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ATTITUDE AS DETERMINANT OF MOBILE ADVERTISING RECEPTION, AND THE MODERATING EFFECT OF CONTROL FACILITIES

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ABSTRACT

Mobile advertisement has emerged as one of the most popular applications in mobile commerce. It is explored to generate value to its providers and customers as tailored wireless information services. However, in spite of the increasing number of companies, investing in mobile advertising campaigns, there is a yet, little academic research on this topic and the implications of this new media for advertising not yet understood in Sri Lanka. This research attempt to help in bridging this gap; it investigates the relationship between attitude of Sri Lankan towards mobile advertising and the acceptance of the new medium as a promotional mix, and the moderator effect of control facilities between attitude and acceptance. Hypotheses form the basis for this research and are empirically tested by means of regression models. The empirical results (n=838), identify, that there is positive attitude towards mobile advertising exists among Sri Lankan mobile phone users, and it reveals a positive relationship between attitude and acceptance of mobile advertising as an innovative promotional mix. Control facilities play a moderator role between the attitude and the acceptance of mobile advertisement. In order to accept the best use of mobile advertising and induce consumers to behave positively, control facilities should be taken into consideration. Therefore it is necessary for researchers to design and effective system capable of recommending control facilities to the customer, when they receive advertising on their mobile phones.

KEYWORDS: *Mobile Advertising; Acceptance; Control Facilities.*

1. INTRODUCTION

Speedily developing new technology and the usage of electronic commerce channel have more and more led to the anticipation of mobile commerce revolution, which is explained to be the second wave of electronic commerce (Gillian & Judy, 2004). Mobile commerce has been defined as the delivery of electronic commerce capabilities directly into consumers" Mobile phones via wireless technology. This type of electronic commerce makes possible for business to reach end-users directly, and it has provided most of the service provided by the Electronic commerce. Mobile Commerce is thought to be the second phase in technology involvement following the Electronic commerce.

Advances in both E-Commerce and M-Commerce has changed the Marketing Communication Environment last few years, especially mass markets have broken down into fragmented markets (Dalgic & Leeuw, 1994). Marketers are developing communication to build and maintain relationship with customers in more narrowly defined niche markets, furthermore, substantial development in information (Nowak & Phelps,1997; Ryals & Knox,2001; Schutz,1993) and Communication technology (Peltier, Schibrowsky & Schultz, 2003; Hoffman & Novak 1996; Lichtenthal & Eliaz 2003) accelerate the movement towards personalized marketing communication. Consequently companies" interaction with customers is increasingly managed by technologies that enable the firms to personalize communications in real time across multiple media platforms and channels (Bezjian, Calder & Lacobucci, 1998).

Mobile advertisement has emerged as one of most popular application in mobile commerce (Dimitris & George, 2006). It is explored to generate value to its providers via time and location sensitiveness, and personalized wireless information services, as a new medium which creates shared relationship with customers (Carrol, Barnes, Scornavacca, & Fletcher,2007), and can be utilized for the success of Customer Relationship Management(CRM) (Jaakko, Jarisalo, Matti, and Heikkil, 2005).

Sri Lanka liberalized ICT industry way back in 1996, as a result global competitors came into made a substantial investment in terms of GSM technology, which is the one of the best and efficient technologies for mobile communication, has been introduce for the first time in Sri Lanka, in 1995, thus Sri Lanka become the first country in SAARC to use GSM technology. Since 2007 mobile phone penetration has been from 20% to nearly 50%, and speed of penetration is extremely high at present (Priyanths, 2008). Sunil Lakshmanasinge, director of the Nokia Siemens (2008) has predicted that, 14 million Sri Lankan customers will be using their mobile phones in 2010. A study by Lirne Asia and AC Nielson(2006) shows that 36.6 persons out of every 100 owns a mobile phone connection in Sri Lanka while its neighboring countries, India and Pakistan lag behind.

According to the latest figure of Central bank (2009) Sri Lankan mobile sector has shown remarkable progress during the last few years, in terms of improvement in technology, capacity and coverage, which have led to a higher subscribers. The mobile phone penetration increased significantly to 54.8 % in 2008, from 39.9% percent in 2007, surpassing the level of penetration in other countries, number of mobile phone subscribers 7.9 million in 2007 and 11 million at the end of the 2008. In 2010 in the first half of the year a 10.8 percent growth was recorded in the mobile phone penetration. The number of mobile phone subscribers during January 2010 recorded 14.13 million and it increased to 15.87 mobile phone subscribers by the end of June. It accounted for a 1.55 million phone subscriptions during the past six months (TRCSL, 2010).

