean system sizes when the server is in different states.

2.3. MEAN SYSTEM SIZES

Let L_1 be the system size when the server is in the state 1. Then $E(L_1)$is the mean system size when the server is in the state 1, which is defined by

$$E(L_1) = \sum_{n=1}^{\infty} nP_{1n}$$

From equation (8), using L'Hospital rule, we obtain

$$P_1'(1) = \lim_{z\to 1} \frac{[\lambda(1-z)+\gamma_1]P_1(z) - (\alpha P_{00} + \gamma_2 P_{20})}{(1-z)\zeta_1}$$

$$= \frac{\gamma_1 P_1'(1) - \lambda P_1(1)}{-\zeta_1} \quad (19)$$

Thus, we get

$$E(L_1) = \frac{\lambda}{\zeta_1+\gamma_1} P_1(1) \tag{20}$$

Similarly, let L_2 be the system size when the server is in the state 2. Then, $E(L_2)$ is the mean system size when the server is in the state 2, which is defined by $E(L_2) = \sum_{n=1}^{\infty} nP_{2n}$ From equation (9), using L'Hospital rule, we get

$$P_2'(1) = \lim_{z\to 1} \frac{[\lambda(1-z)+\gamma_2]P_2(z)-(\gamma_1 P_{10})}{(1-z)\zeta_2}$$

$$= \frac{\gamma_2 P_2'(1)-\lambda P_2(1)}{-\zeta_2} \tag{21}$$

Thus, we get

$$E(L_2) = \frac{\lambda}{\zeta_2+\gamma_2} P_2(1) \tag{22}$$

Furthermore, the mean system size when the server is on vacation, denoted by $E(L_v)$, is obtained as follows

$$E(L_v) = E(L_1) + E(L_2)$$

$$= \frac{P_{00}}{\zeta_1\zeta_2-\gamma_1\gamma_2 C_1 C_2}\left[\frac{\lambda}{\zeta_1+\gamma_1}\frac{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2}{\gamma_1} + \frac{\lambda}{\zeta_2+\gamma_2}\frac{e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2}{\gamma_2} C_1\right] \tag{23}$$

Equation (7) can be written as

$$P_0(z) = \frac{\gamma_1 P_1(z)+\gamma_2 P_2(z)-\gamma_1 P_{10}-\gamma_2 P_{20}-[\alpha-\mu\delta(1-\frac{1}{z})]P_{00}}{\lambda(1-z)+\mu\delta(1-\frac{1}{z})} \tag{24}$$

Applying L'Hospital rule, we get

$$P_0(1) = \frac{\gamma_1 E(L_1)+\gamma_2 E(L_2)+\mu\delta P_{00}}{\mu\delta-\lambda} \tag{25}$$

Substituting equations (20) and (22), we get

$$P_0(z) = \frac{P_{00}}{\mu\delta-\lambda}\left[\frac{\lambda}{\zeta_1+\gamma_1}\frac{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2}{\gamma_1} + \frac{\lambda}{\zeta_2+\gamma_2}\frac{e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2}{\gamma_2} C_1 + \mu\delta\right] \tag{26}$$

Using normalization condition

$$P_0(1) + P_1(1) + P_2(1) = 1$$

we arrive at

$$P_{00} = [\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2]\left\{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2\left[\frac{1}{\gamma_1} + \frac{1}{\mu\delta-\lambda}\frac{\lambda}{\zeta_1+\gamma_1}\right]\right.$$
$$\left. + e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2 C_1\left[\frac{1}{\gamma_2} + \frac{1}{\mu\delta-\lambda}\frac{\lambda}{\zeta_2+\gamma_2}\right] + \mu\delta(\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2)\right\}^{-1} \quad (27)$$

Substituting equation (27) in equation (23), we get

$$E(L_v) = \left[\frac{\lambda}{\zeta_1+\gamma_1}\frac{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2}{\gamma_1} + \frac{\lambda}{\zeta_2+\gamma_2}\frac{e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2}{\gamma_2}C_1\right]\left\{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2\left[\frac{1}{\gamma_1} + \frac{1}{\mu\delta-\lambda}\frac{\lambda}{\zeta_1+\gamma_1}\right]\right.$$
$$\left. + e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2 C_1\left[\frac{1}{\gamma_2} + \frac{1}{\mu\delta-\lambda}\frac{\lambda}{\zeta_2+\gamma_2}\right] + \mu\delta(\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2)\right\}^{-1} \quad (28)$$

Now we $E(L_0)$ derive from the equation (24), using L'Hospital rule

$$E(L_0) = \frac{\gamma_1 P_1^{*}(1) + \gamma_2 P_2^{*}(1) - 2\mu\delta P_{00}}{2(\mu\delta-\lambda)} + \frac{\mu\delta}{(\mu\delta-\lambda)^2}[\gamma_1 P_1'(1) + \gamma_2 P_2'(1) + \mu\delta P_{00}]$$
$$- \frac{3\mu\delta}{(\mu\delta-\lambda)^2}[\gamma_1 P_1(1) + \gamma_2 P_2(1) - \gamma_1 P_{10} - \gamma_2 P_{20} - \alpha P_{00}] \quad (29)$$

where $P_1^{''}(1)$ and $P_2^{''}(1)$ and is obtained by differentiating twice $P_1(z)$ and $P_2(z)$ at $z = 1$. and at . Differentiating twice the equations (14) and (18) respectively with z = 1 , we obtain

$$P_1^{''}(1) = \frac{\lambda P_1'(1)}{\zeta_1} \quad (30)$$

$$and P_2^{''}(1) = \frac{\lambda P_2'(1)}{\zeta_2} \quad (31)$$

Substituting equation (30) and (31) in (29), we get

$$E(L_0) = \frac{1}{\mu\delta-\lambda}\left\{\gamma_1 P_1(1)\left[\left(\frac{\lambda}{2\zeta_1} + \frac{\mu\delta}{\mu\delta-\lambda}\right)\left(\frac{\lambda}{\zeta_1+\gamma_1}\right) - \frac{3\mu\delta}{\mu\delta-\lambda}\right]\right.$$
$$\left. + \gamma_2 P_2(1)\left[\left(\frac{\lambda}{2\zeta_2} + \frac{\mu\delta}{\mu\delta-\lambda}\right)\left(\frac{\lambda}{\zeta_2+\gamma_2}\right) - \frac{3\mu\delta}{\mu\delta-\lambda}\right]\right\}$$
$$+ \frac{1}{(\mu\delta-\lambda)^2}[3\mu\delta\gamma_1 P_{10} + 3\mu\delta\gamma_2 P_{20} + 3\mu\delta\alpha P_{00} + \mu\delta P_{00}] \quad (32)$$

Let L be the number of customers in the system. Then, the mean system size

$$E(L) = E(L_v) + E(L_0) \quad (33)$$

can be calculated from the equations (32) and (28).

$$E(L) = \frac{P_{00}}{\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2}\left[\frac{\lambda}{\zeta_1+\gamma_1}\frac{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2}{\gamma_1} + \frac{\lambda}{\zeta_2+\gamma_2}\frac{e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2}{\gamma_2}C_1\right]$$
$$+\frac{1}{\mu\delta-\lambda}\left\{\gamma_1 P_1(1)\left[\left(\frac{\lambda}{2\zeta_1}+\frac{\mu\delta}{\mu\delta-\lambda}\right)\left(\frac{\lambda}{\zeta_1+\gamma_1}\right)-\frac{3\mu\delta}{\mu\delta-\lambda}\right]\right.$$
$$\left.+\gamma_2 P_2(1)\left[\left(\frac{\lambda}{2\zeta_2}+\frac{\mu\delta}{\mu\delta-\lambda}\right)\left(\frac{\lambda}{\zeta_2+\gamma_2}\right)-\frac{3\mu\delta}{\mu\delta-\lambda}\right]\right\}$$
$$+\frac{1}{(\mu\delta-\lambda)^2}[3\mu\delta\gamma_1 P_{10} + 3\mu\delta\gamma_2 P_{20} + 3\mu\delta\alpha P_{00} + \mu\delta P_{00}]$$

Some performance measures

In this section, we derive some other performance measures.

1. Probabilty that the server is on vacation

The probability that the server is on vacation is given by

$$P_v = \sum_{n=0}^{\infty} P_{1n} + \sum_{n=0}^{\infty} P_{2n}$$
$$= P_1(1) + P_2(1) \qquad (34)$$

Substituting the values of $P_1(1)$ and $P_2(1)$ in equation (31)

$$P_v = \frac{P_{00}}{\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2}\left[\frac{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2}{\gamma_1} + \frac{e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2 C_1}{\gamma_2}\right] \qquad (35)$$

2. Probabilty that the server is busy

The probability that the server is busy is given by

$$P_b = \sum_{n=1}^{\infty} P_{0n} - P_{00} \qquad (36)$$

Substituting the values of $P_0(1)$, we get

$$P_b = P_{00}\left[\frac{1}{\mu\delta-\lambda}\left(\frac{\lambda}{\zeta_1+\gamma_1}\frac{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2}{\zeta_1\zeta_2-\gamma_1\gamma_2 C_1 C_2} + \frac{\lambda}{\zeta_2+\gamma_2}\frac{e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2 C_1}{\zeta_1\zeta_2-\gamma_1\gamma_2 C_1 C_2} + \mu\delta\right) - 1\right] \qquad (37)$$

Where

$$P_{00} = [\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2]\left\{e^{\frac{\lambda}{\zeta_1}}\alpha\zeta_1\zeta_2\left[\frac{1}{\gamma_1} + \frac{1}{\mu\delta-\lambda}\frac{\lambda}{\zeta_1+\gamma_1}\right]\right.$$

$$\left. + e^{\frac{\lambda}{\zeta_2}}\alpha\gamma_1\zeta_2 C_1\left[\frac{1}{\gamma_2} + \frac{1}{\mu\delta-\lambda}\frac{\lambda}{\zeta_2+\gamma_2}\right] + \mu\delta(\zeta_1\zeta_2 - \gamma_1\gamma_2 C_1 C_2)\right\}^{-1}$$

3. PROPORTION OF CUSTOMERS SERVED

Clearly, the expected number of customers served per unit of time is $\mu\delta P_b$, implying that the proportion of customers served is given by

$$P_s = \frac{\mu\delta}{\lambda}P_b \tag{38}$$

where is given by the equation(38).

4. AVERAGE RATE OF ABANDONMENT DUE TO IMPATIENCE

When the system is in state $(1,n)$, $n \geq 1$, the rate of abandonment of a customer due to impatience is $n\zeta_1$ and in state $(2,n)$, $n \geq 1$, the rate of abandonment of a customer due to impatience is $n\zeta_2$. Thus the average rate of abandonment due to impatience is given by

$$R_a = \sum_{n=1}^{\infty} n\zeta_1 P_{1n} - P_{10} + \sum_{n=1}^{\infty} n\zeta_2 P_{2n} - P_{20} \tag{39}$$

5. CONCLUSION

A single server queueing model which has Poisson arrivals and exponentially distributed service times with two types of vacations, customers' impatience and feedback is analyzed in steady state regime. The explicit solution for the system size probabilities is obtained. Additionally, the mean number of customers in the system in steady state as the performance measures.

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Participatory Ergonomics-An Exemplary Paradigm In Work-Place Design

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A B S T R A C T

Employee participation in the decision-making process has always been extolled as a great management practice in employee engagement initiatives by the corporates around the globe. While this was true to the extent of managerial decisions, a newer paradigm has emerged. An employee knows his work better than anybody. So, who better than the employee, be involved in the work-place design process? While designing a physical work setting, employees are at the centre of the design and not just the chair, table, light fan etc.

Efforts are made to align the physical surroundings to suit the individual needs. While customization heralded a new era in the field of manufacturing and has embraced every walk of our lives, it is high time firms look at customizing the environment where employees spend quality and quantity time. This not only creates a sense of ownership but also enables employees work in a safe and sound environment. Issues like Productivity, absenteeism, accidents at work place, attrition etc due to non-engaging physical work set up can be addressed with participatory ergonomics. For a program of this sort to take shape, see the light of the day, and be sustainable, the support top management extends plays a crucial role. While the management is ready to shell out huge money and approve budgets for re-skilling employees which helps them contribute to the bottom line; a healthy worker ideology needs to dawn upon the new age leadership. This conceptual paper is an attempt to explore literature that is similar to the train of thought the researcher posits.

Keywords: Participatory Ergonomics (PE), workplace, working environment, employee participation

1. INTRODUCTION

Industrial ergonomics experts swear by a dictum that goes, "Know your user, Know your user‟s task". The philosophy of a good ergonomic solution, therefore is to understand the reciprocal relationship that the job and the doer of the job share. A divorce between understanding the two in tandem leads to failed attempts to address problems that workers face due to a workplace that is ergonomically ill designed.

In any participatory ergonomics (PE)program a company wants to initiate, all stakeholders like employees, managers, OSHA experts, maintenance personnel, HR managers etc will take active part. It is an integrative approach to designing a place which helps improve productivity and reduce injuries. PE can help reduce work place injuries, musculoskeletal disorders, lower back injuries etc by addressing specific problems workers face. Incidentally it reduces the cost company incurs in medical claims of employees who suffer from injuries while at work. While accidents at work place is dealt with law, physical discomfort employees face while using equipment‟s, or poorly designed chairs, desks, ill lit and ill ventilated working area are issues which law doesn‟t address. Hawthorne experiments gave a perspective of how lighting can influence employee productivity.

Instead of a desk researcher giving insights about the causes, effects and suggestions to overcome physical problems associated with worker‟s interaction with the job, an ergonomist who interacts with the actual workers, facing problem will be able to offer better solutions. The worker‟s exposure to musculoskeletal disorders is greatly reduced due to PE. It empowers employees physically and mentally. The fact that they are involved in the process makes them more responsible to their productivity. Once PE is implemented workers feel safe at work and appreciate company‟s interest in providing a safe working environment.

2. RESEARCH METHOD

The researcher engaged in a thorough literature review using sources like EBSCO, Pro Quest, Research Gate and Journals related to ergonomics. While participatory ergonomics remained the keyword for most of the searches, management support for ergonomics, employee participation in ergonomics, employee‟s involvement in designing workplaces were some phrases that yielded good results. The inclusion criteria included relevance, review, design of the study and geography. As far as relevance is concerned, the researcher aimed at articles which emerged from the search using keyword or phrases (as highlighted earlier). All the sources used were peer reviewed journals. The articles included single firm studies, case studies, conceptual notes and empirical studies. Since no much research on PE is done in India, it was a good enough reason to serve as research gap. Largely studies conducted in the US and UK dominate this work.

3. LITERATURE REVIEW

Participatory Management has been in vouge since the times of Hawthorne experiments where changing working conditions and their impact on workers were studied by involving workers. It is an approach

where employees are empowered to participate in organizational decision making. Such participation is likely to increase motivation, job satisfaction and productivity.

The concept of Participatory Ergonomics (PE) seems to be inspired by the Japanese concept of Quality Circles(QC). The aim of quality circles is to bring a group of workers of a certain unit to ideate on problems faced by them at workplace and brainstorm on the possible solutions, finalize on a solution, implement it and review its impact. These QCs are used for problem solving often supported by the top management. More often than not solutions are simple and are implemented without much fanfare. QCs try to address small but significant problems which if left unattended may lead to blunders. They not only help solve problems but also improve productivity, reduce workplace accidents and injuries, increase motivation and give a sense of ownership to employees. Among various topics dealt with, improving occupational health and safety is the top priority.

Wilson and Haines (1997) defined PE as a process of involving people in planning and controlling of their work. They believe workers have a better knowledge and power to influence both processes and outcomes in order to achieve goals.

The ideology of QC is supposedly be the motivation for PE as established by Vink, P., Peeters, M., Gründemann, R. W. M., Smulders, P. G. W., Kompier, M. A. J., &Dul, J. (1995) in their work. They suggest an ideal participatory ergonomics approach must include steps like preparation(core committee to oversee the process, organizational commitment, budget, goal setting and framework creation), work and health analysis (monitoring of work through questionnaire, checklist or observation to be carried out), evaluating solutions (major risk factors and employees are selected and solutions are tested), implementation (training, promotion and instruction) and evaluation (measure the effectiveness of the program). This approach was found successful because it was a step by step procedure, it made workers conscious about the need for improvements and they were motivated with their participation making a difference in the whole exercise. Though a time-consuming process it will be useful in making workplace‟s environment workable. The authors suggest the purchasing team to be part of the core committee to avoid delays in procurement of ergonomic furniture developed as per the employee‟s requirement.

A common theme that runs parallel in most of the PE research is the role of top management commitment. In their study, Wilson and Haines(1997) and Haims and Carayon (1998) urge the management‟s support for the success of any PE initiative. Lee(2005) believes the first step in any PE program is the commitment by the management. A significant amount of work by Halpern and Dawson

(1997), Laitinen et al (1997), Moore and Garg(1998), Dale(2004), Torma and Krajewski et al (2007) have highlighted the role of board of management and the support it extends to be a driver of change implementation. The effect of no support by the management is recorded in studies by Rosecrance and Cook (2000),Polyani et al(2005), Bohr, Evanhoff and Wolf(1997), Jensen(1997). Shannon(2000) states the management‟s commitment to safety alone will help them contribute to PE program. Summation of research in PE unequivocally stress upon the management‟s philosophy and support as basic force that drives success of such initiatives. Nagamachi (1995) was of the opinion that a committee that oversees PE must be equipped with knowledge related to Japanese techniques like Just In Time, Kaizen, quality circles and quality control techniques. Improving occupational health and safety is a direct outcome of participatory ergonomics.

Studies suggest a variation in the perspectives that govern the support different departments give towards the implementation of PE programs. In a study by Vallas(2003), the author found conflicting ideologies of departments. It was observed that the production department was of the opinion that decisions regarding work arrangements had to centralized, whereas the HR manager felt a participatory style of management was better. It was no surprise that the HR manager‟s views were brushed under the carpet, for the management felt the HR manager was not able to digest the „power‟ other departments had over them. The resistance middle management exhibited for reasons such as additional burden on them or self interest was found to be bothering the PE program as found in a study by Harley et al (2006). The general belief that the middle management is a representation of top management, among lower level employees is found to be a myth, as they are working towards furthering their own interest than the welfare of employees at the lower level. Balogun(2003) found lack of support and time to be the reasons why middle level managers resisted change. A major concern expressed in the literature is the varied levels of commitment in pursuing company interests such as health and safety, and initiatives like PE programs by different managers in different levels.