By means of the higher penetration rate of mobile phone subscribers, and the global marketers interest, Sri lanka‟s mobile operators have signed many contracts to manage mobile advertising campaigns (Mobile marketing magazine, 2008), for example one of the Global brands Coca-Cola launched the biggest ever SMS based mobile marketing promotion and have an expectation to continue with mobile advertising in Sri Lanka (Messenger, 2008). However it is essential for getting to know the attitudes and responses of Sri Lankan Consumers towards this new medium, because consumer attitude towards mobile advertising is different than the attitude toward other traditional media like TV, and Internet (Tsang, Ho, & Liang, 2004).

Consumer survey conducted in three European countries (Finland, Germany and Greece) shows that there are significant differences regarding consumer attitudes toward mobile commerce among the investigated countries (Vrechopoulos, Pramataris, Doukidis & Lekakos, 2003). People in some countries are more receptive to mobile advertising than others. Studies show, consumers in china generally have slightly less favorable attitude toward receiving mobile advertisement (David, 2007), New Zealand consumers have a neutral attitude (Chadinee &David, 2005), consumers from both U.K (Fatim Bamba & Barnes, 2007) and Taiwan (Tsang, et al, 2004) have negative attitude toward mobile advertising, and mobile advertising is accepted as an entertainment fact of life among Australian than Japanese (Haghirian & Madlberger, 2005). From the above findings shows that attitude of consumers towards this new medium, in a particular country differs from the attitude of consumers living in other country.

In cultural research, culture is always viewed as a collective phenomenon. People learn patterns of thinking, feeling and potential action by living within a social environment, normally typified by

the country where they exist in. Negative and positive consumer reaction becomes more understandable and predictable when a person‟s cultural context is taken into account (Chau, Melissa, Massey, Montoya-Weiss & O‟Keefe, 2002). Thus a necessary pre requisite for mobile advertisement, marketers need to understand the attitude ofconsumers in different cultures.

Understanding cultural different is often considered pre-requisites for successful international advertising Communications this because, culture influence advertising. They respond to mobile advertising in a manner that congruent to their cultural values. Consequently; Cultural characteristics of the target audients may limit the choice of the mobile advertising in one particular culture.

2. RESEARCH PROBLEM

Consumers are accustomed to the value systems, beliefs, and perception process in theparticular cultures in which they grow up to develop (Asoka, 2000). Sri Lankan Collectivist culture differentiates, the people by the cultural characteristics as, independent relationship with one another, and group goals takes precedence over individual's goals. Consequence of this cultural conditioning, the advertising Medias are more concentrated to design to convey values such as togetherness, caring, respect, authority, protection, and hard work through advertisement to Sri Lankan consumers (Keen, 1989). Therefore it is clear; that attitudes and the acceptance of Sri Lankan consumers towards this new marketing medium will differ from consumers in other surveyed countries. By understanding Sri Lankan attitude toward this newmedium, it is a need to sure about whether they are willing to receive advertisement through their mobile phones. To identify that, this study intends to give attitudinal explanations of acceptance to use this specific advertising medium by the Sri Lankan consumers. Therefore the following research questions will convey the answer.

3. RESEARCH QUESTIONS

1) Whether the Sri Lankan consumers have positive or negative attitude towards mobile advertising, and what is the level of acceptance of the mobile advertising?
2) Is there any relationship between attitude towards mobile advertising and the acceptance of mobile advertising?
3) If it is there, how control facilities moderate the relationship between attitudes andacceptance of mobile advertising

RESEARCH OBJECTIVES

1. To identify the attitudes of Sri Lankan towards mobile advertisement, and the level of their acceptance.
2. To find out the relationship between attitude toward mobile advertising and theacceptance of that
3. To recognize the moderator effect of control facilities on the relationship between attitude toward the mobile advertising and the acceptance of mobile advertising

LITERATURE REVIEW

Mobile marketing can be seen as the process of planning and execution conception, pricing, promotion, and distribution of products and services through the mobile channel (IMAP 2003). Mobile marketing is the only personal channel enabling spontaneous, direct, interactive and targeted communications at any time, and any at any place. Mobile advertisement means as marketing with the use of the mobile medium as a communication and entertainment channel between the brand and the end user (The mobile marketing association, 2003). There are different

synonyms for advertising via mobile devices, such as wireless advertising (Krishnamurthy, 2003) or wireless advertising messaging (Pretty, 2003). To avoid the confusion concerning the concept of mobile advertising it is valuable to clarify the concept of mobile advertising and wireless advertising. While mobile advertising refers to the use of mobile channel as a medium to deliver the advertising messages to mobile devices, wireless advertising can be seen as a wireless internet and online advertising in the first place (Paaviliainen, Barnes, 2002).