While PE is looked at as a team effort to make the workplace ergonomically sound, researchers have stressed upon the need for training this team. Topics like the framework for PE program, ergonomic concepts and principles, identifying the problem areas record keeping etc must be covered in the program.

4. DISCUSSION

Adapting to the environment and adapting things around us for better use has been in existence from the times of cave men. Spearheads, arrowheads and other hunting tools were designed in a manner that best

fits the user. The best part about these tools was the fact that the designer of the tool and user were the same, thereby reducing possible problems that could have occurred over time due to its usage. Gibson(1979) referred to the reciprocity of relationship between the user and the tool as an example of individual-environment mutuality. While he suggested an affordance perspective which focuses on environment‟s role in defining an individual‟s action, Turvey and Shaw (1979) suggested an actor‟s effectivities approach where user‟s perspective dominates the creation of new things. However, the need of the hour is a marriage between these two approaches which leads to a participatory ergonomics paradigm.

Traditional ergonomic solutions have focussed on either the user or the work environment separately and ignored their interactions. Physical discomfort employees face at workplace is due to the interactions between the user and their environment, therefore solutions must be considering the interactions and not in isolation. Another mistake that conventional ergonomists may commit is consider the users to be mute spectators than active sources of information as opined by McNeese &et.al(1995).

Liker and Colleagues (1989) were of the opinion that Japanese firms used quality circles and safety circles to address ergonomics issues, whereas US firms constituted ergonomic teams which made conscious efforts to solve ergonomic problems at workplace. In a study by Gadbois et al (1995) it was found that firms in France emphasized the role of joint committees who set the objectives for core team that was constituted to implement a PE program. Theberge, N., Granzow, K., Cole, D., & Laing, A. (2006) in their work spoke extensively about the roles and responsibilities of an Ergonomic Change Team(ECT). Their belief that ECTs give voice to the workers at the shop floor level, concurred with another study by Wands and Yassi (1992). Some of the problems that they found that bothered ECTs were the mix of employees and members from the management whose ideologies were at loggerheads at times, quality of time each could dedicate to the program would vary; while the former had to juggle between work shifts and work load, the latter had to spend time on other strategic activities. Similar sentiments were echoed in studies by Bohr et al(1995) and Westlander et al (1995).

PE is supposed to have an impact on employee satisfaction and profitability of the firm as opined by Nagamachi(1995). The workers are positive about adapting to the new work environment which was designed in line with their needs. Workers participation in the assessment, problem solving, and implementation of solutions lies at the heart of any PE program. Group dynamics research by Lewin(1943) and Cosh and French (1948) have stressed upon the benefits of involving people in discussions and decision making. Participation enables better understanding of the problem, team building and sense of involvement among employees.

Imada(1991) was of the opinion that a participatory approach promotes active stakeholder participation, collaboration and better understanding of the problems. PE programs are also believed to have a positive impact on employee health in various industries like construction ,healthcare food processing etc as highlighted by various studies by Bohr, Evanoff and Wolf (1997), Bohr and Wolf (1999). Studies in the past have also proclaimed positive improvement in workplace factors and employee health, Rivilis et al (2008).

5. CONCLUSION

In conclusion, it can be stated that a successful PE requires a systems approach. This includes employee feedback about the working environment, their problems faced due to faulty equipment and postures as input, ergonomics expert‟s action plan and implementation of ergonomically sound work environment as process, finally employee wellbeing both physically and mentally as output.. While medical practioner‟s intervention is seen as a treatment for physical discomfort, PE is seen an organization‟s treatment towards workers safety and wellbeing. A PE program cannot be implemented overnight, results are not immediate, and success not guaranteed unless a dedicated team works on it. Organizations will be rewarded with healthy workers, cost reduction in the long run and an employer of choice tag if participatory ergonomics is implemented in letter and spirit.

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Determinants Of Indian Mobile Telecommunication Service Quality

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A B S T R A C T

Mobile telecommunication industry has revolutionized the world of communication and its impact has become more far reaching than ever before. These impacts are pronounced globally and more so in India. The Indian Mobile industry has progressed by leaps and bounds in the last decade and half. As per TRAI, the total number of mobile subscribers by the end of March 2018 was 1183.41 million, taking the tele-density to 91.09, of which the urban tele-density is a prodigious 168.17 and the rural tele-density is 58.67. The objective of this study was to assess what do customers perceive to be the key determinants of mobile communication provides" service quality and how do each one of them impacts the customer satisfaction.

Keywords: Service Quality Customer Satisfaction Mobile Communication Confirmatory factor analysisAMOS 25

I. INTRODUCTION

India is the second largest market for mobile communication services with the total number of mobile subscribers by the end of March 2018 was 1183.41 million, taking the tele-density to 91.09, of which the urban tele-density is a prodigious 168.17 and the rural tele-density is 58.67. This phenomenal growth has come in little over one and half decade.

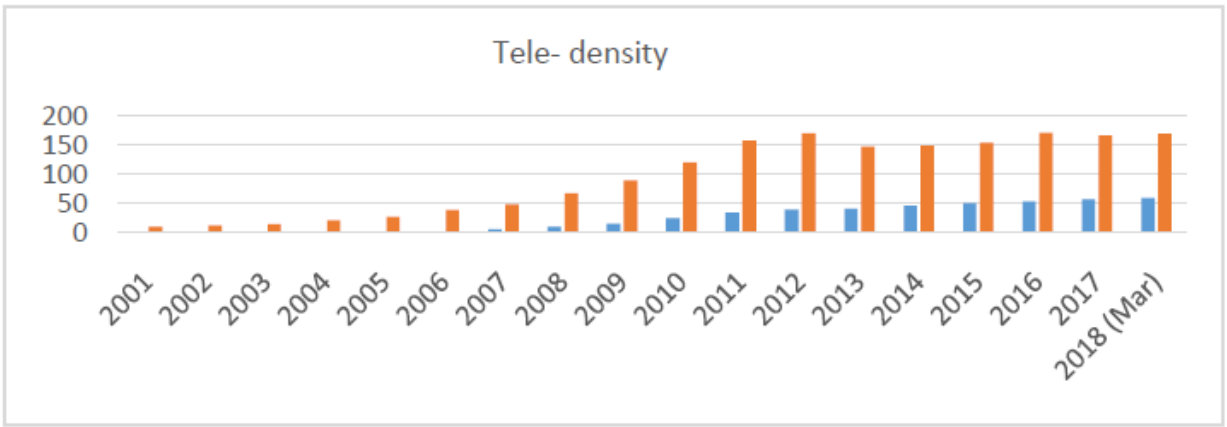

Figure I: Tele-density over the years (Source: compilation from TRAI subscriber reports.)

Currently, the Indian Mobile communication industry comprises of eight service providers. Their respective market share is shown in figure 2.

High penetration levels of the mobile service, is leading to intense competition amongst the players of this industry. To add to the woes of the mobile service operator is Mobile Network Portability (MNP). Launched in the year 2011, MNP enables a dissatisfied customer to change his/her operator without changing the mobile numbers.

Intense competition made acquiring new customers a tall task. This led to a drop in tariff rates. The result was decreased average revenue per user (ARPU). Thus, in spite of unprecedented growth in the mobile subscribers, the margins of the mobile service providers were declining quarter on quarter.

Error! Reference source not found. shows that while the mobile subscribers have been continuously growing (with the exception of the year 2012), the ARPU has not shown a similar trend. The year 2016 which witnessed the launch of the disruptive new entrant Reliance Jio, plunged the ARPU lower than that in the year 2010. This was followed by tariff revision by various incumbent mobile services providers pushing the ARPU further south.

Figure 2: Market Share (Source: TRAI subscriber reportsNov‟18)

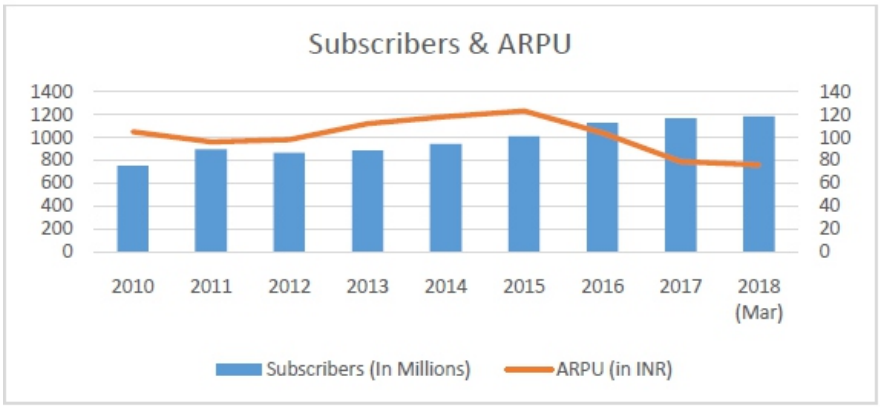

Figure 1: Subscribers and ARPU (Source: Compiled from TRAI performance reports)

High level of market penetration, MNP and presence of multiple mobile operators make it important for the companies to focus on service quality and loyalty to maintain its respective market share. Customer loyalty is all about attracting the right customers, getting them to purchase, purchase often, purchase in large quantities, and bring in more customers. It expresses the behavioral intention related to goods or services. Dawes and Swailes (1999) propounded that high customer loyalty is central to successful customer retention, and firms who compete on the basis of loyalty will win over the battle of competition. Improving the service quality is key to creating customer satisfaction which leads to customer loyalty (Anderson & Mittal,(2000), Shah & Schaefer,(2005) and Sweeney & Swait,(2008))

Since service quality is the antecedent of customer satisfaction and customer loyalty, It is vital that mobile service providers deliver the best service quality to their customers. Thus it is imperative for the mobile communication industry to understand what constitutes service quality from customer‟s perspective. This study will investigate the various attributes of service delivery and yield those aspects of service delivery that are perceived by the customers critical to good service quality. Therefore this research intends to address the following two research questions:

RQ1: What do customers perceive to be the key determinants of mobile communication provides‟ service quality.

RQ2: Which service quality dimensions are most significantly associated with mobile communication customers‟ satisfaction?

II. LITERATURE REVIEW

Service Quality is one area that has been extensively researched and various scholars have developed their own opinions over more than three decades (Gronroos, 1984; Parasuraman, Zeithmal, & Berry, 1988; Cronin & Taylor, 1992; Frimpong & Boateng, 2014). Researchers have pointed out that providing high quality services is a key startegic tool to acquire competitive advantage (Liu, Guo, & Lee, 2011) and long tem success (Santos, 2003; Zeithaml, Bitner, Gremler, & Pandit, 2013).To heighten service quality, it is necessary to identify dimensions of service quality as perceived important by the customer.

Service literatuire shows various approaches to measuring service quality. Gronroos (1984)proposed that service quality should be conceptualized around the process of how the service delivered and the outcome of the delivery. Carman (1990) and Bolton & Drew (1991) viewed service quality as an overall assessement of service delivery and experience. Some other reseachers proposed that service quality is

the extent to which services deliverd by an organization meets the requirements of the customer. Numerous scholars define service quality as the extent to which a service meets customers‟ expectations (Parasuraman, Zeithmal, & Berry, 1988; Cronin & Taylor, 1992; Teas, 1993)

Assessing the quality of service deliverd, gives the organization an opportunity to identify the areas of improvementwhich leads to building competive advantage. However, the fundamental characteristics of service, being intangible, inseperable and hetrogenous pose serious challneges in assessing the service quality (Zeithmal, Bitner, Gremler, & Pandit).

Service literature contains numerous tools that have attempted to overcome the challenges and assess the service quality. SERQUAL developed by Parasuraman, Zeithmal, & Berry (1988) is a popular tool to assess the service quality. This 22 item scale measures the customer expectations and perceptions of service delivery across 5 dimensions namely:

- Tangibles: which is the service place, facilities and the appearance of service staffs
- Reliability: The ability to provide promised service to customers reliably and correctly
- Responsiveness: The will of service staffs to help customers and to provide real-time service
- Assurance: Service staffs are professional, polite and reliable
- Empathy: Companies care for the customers and provide some special attention.

However, SERVQUAL was questioned for about the need to measure expectations (Cronin & Taylor, 1992) for psychometric reasons. Scales directly measuring perceived performance relative to expectations have also been found to be less biased and more useful than scales merely measuring performance (Devlin, Susan , Dong , & Brown , 1993)

SERVPREF is another tool to measure service quality, developed by Cronin & Taylor (1992), which focused on the service performance. Sachdev and Verma (2004), in their assessment of the relative importance of quality dimensions in selective service industries, identified two perspectives of quality measurement: internal and external. While internal perspective is defined as zero defect or conformance to requirements, the external perspective understands service quality measurement in terms of customer perception, satisfaction, attitude, and delighting the customer.

Mobile Service Quality

Relatively scant research has attempted to identify the determinants of the service quality for mobile services. Oodan, Ward, & Mullee (1997) reported assurance, availability, flexibility, reliability, security, and simplicity as quality criteria of concern to customers of telecommunications services. they further reported that the tendency in the past has been to treat network quality criteria in isolation and separated from other mentioned dimensions. From the customer‟s perspective, this is not as such desirable and also, unreasonable to expect customers to separate the network and non-network related quality requirements.

Wang & Lo (2002) used the approach of excluding the expectations measure in SERVQUAL but with added technical dimension of service quality to measure service quality of mobile service providers in China. Kim, Park, & Jeong (2004), have revealed three important facets of mobile service quality in the context of South Korean telecommunications service: call quality, value added services, and customer support. Seth, Momaya, & Gupta (2005), developed an instrument for assessing the service quality of cellular services comprising of technical quality along with the service delivery aspects. Lu, Zhang , & Wang (2004), have tested their proposed model of mobile service quality based on data collected from Chinese telecommunications brokerage service companies. They have derived and validated three key dimensions of mobile service quality, such as interaction quality, environment quality (how services are delivered to consumers, e.g. equipment), and outcome quality (the result of a service encounter, e.g. punctuality). Su (2014), proposed a conceptual framework derived from technical acceptance model. Based on the framework, they developed an instrument to measure perceived service quality of mobile data services. The service quality instrument consisted of six-dimensions: content quality, usability, reliability and speed, interaction, entertainment/enjoyment, and security/privacy.

In summary, service quality measurement plays an important role in studying the customers‟ perceptions regarding the quality of services offered by the service providers. The literature reviewed supports that the quality of services can be effectively measured with the help of service quality dimensions developed by the authors Parasuraman, Zeithaml and Berry (1988). However, some researchers have explored few additional dimensions to the original model of SERVQUAL. Seth et al (2008) and Su(2014) have also developed new dimension of service quality viz – „Network Quality‟ which examines technical quality of mobile services. Though there have been numerous research contributing to the theoretical and empirical study of service quality, they have confined their studies to different countries. They do not address the largest and the fastest growing telecom markets of the world – India (The Economist Intelligence Unit, 2017). Due to lack of studies in these markets, it is difficult to

ascertain which of the service quality dimensions do customers‟ perceive to be more important in their experiences and the overall evaluation of the service.

III. METHODOLOGY

Service quality was measured using the most popular SERVQUAL model exhibiting five dimensions – reliability, responsiveness, tangibility, assurance and empathy. The SERVQUAL model was developed by Zeithmal (Zeithaml, Berry, & Parasuraman, 1996). The extended SERVQUAL (Seth et al, 2008) instrument determines service quality structure along with technical quality (network clarity, coverage etc.) This has been adopted to assess the service quality of the mobile communication provider. Therefore the final instrument for 24 statements covering six dimensions- reliability, responsiveness, assurance, empathy, tangibility and technical quality, along with questions probing the demographics of the respondents. The instrument used in given in table 1.

Table 1:

Dimensio	Code	Item
Reliability	Re1	Delivers the service as it had been promised
	Re2	Is dependable in solving customers? problems
	Re3	Provides the right service(as you requested) in the first time itself
	Re4	Honors timelines in delivering the service
	Re5	Maintains error-free records(of usage, billing etc.)
Responsiveness	Res1	Keeps customers informed about when services will be performed(eg. Activating data
	Res2	Gives satisfactory service in critical times
	Res3	Is willing to help customers
	Res4	Readily responds to customers? specific requirements
Assurance	A1	Behavior of employees (at call center or stores) instill confidence in customers
	A2	Employees (at call center or stores) make customers feel safe in their transaction
	A3	Employees (at call center or stores) are consistently courteous
	A4	Employees (at call center or stores) have appropriate knowledge to answer customer
Empathy	E1	Gives customers individual attention
	E2	Employees (at call center or stores) have the customer?s best interest at heart.
	E3	Employees (at call center or stores) take genuine efforts in resolving customer com
	E4	Contact center/ store has business hours which are convenient to customers
Tangibility	T1	Stores are visually attractive
	T2	Has Modern and latest technology equipment.
	T3	Employees who have a neat, professional appearance
	T4	Visually appealing materials (SIM Kits, bill envelopes, posters etc) are associated
Technical Quality	Tech1	Has excellent Network coverage
	Tech2	Has excellent Network/ voice clarity
	Tech3	Provides high data speeds

In this study Proportionate Stratified Random sampling is used. The population of mobile consumers is divided into strata based on the Mobile communication provider (company) whose services are being used by the customers. The proportion of samples to be extracted from each strata is equal to the market share of each mobile communication provider. This ensures that customers of each mobile communication provider are adequately represented in the sample.

IV. DATA ANALYSIS

Reliability of the scale are measured by calculating the Cronbach‟s alpha. It measures how closely related a set of items are as a group. The Cronbach‟s alpha for instrument measuring service quality was 0.951 indicating good consistency and reliability.

Post the tests establishing the reliability of the constructs, factor analysis was done to confirm the factors of service quality.

Factor Analysis is a technique for modeling observed variables, and their covariance, in terms of a smaller number of underlying (latent) "factors." The factors typically are viewed as broad concepts or ideas that may describe an observed phenomenon. Factor analysis is used to identify groups of inter-correlated variables called factor. To check the factorability, either the values of correlation matrix should be greater than 0.3; values on anti-image correlation diagonals should be greater than 0.5.