Usually, mobile advertising messages are transmitted via short messages services (SMS) (De Reyck and Degraeve, 2003). Mobile advertising allows marketers to exploit the medium‟s unique features in order to customize their messages to consumers‟ attributes. Good marketing management always emphasis the building of long term relationship with customers through proper medium (Houston and Gassenheimer, 1987). Mobile advertising can support these goals in various ways because it allows reciprocal communication process between marketers and customers. As more wireless bandwidth become available, content rich advertising involving audio, pictures and video clips can be produced for individual users with specific needs, and inclinations (Varshney, 2003). Technologies such as the multimedia messaging services (MMS) help to overcome this limitation. Phones with higher resolutions and multicolor displays can include visual elements for innovative mobile advertisement (Dickinger, Haghirian, Scharl & Murphy, 2004).

Basically mobile advertising can be divided into two main categories; push and pull advertising (Barnes,2002), advertising that push to the users devices is generally used in conjunction with mobile advertising. Push advertising may be unsolicited such as special promotion delivered by SMS to the users within the context of an existing customer relationship or it may be solicited where users agree to have certain services or promotions pushed to them at certain time (for example sponsored sports score alerts, Government news alerts). Pull advertising is other hand, is defined as an advertising that is attached to the content or services that users request or "pull" to themselves. For instances, when a customer request the local whether from mobile service provider, the content of the response , including any related advertising, is pull advertising.

Advertisement is defined as predisposition to respond in a consistently favorable or unfavorable manner toward advertising in general (Mac Kenzie and Lutz, 1989). Attitude is also important construct for advertising media research. Consumer attitudes toward advertisement in general have long been found to be negative. Zanot, for instance, found that attitudes towards advertising become increasingly negative after the 1970s. Bauer and Greyser (2002) reported that more people held favorable attitudes toward advertising than unfavorable attitudes. Harris and associates, found that a majority of respondents considered TV advertising to be seriously misleading (Shavitt, Lowrey,& Haefner, 1998). Later studies have provided more evidence of the unfavorable public attitude toward advertising (Alwitt, 1994). Elliot and Speck (1998) investigated six major Medias (TV, broadcasting, magazine, newspaper, yellow page and direct mail), and found that television and magazine exhibits the highest level of ad-related communication problem. Perceived cutter, hindered search, and disruption were related to less favorable and greater ad avoidance. This effect varied in different media (Elliot & Speck, 1998). The different in the way different media affect consumer attitudes were also reported by Bogart (1990).

Since the mobile phone is a very personal devices that allows an individual to be accessed virtually any time and anywhere, mobile advertising must be more personalized and may take many forms. Based on different strategic application, mobile advertising can be either permission based, incentive based or location based (Zoller, Housen and Matthews, 2001). Permission based advertising different from traditional irritation advertising in that messages about specific product

and services, or content are send only to individuals who have explicit indicated their willingness to receive the message. Consumers often impatiently ignore the message when interrupted by an advertisement. By relying on the permission of the target audience, permission based advertising focusing on reducing the irritation (Fatim, Stuart and. Barnes, 2007). incentive based advertising provides specific financial rewards to the individuals who agree to receive promotion and campaigns, for example mobile phone companies may reward customers with free connection time for listening to voice advertisement. Both permission based and incentive based advertising mechanism are feasible for mobile advertising, because the wireless technology makes it possible to identify individual users (Tsang, Ho, and Liang, 2004). In addition to individual identification, Mobile technology also makes it possible to locate a particular consumer. Location based advertising takes advantages of this feature to target people in a certain location. Advertisements are sent based on where the user is or where the user is going (Zoller, Housen and Matthews, 2001).

Mitchel (2003) found that control is important with building trust and in-turn relationships with customers. Phelps, Nowak and Ferrell (2000), pointed out that individuals like to control, how personal information about them is used by the marketers, the kind of advertising mail and catalogs that they receive and the volume of advertising they receive. This study also concluded that offering more control has a relatively dramatic (Positive) impact on customers" purchase acceptances furthermore; direct marketing literature (Milne and Boza, 1999; Phelps, D"Souza and Nowak, 2001) consistently suggests that the amount of information control desired by consumers is positively related to the amount of acceptance.

Individuals have right to control the information held about them by third parties, and send to them by third parties (Chaffey 2004). Dickinger et al. (2005) observed that the mobile phone cannot distinguish between spam and genuine communication automatically. They also found that consumers prefer to register SMS-based information services, which can be controles, If the consumer is interrupted during his or her daily activities this can severely damage brand image, which were advertised (Hoyer and MacInnis, 2004). The major privacy violations in term of information capture are demographics and purchase data disclosure without consumers" consent, click stream patterns and browsing history, and physical location and purchase context for this reason, the notion of control over the wireless service is pertinent (Barnes and Scornavacca, 2003). Barnes and Scornavacca (2003) establish that mobile marketing acceptance depends on users" control over wireless service provision. Dickinger et al."s (2005) model of success factors for SMS marketing explained that control facilities available to consumers are consumer preference factors for mobile advertising acceptance. consumers may base their choice on a non-compensatory model where a specific attribute is valued and any negative information from this attribute will leads to a rejection of the offer for example consumers can refuse their acceptance if an ad is non controllable without even considering any aspects.

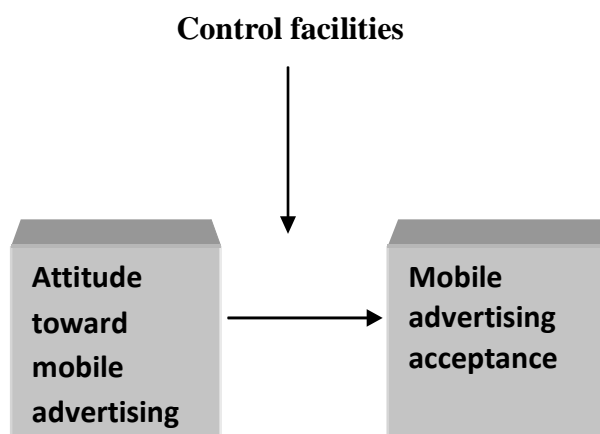## PROPOSITIONS AND HYPOTHESIS

H1: There is a positive Attitude of Sri Lankan towards mobile advertising.

H2: Sri Lankan consumers have higher level of acceptance for mobile advertising.H3: Attitude towards mobile advertising positively impact on its acceptance
H4: There is a moderator effect of control facilities between attitude towards mobileadvertising and acceptance of mobile advertising.

CONCEPTUAL FRAMEWORK

The following conceptual model is developed, to understand the relationship between attitude toward mobile advertising and the acceptance of mobile advertising. Further this model shows the moderator effect of control facilities on the relationship between them.

Control facilities

```
                            ┌──────────────┐
           Attitude         │    Mobile    │
           toward    ──────▶│  advertising │
           mobile           │  acceptance  │
           advertising      └──────────────┘
```

Source: current study

2. RESEARCH METHODOLOGY

The target Population of the study is Sri Lankan consumers, who are mobile phone users. The reason why these users were considered was due to the fact that they were considered to be more likely to accept mobile advertising in the future than those without a mobile device. The surveys for this study were distributed at mobile phone service providers branches located in different shopping malls in Sri Lanka. The survey was given to every third customer who enters the shop. For users who did not want to fill in the form in the shop, e-mail addresses of these users were requested and the questionnaire was e-mailed to them. A total of 650 hardcopies of questionnaires were distributed in the shops, while another 250 soft copy of questionnaires were sent via e-mail. Out of these 900 samples 62 samples were rejected due to partial response and/or missing data, thus giving a total response rate of 92 percentage. In order to ensure the content validity of the scale used, it is advised to largely adapt the items for each contract prior researchers (Luarn and Lin, 2005).