This study conducted the Factor Analysis using the Principal Component Analysis with Varimax rotation. In Principal Component Analysis, the total variance of the data is considered.

Table 2 KMO and Bartlett's Test – Service Quality

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.947
Bartlett's Test of Sphericity	Approx. Chi-Square	6288.873
	df	276
	Sig.	0.000

From the above table is observed that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.947 which is greater than 0.5. Hence it is appropriate to apply factor analysis (Malhotra & Dash, 2016).

Table 3 Total Variance Explained- Service Quality Construct

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.134	46.393	46.393	11.134	46.393	46.393	5.005	20.855	20.855
2	1.970	8.209	54.603	1.970	8.209	54.603	4.538	18.909	39.764
3	1.437	5.990	60.592	1.437	5.990	60.592	2.829	11.788	51.552
4	1.101	4.586	65.178	1.101	4.586	65.178	2.675	11.146	62.698
5	1.078	4.076	69.254	1.078	4.076	69.254	1.574	6.557	69.254
6	0.763	3.180	72.435						
7	0.607	2.531	74.966						
8	0.556	2.315	77.281						
9	0.527	2.194	79.475						
10	0.487	2.031	81.506						
11	0.465	1.939	83.445						
12	0.427	1.780	85.225						
13	0.410	1.707	86.932						
14	0.399	1.661	88.593						
15	0.377	1.570	90.164						
16	0.348	1.450	91.614						
17	0.347	1.448	93.061						
18	0.312	1.302	94.363						
19	0.275	1.146	95.509						
20	0.264	1.101	96.610						
21	0.245	1.020	97.631						
22	0.222	0.923	98.554						
23	0.187	0.778	99.332						
24	0.160	0.668	100.000						

Extraction Method: Principal Component Analysis.

From Table 3, it is observed that there are six factors extracted. The Eigen values of all the factors is greater than unity. Eigen values represent the amount of variance associated with the factor. Factors with Eigen values greater than one are retained. (Malhotra & Dash, 2016).

The first factor explains 46.3% of variance, followed by 8.2% variance being explained by factor 2. The cumulative variance percentage extracted by the factors should be greater than 60% (Malhotra & Dash, 2016). The factors extracted from table 4.5.2 account for 69.2% of cumulative variance.

Table.4 Factor Loadings- Service Quality Construct

	Component				
	1	2	3	4	5
Re2	0.730				
Re4	0.695				
Re3	0.690				
Re1	0.673				
Res3	0.652				
Res4	0.646				
Res2	0.641				
Re5	0.636				
Res1					
A1		0.829			
A2		0.781			
A3		0.750			
A4		0.727			
T2		0.715			
T3		0.629			
Nw Coverage			0.864		
Nw Clarity			0.844		
Data Speed			0.775		
E2				0.764	
E1				0.713	
E4				0.620	
E3				0.617	
T1					0.863
T4					0.697

Extraction Method : Principal Component Analysis. Rotation Method : Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Table 4 indicates the factor loadings of items on respective factors. Although factor loadings values 0.50 (Positive or Negative) are generally considered necessary for practical significance (Hair, Black, Babin, & Anderson, 2016). The present study factor loadings values 0.60 and above only are considered for further analysis.

Items Re1, Re2, Re3, Re4, Re5, Res2, Res3 and Res4 with factors loadings from 0.636 to 0.739 load onto factor1.All these items measure the ability of the mobile communication provider to deliver the service in the right manner and responding to customers‟ needs. Hence Factor 1 will be addressed as‟‟Sevrice Delivery (ServDelv)‟‟.

Items A1, A2, A3, A4, T2, T3 are part of Factor 2 with factor loadings ranging from 0.629 to 0.829. Since all these items relate to the assurance given by the employees and other tangible assets which reinforce confidence in the customer, Factor 2 will be called as „Assurance".

Items NwCoverage, NwClarity, DataSpeed load onto factor 3 with loadings of 0.864, 0.844, 0.775 respectively. Since all these items corresponds to the technical performance of the mobile communication provider"s network, this factor will be called as „Technical Quality (TechQlty)".

Items E1, E2, E3, E4 are a part of factor 4 with factor loadings ranging from 0.617 to 0.764. These items reflect the empathy shown by the mobile communication provider and hence will be called as „Empathy"

Items T1 and T4 have factor loadings 0.863 and 0.697 respectively and load onto factor 5. Both these items refelect the customers" perception about the tangible and physical things used or are a part of the service delivery. Hence Factor 5 will be called as „Tangibles "

Table 5 summarizes the item details and names given to each factor.

Table 5 Items and Factor names

Factor	Item	Item description	Factor Loadings	Factor Name
Factor 1	Re1	Delivers promised the service as it had been promised	0.673	ServDelv
	Re2	Is dependable in problems solving customers' problems	0.730	
	Re3	Provides the right service (as you requested) in the first time itself	0.690	
	Re4	Honors timelines in delivering the service	0.695	
	Re5	Maintains error-free Records (of usage billing etc.)	0.636	
	Res2	Gives satisfactory service in critical times	0.641	
	Res3	Is willing to help customers	0.652	
	Res4	Readily responds to customers? specific requirements	0.646	

Factor	Item	Item description	Factor Loadings	Factor Name
Factor 2	A1	Behavior of employees (at call center or stores) instill confidence in customers	0.829	Assurance
	A2	Employees (at call center or stores) make customers feel safe in their transaction	0.781	
	A3	Employees (at call center or stores) are consistently courteous	0.750	
	A4	Employees (at call center or stores) have appropriate knowledge to answer customer	0.727	
	T2	Stores are visually attractive	0.715	
	T3	Employees who have a neat, professional appearance	0.629	
Factor 3	NwCoverage	Has excellent Network coverage	0.864	TechQlty
	NwClarity	has excellent Network/ voice clarity	0.844	
	DataSpeed	Provides high data speeds	0.775	
Factor 4	E1	Gives customers individual attention	0.713	Empathy
	E2	Employees (at call center or stores) have the customer?s best interest at heart.	0.764	
	E3	Employees (at call center or stores) take genuine efforts in resolving customer com	0.617	
	E4	Contact center/ store has business hours which are convenient to customers	0.620	
Factor 5	T1	Has Modern and latest technology equipment.	0.863	Tangible

Factor	Item	Item description	Factor Loadings	Factor Name
	T4	Visually appealing materials (SIM Kits, bill envelopes, posters etc) are associated	0.697	

The results of the Exploratory Factor analysis showed 5 distinct factors with Eigen values greater than 1 and explain 69.2% of the cumulative variance. The grouping of the items on the basis of factor loadings revealed that the determinants of Service Quality as perceived by the customers of mobile communication services are Service Delivery, Assurance, Empathy, Tangibles and Technical quality.

Confirmatory Factor Analysis (CFA) is used to check the construct validity. The results obtained through the Factory analysis are further checked by confirmatory factor analysis. CFA is conducted using AMOS 25.

Figure 4.1 shows the factors of the multidimensional construct Service Quality. Measurement model validity is dependent on establishing acceptable levels of goodness-of–fit for the measurement model and finding specific evidence of construct reliability and validity. Validity is defined as the extent to which data collection methods accurately measure what they were intended to measure (Saunders and Thornhill, 2003).

Table 6 Model fit Indices for Confirmatory Factor analysis

Fit Indices	Values
Chi-Square	637.64
Degrees of Freedom	220
P-value	0.00
GFI	0.91
NFI	0.97
CFI	0.98
RMR	0.052
RMSEA	0.072

The above table shows that the standardized Root Mean Square Residual (RMR) and Root Mean Square Error of Approximation (RMSEA) are at 0.052 and 0.072 respectively, which is well below the cut-off value of 0.1 (Malhotra & Dash, 2016). The Goodness of Fit Index (GFI), Normed Fit Index (NFI) and Comparative Fit Index (CFI) are 0.91, 0.97 and 0.98. These indices should be greater 0.8 for a good model fitment, hence proving the confirmatory factor analysis a good model fit.