The questionnaire is divided into two parts. The first part of the questionnaire elaborates on the independent, dependent, and moderator variables that would be tested in the survey. The second part of the questionnaire identifies the personal information of the respondents. Questionnaire in the form of scaled-response questions was adopted in the second part because "scaling permits measurement of the intensity of respondents" answers" (Churchill and Brown, 2004). The items of the questionnaire were adopted from different sources of the extant literature. The items for the independent variables „credibility" "irritation" and "informativeness" were adopted from Tsang (2004), the items for dependent variable„ acceptance of advertising" were adopted from Barnes & Scornavacca (2003).. The items for the control facilities adopted from Mitchel (2003); Phelps, Nowak and Ferrell (2000), Milne and Boza, (1999); Phelps,; D"Souza and Nowak, (2001). Likert scale format was applied as the scale was suitable for self-administered survey method (Hair, Bush and Ortinau, 2004). A 5-point Likert scale anchored by "strongly disagree" (1) to "strongly agree" (5) was adopted as the measurement for the independent and dependent and moderator variables.

As mentioned in the objectives 1 of the research is to measure the attitude, and the level of acceptance of Sri Lankan towards mobile advertising This study defined the positive attitude, and the higher level of acceptance as the range above 4, neutral attitude and medium acceptance lies between greater than or equal 3(3≤) and less than or equal ≤ 4 and negative attitude and low level of acceptance concentrated as below 3. It means that value given by the mobile phone users which is lies above 4, means the have positive attitude and higher level of acceptance towards mobile advertising. The score which lies between greater than or equal 3(3≤) and less than or equal ≤ 4 means the customers have neutral attitude and medium level of acceptance toward mobile advertising , and the score , lies below 3 means they have negative attitude, and low level of acceptance toward advertising.

RESULTS AND DISCUSSION PROFILE OF THE RESPNDENT

The demographic profile of the respondents is presented in the table1, which included gender, age group, marital status and highest level of academic qualification. The total sample for the survey consists of 838 respondents.

The gender distribution of the survey respondents is 54.4 % males and 45.5 % female. The results also indicated that the samples have age predominantly between 21 and 25, which is 65%. More than 80% of the respondents are single. Majority of the respondents have college or higher education level: 13% are master degree holders, 54% of the respondents are at the degree/or professional qualification level and 36% of respondents are diploma/advanceddiploma holders.

TABLE 1: DEMOGRAPHIC PROFILE OF THE RESPONDENTS

Variables	Category	Free	%
Gender	Male	456	54.4
	Female	382	45.5
Age	≤ 20 years	44	5.25
	21-25 years	544	64.9
	26-30 years	188	22.4
	31-35 years	44	5.25
	36-40 years	10	1.19
	≥41 years	8	0.95
Marital status	Single	696	83.0
	married	142	16.9
Highest level of academic qualification	Under certification qualification Diploma/advance diploma Degree /professional qualificationMaster degree	80 298 450 110	9.5 35.5 53.6 13.12

In this study, all the respondents have at least one mobile phone with different technology facilities. Table 2 shows the service categories that are experienced by the respondents. Communication and entertainment services are the most popular services used by the respondents. The data also shows that the number of dialog subscribers is highest in the sample with 43.4%. About 32.9% are mobitel subscribers, 13.2% are Hutch subscribers, Airtel subscribers are 6.9% and 3.46% are the subscribers of other mobile service providers.

TABLE2: SERVICE CATEGORIES

Variables	Category	free	%
Pricing scheme	Post paid	432	51.5
	Pre paid	406	48.4
Subscribed providers	Dialog MobitelHutch Airtel others	364	43.4
		276	32.9
		111	13.2
		58	6.9
		29	3.46
Mobile services	Information services Entertainment Transaction services Location based services Communication services	128	15.2
		331	39.4
		180	21.4
		22	2.62
		838	100

The mean score of overall attitude toward mobile advertising was 4.2, (sd:0.0765) which implies that respondents attitude towards mobile advertising is positive, therefore hypothesis one is accepted, and the mean score of the acceptance of mobile advertising is 2.4 (sd:0.089), which means that consumers have low level of acceptance of mobile advertising. Therefore hypothesis two is being rejected

Multiple regression analysis is defined as "a statistical technique which analyzes the linear relationships between a dependent variable and multiple independent variables by estimating coefficients for the equation for a straight line" (Hair et al., 2004). Multiple regression analysis was carried out to test the hypotheses 3 and the results were presented in Table3.

TABLE 3- STANDARD REGRESSION COEFFICIENT

Independent variables: attitude toward advertising	Dependent variables : mobile advertising acceptance
ß	0.970
Significance of F	0.000
Adjusted R^2	0.725

According to the regression results in the Table 3 the fitted model encountered a significant relation between attitude toward mobile advertising and its acceptance. The R^2 value multiplied by 100 tells the percentage of variance in one variable accounted for by the predictor variables. The adjusted R^2 value is 0.725so, that 72% Percentage is accounted for by the predictor variable. Considering all above facts the, the hypothesis 3 is being accepted, and it could be proved that there is a significant evident of the impact of attitude towards mobile advertisement on mobile acceptance.

For the purpose of explaining the impact of attitude toward mobile advertising on its acceptance, researcher has used two models. Model 1: First Model is used to test the third hypothesis to show the impact of X1 (creditability), X2 (Informativeness), X3 (Irritation) on Y (acceptance of mobile advertising). Model 1 fit for the relationship between attitude toward mobile advertising and its acceptance. This explained that 72.5% variation by the fitted model. It entails that around 72% of the variation in mobile acceptance is explained by the attitude toward mobile advertising, therefore hypothesis three is accepted.

$Y = 0.556 X_0 + 1.562 X_1 + 0.957 X_2 + 0.086 X_3$

Model 2: this model is fitted to test the hypothesis 4, and explains the relationship between predictor variable and dependent variable. It means that the fitted model reveals that, the variation in mobile advertising acceptance is explained by the moderating effect of control facilities between attitude towards mobile advertising and its acceptance. It is used to test the fourth hypothesis to show the relationship between the y (acceptance) and the X (product of control facilities and attitude toward advertisement).

$Y = 1.23 X_0 + 0.331 X_1$

It has been noted that fitted model revealed the significant relation ship between predictor variable ATTIFACICON; the product of attitude and control facilities and the dependent variable mobile advertising acceptance. It explains that there is a statistical significant of moderation effect between attitude toward mobile advertising and its acceptance (i. e. ß =97.4; p value<0.05). H4 is accepted.

TABLE: 4 STANDARD REGRESSION COEFFICIENTS

Independent variables: ATTIFACICON (product of attitude and control facilities)	Dependent variables: Acceptance of mobile advertising
ß	0.974
Significance of F	0.000
Adjusted R^2	0.852

Model 2 fit for moderator effect between attitude toward mobile advertising and its acceptance. This explained that 85.2% variation by the fitted model. It entails that around 85% of the variation in mobile acceptance is explained by the attitude toward mobile advertising; therefore hypothesis four is being accepted.

CONCLUSION AND MANAGERIAL IMPLICATION

According to the defined scale in the research, Sri Lankan consumers have positive attitude toward mobile advertising and have a low level of acceptance, therefore hypothesis one is being accepted and two is being rejected, and two regression models were used to test the hypotheses three and four. Findings show that there is an impact of attitude toward mobile advertising on the acceptance of it, and there is a statistical significant moderator effect of control facilities existing between those two constructs. It means that if the consumer will have control facilities on the mobile advertisement, which they will receive on their mobile phones change the acceptance level of this new advertising media. The results of survey show that potential receivers of mobile advertising seek control facilities, and the control is found to be the most important factor that motivate mobile phone users" acceptance of mobile advertising.

The research findings and contributions brought some implications to various stakeholders. The implications can be divided into two categories: theoretical and managerial implications. In terms of theoretical implication, the current empirical research affirms the notion that the mobile advertising can be applied in a highly facilitated with consumer control media environment in Sri Lanka. In terms of managerial implication, the findings do provide some insights and feedback for administrators of media industry in drafting various advertising strategies on how to increase the consumers" acceptance of advertising. Obviously, control facilities plays very important role in moderating the relationship between attitude towards mobile advertising and its acceptance. Control facilities not only enhance people"s acceptance of mobile advertising, but also improve acceptance when the people have negative or less favorable attitude towards advertising.

On the whole mobile advertising has been developing as a promotional channel in Sri Lanka, based on the astonishing growth of SMS and mobile phone users. Practitioners will gain insight from the findings of the present study on how to design effective mobile advertising campaigns. Further investigation can be conducted to identify what factors will contribute to

the control facilities and how to make the mobile advertising effectively to meet the needs of the customers.