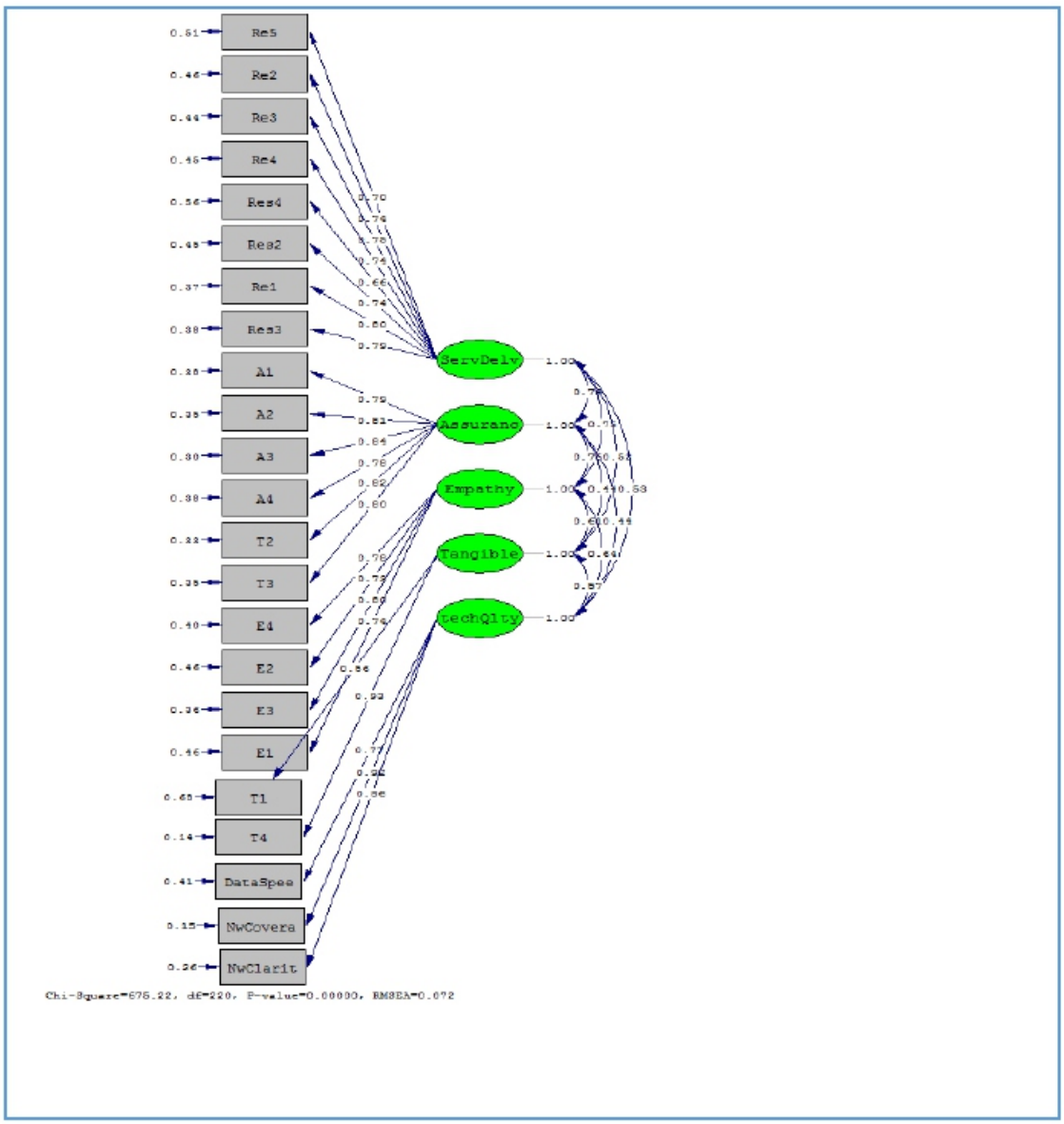

Figure IV:CFA of Service Quality

Regression analysis is a type of predictive modelling technique which examines the relationship between a dependent variable and independent variables or predictors. Regression analysis was used to assess if there is any impact or relationship of service quality on customer satisfaction. Service Quality is a multi-dimensional construct consisting of Service Delivery, Assurance, Technical Quality, Empathy and Tangibles (as established by the confirmatory factor analysis, above). Impact of each of these variables on customer satisfaction will be assessed.

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Regression Model Summary: Service Quality and Customer Satisfaction

Model	R	R Square	Std. Error of the Estimate	F	Sig.
1	.826a	0.682	0.56717106	171.379	0.000
a. Predictors: (Constant), Tangibles, Empathy, Technical Quality, Assurance, Service Delivery					

Table 7 shows that the p-value is 0.000 which is less than 0.05. Hence it can be inferred that there is a significant relationship between the service quality and customer satisfaction. It is also observed that R^2 is 0.682, implying that 68.2% of variation in customer satisfaction is explained by the various dimensions of service quality.

Table 8 Regression Coefficients: Service Quality and Customer Satisfaction

Model		Unstandardized Coefficients		Standardize d Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.031	0.028		5.560	0.043
	Service Delivery	0.531	0.028	0.531	18.802	0.000
	Assurance	0.274	0.028	0.274	9.722	0.000
	Technical Quality	0.342	0.028	0.342	12.135	0.000
	Empathy	0.268	0.028	0.268	9.491	0.000
	Tangibles	0.370	0.028	0.370	13.097	0.000
a. Dependent Variable: Satisfaction						

The above table shows that all the independent variables namely Service Delivery, Assurance, Technical Quality, Empathy and Tangibles have positive coefficients and the p-values are less than 0.05. Thus it can be inferred that all the independent variables have a positive impact on the dependent variable – Customer Satisfaction. The estimated regression model is given below:

CSAT= 0.031+0.531(SD) + 0.274(ASR) + 0.342(TQ) + 0.268(EMP) + 0.370(TANG)

Where abbreviations are:

CSAT : Customer Satisfaction
SD: Service Delivery
ASR: Assurance
TQ: Technical quality
EMP: Empathy
TANG: Tangibles

This implied that all the dimensions of service quality had a positive impact on Customer Satisfaction. Amongst the five dimensions, Service delivery had the most impact on Customer Satisfaction and Empathy had the least impact.

V. FINDINGS AND CONCLUSION

In the current competitive scenario of mobile service industry, it is a perplexing task to create, deliver and market the services in accordance with the customer needs. Increasing sophistication of customers, improvement in technology, increased cost of meeting the customers‟ needs, and decreasing service differentiation are posing a serious challenges to mobile communication providers to attract new customers. Thus it is necessary for the mobile communication providers to delight the customers with ace experience of the service.

Quality is an important aspect of any service delivery and a vital ingredient in delivering a good experience to the customers. Compounded competition, contributes to continuously evolving perceptions of service quality making it necessary for the mobile communication providers to manage service delivery effectively. Improving mobile service experience by identifying and emphasizing more on those critical dimensions of service quality that have strongest influence on customer satisfaction and loyalty is the key to success in the intensely competitive industry.

The results of the Exploratory Factor analysis showed 5 distinct factors with Eigen values greater than 1 and explain 69.2% of the cumulative variance. The grouping of the items on the basis of factor loadings revealed that the dimensions of Service Quality in the Mobile market of Mumbai were Service Delivery, Assurance, Empathy, Tangibles and Technical quality.

Service Delivery measures the ability of the mobile communication provider to deliver the service in the appropriate manner as expected by the customer and responding to customers‟ needs.

Assurance measures the confidence instilled in the customer by the employees of the mobile communication provider and some of its tangible assets.

Empathy assesses the caring predisposition of the mobile communication provider and its employees as well as their ability to cater to special requests of the customers.

Tangibles are the customers‟ evaluation of the mobile communication provider‟s physical facilities, the appearance of the stores and its personnel and communication materials etc.

Technical Quality measures the technical aspects of the mobile communication provider‟s service. It consists of Data Speed, Network coverage, and Network Clarity. Data Speed is the speed which customer think he/she gets while using internet on the mobile phone. Network Coverage is the vastness of connectivity that enables the customer to smoothly access the network on highways, inside building, while traveling between cities and states etc. Network Clarity refers to the clear undisturbed voice exchange during a call and minimum call drops ie premature termination of calls.

The confirmatory factor analysis reinforced the results of the exploratory factor analysis. The above-mentioned dimensions of service quality had the goodness-of-fit indices GFI and CFI as 0.91 and 0.97 which are both greater than the cut-off value of 0.9.

Thus it was inferred Service Quality is a multi-dimensional construct with the dimensions being Service Delivery, Assurance, Empathy, Tangibles and Technical quality. In other words, the respondents assess the service quality of the mobile communication providers by assessing the items related to Service Delivery, Assurance, Empathy, Tangibles and Technical quality.

Having established a relationship between service Quality and customer satisfaction, it was important to assess the extent of relationship of each of the service quality dimension with customer satisfaction. The service quality dimensions established in this study were Service Delivery, Assurance, Empathy, Tangibles and Technical Quality. Liner regression was used to assess this relationship. The regression equation obtained is given below:

CSAT= 0.031+0.531(SD) + 0.274(ASR) + 0.342(TQ) + 0.268(EMP) + 0.370(TANG)

This implies that all the dimensions of service quality had a positive impact on Customer Satisfaction. Amongst the five dimensions, Service delivery had the most impact on Customer Satisfaction and Empathy had the least impact.

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Factors Influencing The User Acceptance E-Government Services

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A B S T R A C T

e-Governance is a system where the information is being integrated with the help of communication technology for the maintenance of public administration with ease. It helps in bringing forth good governance in a quicker and transparent manner. For successful implementation of e-government services government agencies should identify the factors that influence the willingness to adopt e-government services. This paper uses Technology Acceptance Model (TAM), Diffusion of Innovation (DOI) and Website quality are the major determinants of intention to use e-government services. A model containing the constructs of TAM, website quality and Relative Advantage is used to study the adoption of e-government services. The results reveal that website quality and TAM has a strong positive influence on Relative advantage which further leads to intention to use e-government services.

Key words: e-Government services, TAM, Relative Advantage, Website Quality, Intention to Use.

1. INTRODUCTION

India's growth in the field of Information Communication Technology (ICT) is fast paced and registered significant milestones. According to the National e-governance policy of the Government of India, the purpose of e-governance is to make all Government services accessible to the common man in his locality, through common service delivery outlets or through various self service portals and to ensure efficiency, transparency, and reliability of such services at affordable costs . E-Governance uses application of Information and communication technology for delivering and integration of various Government services and systems between Government to citizen (G2C),Government to Business(G2B),Government to Government(G2G) and Government to Employees(G2E) (Carter and Belanger, 2003; Tan et al., 2005).Lee et al. (2005) described e-Government is mainly used for building better government-to-citizen (G2C) relations for government services , similar to the function of Customer Relationship Management (CRM) in the business sector. Lam W., 2005, in his study "Barriers

to e-government integration" reports an e-government service provides greater efficiency, accountability, transparency and citizen empowerment.

According to the E-Government Development index (EGDI) of the United Nations Member States, India is ranked 96 among world with EGDI value 0.5669 whereas the top 10 countries show EGDI greater than 0.8783 (United Nations of e-Government Development Database, 2018).The average internet penetration rate of the top ranked countries is significantly at a high level of above 80 percentage whereas in India it is only 34.1 percentage, that means the internet penetration rate is also influencing the adoption of e-governance in India.

E-Government Development index incorporates the access characteristics, such as the infrastructure and educational levels, to reflect how a country is using information technologies to promote the access of ICT applications among its people. The EGDI is a composite measure of three important dimensions of e-government, namely: provision of online services, telecommunication connectivity and human capacity. (United Nations e-Government Development, 2018). In Kerala, even though the first IT Park and first electronic enterprise has started in 2008 the adaption of e-services among the public is poor and is only 1.4 percentages in 2016-17. (Performance Report of Dept of IT, Government of Kerala).Hence it is significant to identify the factors influencing the adaption of e-government services in Kerala.

Various studies in the field of e-Governance domain reveal that Technology acceptance Model (TAM) (Davis, 1989) is frequently used in technology adoption research in ICT applications. (Wang, 2002; Al-adawi et al., 2005; Sahu and Gupta, 2007; Belanche et al., 2010). Perceived usefulness and Perceived ease of use constructs [Technology Acceptance Model (TAM), Davis 1989] had strong positive effect towards the acceptance of e- government services. In a study of user acceptance of e-government services in Jordan, Charbaji (2003) et al. indicated that people's awareness on e-government service strongly influence the user acceptance. Pradeep Mittal et al identified that Low IT literacy, User friendliness of the web sites or website quality, lack of self confidence on technology provided by the government, Ease of Use, Usefulness and lack of awareness in people are the main social and environmental challenges in implementation of e-governance in India. This study analyses the effect of TAM constructs perceived Ease of use, Perceived Usefulness along with Website quality on intention to use e-government services.

2. REVIEW OF LITERATURE

2.1 TECHNOLOGY ACCEPTANCE MODEL (TAM)

Davis' (1989) Technology Acceptance Model (TAM) has been widely used in many countries to examine technology acceptance in e-governance. TAM was adapted from Theory of Reasoned Action (TRA) developed by Ajzen and Fishbein (1980). This theory is in the field of social psychology used to model user acceptance of information systems. Davis (1989) identified that the aim of TAM is to provide an explanation of the determinants of computer acceptance in general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations. Perceived ease of use and perceived usefulness, are the two fundamental constructs of TAM, which is considered as important in determining the individuals' acceptance and use of Information Technology. Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of physical and mental effort" and perceived usefulness of the system as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Karavasilis, I et al ,2010).

2.2. DIFFUSION OF INNOVATION (DOI)

Research on the diffusion of innovation has been widely applied in disciplines such as communication, marketing, and information technology. An innovation is an idea, practice or object that is perceived as new by an individual or another unit of adoption (Rogers, 1995, p. 11). Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995, p. 5). The theory is modified and the properties of innovations within the concept of information systems were refined by Moore and Benbasat (1991). These factors are relative advantage, compatibility, complexity, trialability, and observability. Relative advantage is the extent to which an innovation is perceived to better the idea it substitutes. According to Diffusion of Innovation (DOI) theory, the rate of diffusion is affected by an innovation's relative advantage, complexity, compatibility, triability, and observability. Tornatzky & Klein (1982) in their meta-analysis of research on adoption of innovations, argue that trialability and observability are not related constructs of technology adoption. Carter and Belangar (2003) conducted a pilot study of G2C adoption using Diffusion of Innovation Theory and found perceived relative advantage and compatibility as significant factors in predicting citizens' intention to use e-government services.

Lean et. al. (2009) in order to measure the intention of Malaysian citizens to use e-government services, a theoretical framework was developed. The proposed model was based on Technology Acceptance Model and Diffusion of Innovation. The findings showed that trust, perceived usefulness, perceived relative advantage and perceived image had a significant relationship with citizens' intention to adopt e-government services.

2.3. WEBSITE QUALITY

Hong and Tam (2006) pointed out that perceived ease of use and perceived usefulness may not completely explain an individuals behavioural intention to use a technology. They argued that website quality is alo associated with technology acceptance. In a study conducted in Maharashtra (India), Iyer & Srivastava (2014) proposed a theoretical model to determine major factors, which affect the intention to adopt e-Government services especially through the e-Government portal, it is found that website design and quality had a strong positive association among the people to use e-Government services.

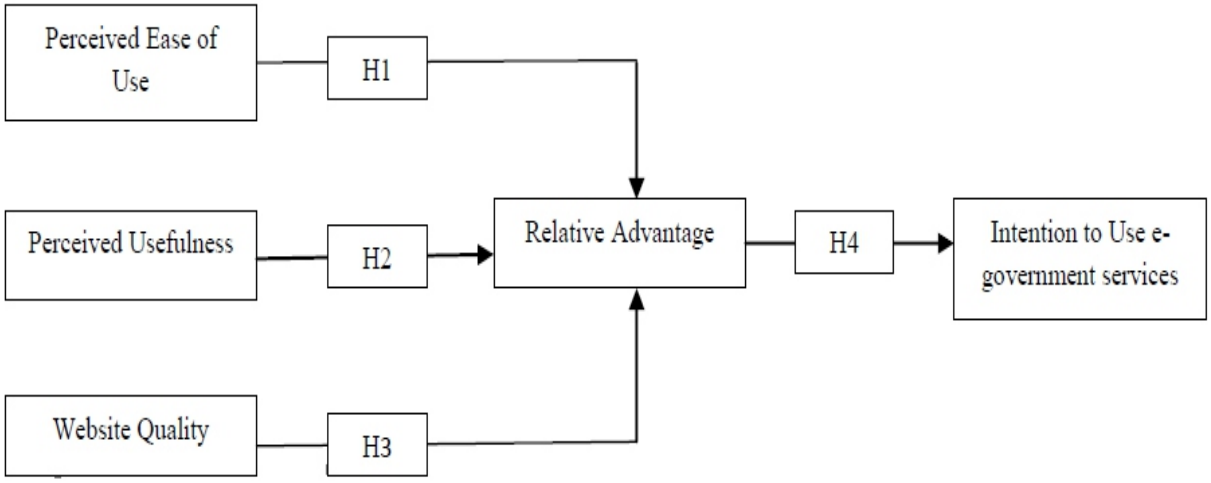
Although much research supports the TAM as an excellent model to explain the acceptance of ICT related applications, many empirical studies recommend integrating TAM with other theories to cope with rapid changes in the technology and improve specificity and explanatory power (Carter & Belanger, 2003). TAM and DOI are similar in some constructs and complement each another to examine the adoption of technology. Researchers indicate that the constructs employed in TAM are fundamentally a subset of perceived innovation characteristics, thus, the integration of these two theories could provide an even stronger model than either standing alone.

In the previous sections, various literatures have been reviewed to understand the user acceptance of e-governance in different countries including India. The research shows that TAM constructs viz Perceived ease of Use and Perceived Usefulness along with website Quality contributed positively towards the user acceptance of e-governance, but only a dearth of studies were available to analyses the effect TAM constructs on DOI and further how it leads to intention to use. In the present study, an integrated model of TAM constructs along with Website Quality is tested among Indian citizens, in the state of Kerala, in order to evaluate how far these factors influence the DOI and further leads to intention to use e-governance services.

3. RESEARCH MODELAND HYPOTHESIS

This paper proposes a model which combines the theory of both the Technology acceptance model (TAM) and Diffusion of Innovation (DOI). The influence of Perceived Ease of Use and Perceived Usefulness constructs of TAM on the relative advantage construct of DOI is tested and further it explores how it leads to Intention to use e-Government service. The influence of website quality is also examined.

Fig 1: Conceptual Research Model



3.1 HYPOTHESIS

H_0 1: Perceived Ease of Use (PEOU) has a positive influence on relative advantage of using e-government services.

H_0 2: Perceived Usefulness (PU) has a positive influence on relative advantage of using e-government services.

H_0 3 :Web site Quality (WQ) of e-government web sites has a positive influence on relative advantage of using e-government services.

H_0 4: Relative advantage of using e-government services has a positive influence on intention to use e-government services.