Mobile advertising is currently a popular market instrument, the understanding of consumer attitude toward mobile advertising is important for marketers to design a high-quality promotion campaign. As SMS and MMS are continually growing at an enormous rate in Sri Lanka, their business application in mobile advertising must be systematically evaluated and properly integrated into a merchant"s business strategies and marketing initiatives. This research identified the relationship between attitude towards mobile advertising and its acceptance, and the role of control facilities between them, further the control facilities is an important element that will improve consumer acceptance of mobile advertising. Consumers are willing to give out their personal information to receive mobile advertising if it is controllable. Attitude towards mobile advertising is positively related to its acceptance to receive it on their mobile phones.

The internet has proven to be an efficient way of communicating, marketing and selling products and services. In parallel with internet, mobile communications and 3G technologies have emerged to play an important role in business and especially direct marketing. Therefore, emerging wireless mobile technology has been expected to bring a lot of opportunities for marketers. If mobile advertising is adopted by mobile phone users, mobile retailers will get revenue generating direct marketing tool in Sri Lanka.

Mobile phone users have positive attitude toward mobile advertisement, it reveals that people have a positive thoughts of mobile advertisement and have the low level of its receipt, the control facilities has a strong diplomat effect between the two construct, it means that if the consumer will have control facilities on the mobile advertisement, which they will receive on their mobile phones alter the acceptance level of this new advertising media. The results of survey show that potential receivers of mobile advertising seek control facilities, and the control is found to be the most important factor that motivated motive mobile phone users" acceptance of mobile advertising.

In addition developing successful marketing strategies lies to determine right customers, independent T-test and independent sample one-way ANOVA were used. According to results, mobile phone users who are young and middle age have high income, working as officials in private and private institutions and have graduate and undergraduate degrees are the most important target customers for mobile advertisement, therefore mobile commerce companies should target mobile phone users who have these demographic characteristics.

LIMITATION AND FURTHER RESEARCH

Present study account for one aspect in mobile commerce, as mobile advertising other mobile promotional mixes as mobile direct marketing, mobile CRM, mobile sales promotion are not considered. This study not considered the relationship to the company/ brand /product/service with mobile advertising. Even if the empirical study is limited in these aspects, it shows that it is necessary to consider that products and services may have different responsiveness patterns. Further studies are warranted from scientific point of view especially with the focus on understanding how consumer characteristics and product/ services characteristics influence responsiveness, for example for some consumers only some media may be relevant for particular product/services than to others. Strong arguments have been made for mobile advertising as a determinant of customer acceptance of mobile communication; however an

equally compelling argument was made for control facilities, which moderates the relationship between mobile advertising and its acceptance. The literature was generally non- existent relating to the influence of demographic data such as gender, age, income, education. This study focused on only the house hold customers in Sri Lanka, future studies could be concentrated on mobile advertising in business to business customers.

Apart from the above suggestions, the main directions of further research should be a deeper analysis of the role of the customer in value creation process via mobile advertising. Further studies could also focus attention on deeper understanding of the interaction process and flows of knowledge and resource in implementing mobile advertising, in purchasing the co- creation of value to customers. Further additional empirical testing and investigation is required to gauge how mobile advertising links with brand awareness in different brands, brand recall and promotional performance.

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DO RETAIL STORES' ATTRIBUTES INFLUENCE CUSTOMER SATISFACTION IN INDIA?

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ABSTRACT

Retail industry in India is witnessing a fast growth in almost all cities in India. Recent Indian Government decision of allowing the foreign investment in organized retailing in India will further lead to high growth. Attracting customers and retaining them become keys to success in increased industry competition. Retail store attributes play as important role in selection of a retail store by customers as well as in customer satisfaction. This study is an effort to examine the relationship between retail store attributes and customer satisfaction. Respondents were surveyed about their expectations and experiences with respect to ten dimensions of store attributes using a structured questionnaire using Mall Intercept Survey technique. Correlation and regression analysis were used for data analysis. The outcome of the analysis is establishment of relationship between store attributes and customer satisfaction.

KEYWORDS: *Indian retail industry, store attributes, customer expectation, customer satisfaction.*

1. INTRODUCTION

India retail industry is one of the fastest growing industries in India, especially over the last few years (Indian retail industry, 2010). According to the 8th Annual Global Retail Development Index (GRDI), revealed by consulting firm AT Kearney, Indian retail market is most attractive (GRDI, 2009). After passing the resolution and allowing the multinational organized retailers in Indian retail industry, this industry is expected to see this growth with many folds. After some domestic organized retail store like Vishal Megamart, Reliance Fresh, Big Bazaar, Trent, Shopper's Stop, Pantaloons, etc, now the Indian retail industry is going to face the existence of some world's largest retail stores like Wal-Mart, Carrefour, Metro Wholesale, etc, that are set to change the Indian consumer market in a large scale in all dimensions including the store attributes offered by various retail stores and expectation of customers with respect to these retail stores.