4. RESEARCH METHOD

The research study was conducted using a survey questionnaire. People who are using Internet were chosen to be surveyed. The reason is that the poor usage of e-Government service in developing countries had a close relationship with the "digital divide" (Mofleh and Wanous,2008).Therefore, the research focuses on people who are electronically capable of accessing internet services. Samples have been selected from the internet users of Trivandrum and Ernakulum districts of Kerala. The rationale behind the selection is that these are the two cities among 100 cities identified by Government of India under the national e-governance plan for the implementation of smart city project. Hence it has been decided to select samples from these districts in order to assess the acceptance of e-governance.

In Ernakulum district, 10 villages from rural area and 3 municipalities & 7 corporation wards from urban area were selected through lottery method. Similarly 10 villages in rural and 2 municipalities & 10 wards from urban area were identified for collection of data from Trivandrum. The sample size was arrived at using the Krejcie and Morgan's formula. The maximum sample size required as per Krejcie and Morgan's table is 384 at 95% confidence level. Multistage sampling method has been used for administering the questionnaire. A total of 425 respondents were selected to be included in the sample and 398 questionnaires were used for final analysis after discarding the incomplete samples.

The questionnaire used in this study is adopted from previous studies with appropriate changes in the Indian context. Likert rating scale was used for measuring constructs. The scale uses a five point rating from "1" to "5", where "5" represents "Strongly Agree" and "1" represents "Strongly Disagree". The scale used for the measurement of the constructs Perceived ease of Use, Perceived Usefulness and Intention to use was adopted from study of Davis (1989) and Carter and Be´langer (2003).The scale used for measuring Website quality and Relative advantage is adopted from Sang et. al. (2009). The reliability test was carried out on a sample of 45 respondents collected from Trivandrum District using Spearman-Brown split-half method. The values ranging from 0.652 to 0.0.823 support for the further study to be authentic.

5. RESULTS AND ANALYSIS

AMOS Version 20 was used to analyse the data. The hypothesized model was first subjected to validity and reliability check, followed by Structural Equation Modeling for testing the hypothesis.

5.1. RELIABILITY AND VALIDITY

Confirmatory factor analysis (CFA) was used for testing the construct validity. CFA involves examining the convergent validity, discriminant validity. Convergent validity refers to the extent to which the items under each construct are actually used for measuring the same construct. It is estimated by the item factor loadings, Composite Reliability, and Average Variance Extracted (Fornell C & Larcker, D.F). The individual item reliability was tested on its corresponding constructs and found that the factor loadings are above the threshold value of 0.55(Teo et al,2008).Also the Average Variance extracted (AVE) has been examined for each construct and presented in Table 1.AVE for a construct gives the ratio of individual constructs variance to the total variance. The observed values are all above the recommended value of above 0.50 (Hair, J.F et al.1998)

Table 1: Composite reliability (CR) and Average Variance Extracted (AVE)

Item	CR	AVE
Perceived Ease of Use	0.827	0.554
Perceived Usefulness	0.743	0.580
Web site Quality	0.761	0.609
Relative Advantage	0.746	0.594
Intention to Use	0.613	0.570

Table 2 shows the inter construct correlations for verifying the discriminant validity. It shows that the estimated correlation between all constructs shows recommended cut off value of below 0.9 (Hair, J.F et al.1998) and it establishes the discriminant validity for the proposed model.

Table 2: Inter construct correlations

	PEOU	**PU**	**WQ**	**RA**	**INT**
Perceived Ease of Use (PEOU)					
Perceived Usefulness (PU)	0.550				
Web site Quality (WQ)	0.700	0.471			
Relative Advantage (RA)	0.701	0.607	0.319		
Intention to Use (INT)	0.404	0.377	0.628	0.809	

5.2. MODEL TESTING

The first step in model testing is to estimate the goodness-of-fit of the research model. Table 3 shows the observed values and the recommended values of goodness-of-fit.The recommended values were arrived from the previous studies (Hair, J.F et al.1998). Goodness-of-fit index (GFI), Normed fit index (NFI,

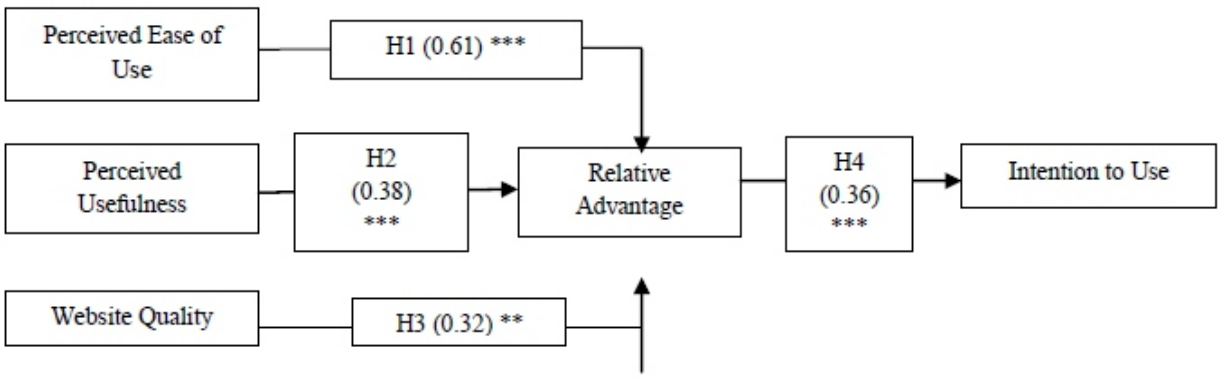
Comparative fit index (CFI), and the Root-mean-square error of approximation (RMSEA). All of the fit indices in Table 3 indicate that the structural model has a good fit.

Table 3: Analysis of Goodness of Fit for the Research Model

Fit Indices	Recommended Value	Research Model
Chi-square/d.f	?3.0	2.74
GFI	? 0.80	0.831
AGFI	? 0.80	0.81
NFI	? 0.90	0.91
RMSEA	? 0.08	0.07
CFI	? 0.90	0.91

The second step in model estimation is to examine the path coefficients of each association of between constructs in the research model. Figure 2 presents the research model after validation along with the hypotheses. The standardized path coefficients of the structure model are shown in the fig 2.

Fig 2: Research Model after validation



*** denotes significance at p<0.01

** denotes significance at p<0.05

5.3. FINDINGS AND INTERPRETATION

The proposed conceptual model was mostly supported by the empirical data. Path analysis results from Fig. 2 provide strong support for all the hypotheses. The result of each hypothesis is summarized in Table 4.

Table 4: Path Analysis

Hypothesis	Relationship	Path Coefficient (β)	P value	Result
H_0 1	PEOU → RA	0.38	**	Supported
H_0 2	PU → RA	0.61	***	Supported
H_0 3	WQ → RA.	0.32	**	Supported
H_0 4	RA → INT	0.56	***	Supported

- The Hypothesis H0 1, Perceived Ease of Use (PEOU) has a positive influence on relative advantage of using e-government services ($\beta=0.38, p<0.05$) is supported since the ease of access of any system compared to the one which is presently using will definitely increase the adoption of the e-government services. The study supports the previous research on the same field that the PEOU had a positive effect on Intention to use (Vankitesh and Davis, 2000) and Karavasilis, I. et al, 2010).

- The hypothesis H0 2,Perceived Usefulness (PU) has a positive Influence on Relative Advantage ($\beta=0.61, p<0.05$) is strongly supported and this finding confirms the positive relationship suggested by Agarwal and Prasad ,1998.However PU has a stronger positive influence compared to PEOU since the path coefficient shows a higher value of 0.61.

- The web site quality in the study also shows positive influence on relative advantage since H0 3, Web site Quality (WQ) of e-government web sites has a positive influence on relative advantage of using e-government services is supported ($\beta=0.32, p<0.05$). This is because an interactive e-government web site with up-to-date information can attract the citizens to make use of the full potential of e-government services through self-service portal.

- Hypothesis H0 4, Relative advantage of using e-government services has a positive influence on intention to use e-government services is supported in this study ($\beta=0.56, p<0.01$). Even though the PEOU and PU of Technology Acceptance model has explained the adoption behavior of e-government system, after the adoption a user can gain a lot of relative and absolute benefits ranging from convenience availability, cost savings, time savings and accessibility from anywhere (Mahmud Akhter Shareef et al., 2010).This study also confirms the same

5.4. SUGGESTIONS

- Government agencies should make sure that Citizens need to be aware of using the e-government system and the factors which influence the adoption of e-government services before switching over from the traditional government office system of working.

- The study also helps the policy makers to identify the prominent predictors of intention to use and to develop strategies for increasing the adoption of e-government services in Kerala. This will help the citizens to get information from government web sites, which will increase the satisfaction and ultimately leads to adoption of e-government services.

- Government agencies may conduct more training programs and should focus the benefits of e-Government systems and to help users to understand the relative advantage of using e-services over existing traditional systems.

6. CONCLUSION

This study tries to identify the most prominent predictors of adoption of e-government services availed by the citizens of Kerala. Previous researches show that constructs of TAM (Davis, 1986) and DOI (Rogers, 1995) are the useful predictors of Intention to use in ICT adoption. This paper made an effort to measure the contribution of website quality, Perceived ease of Use (PEOU), Perceived Usefulness (PU) on relative advantage (RA) and further how it leads to user acceptance of e-government services. The results indicate that PU is a stronger predictor of relative advantage compared to PEOU. Also the study reveals RA has a strong positive influence on Intention to Use.

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