With high expectation of growing number of retail stores in coming few years in India, now, the Indian retail store customers are also expected to get opportunity to select the store of their own choice. Ghosh, Tripathi & Kumar (2009) found that the Indian retail industry's significant growth is visible in the fast increase in number of supermarkets, departmental stores, and hypermarkets in the country. Ghosh et al. addressed issues related to store attributes and their relevance in the store selection process and emphasized that store attributes become one of the key issues influencing the choice of customers, and customers' satisfaction. Sinha & Banerjee (2004) established the relation between the store attributes and the consumers' motivation in selecting various store formats. Mittal & Mehta (2011) explored the factors influencing the shoppers of grocery stores in India with the help of six store attribute factors such as Store Ambience and Layout, Service and loyalty schemes, Price and Quality, One Stop Shopping, Convenience and Salesmen. Very recently, another research in context to store attributes carried out by Verma & Madan (2011). They identified the key store attributes, which have significant impact on store image of an apparel store in India.

In brief, increasing number of retail stores in India creating a competitive challenge for retailers. In view of it, the retailers are focusing more on offering services, which are suitable for the customers in order to attract and retain them. For retailers, store attributes are the tools to interact with customers and satisfy them. The proposed research study is based on investigating the key attributes of an organized retail store which lead to customers' satisfaction. The purpose of this research study is to examine the relationship between store attributes and customer satisfaction in context with retail stores in India.

LITERATURE REVIEWSTORE ATTRIBUTES

Martineau (1958) was the first researcher to work on store attributes (Erdem, Oumlil, & Tuncalp, 1999). He described store attributes as factors responsible for store image formation. Further, he opined that the store image leads to create personality of the store inthe mind of customers and customers' decisions are influenced by the picture of the entire store. The image of the store is formed in customer mind by some store attributes like: Layout and Architecture, Symbols and Colours, Advertising, and Sales personnel matched with various patterns of consumer behaviour.

Through literature review, Kunkel & Berry (1968) understood that store image has increased notably in past decades but the rate of knowledge has not progressed accordingly. Kunkel et al. opined that a man selects a store for buying based his experiences while shopping in a store. Work in this area carried out by developing a behavioural concepts (influenced by societal and subculture norms) of store images (formed by 12 store attributes: Price ofMerchandise, Quality of Merchandise, Assortment of Merchandise, Fashion of Merchandise, Sales personnel, Location convenience, other convenience factors, Services, Sales Promotion, Advertising, Store Atmosphere and reputation on Adjustments).

Lindquist (1974-75) conducted a survey of empirical and hypothetical evidence for defining the meaning of image. He summarised the image-related attributes found or hypothesised by 26 scholars in the field of defining store image through store attributes. He found that following attributes were mentioned by a certain percentage of the scholars: Merchandise Selection or Assortment (42%), Merchandise Quality (38%), Merchandise Pricing (38%), Locational Convenience (35%), Merchandise Styling, Fashion (27%), Service, General (27%) and Salesclerk Services (27%).

There are studies related to store selection based on consumer perceptions, which are formed or influence by store attributes. Joyce & Lambart (1996) found that consumers' perceptions about the store image are likely to be influenced by the types of stores visited repeatedly in past and attributes of these stores such as Color, Lighting, Signage, Clientele, Salespeople.

Sinha & Banerjee (2004) tried to know the factors of retail store selection based on the consumers' perception developed by visiting various types of stores and their observation about various services and physical parameter of these stores. Treblanche (1999) identified the determining factors of store attributes influencing consumer perception about a store as: Types of Customer, Store Location, Price levels, Services offered, Merchandising Mix, and Advertising and Physical facilities.

CUSTOMER SATISFACTION

Miller (1976) had an insight to the stores customers' satisfaction in terms of customer discontent. This article primarily investigated the possibilities of identifying segments of discontented customers.

Westbrook (1981) used some range of non product related factors and identified eight variables Sales personnel, Store environment, Merchandising, Services, Product satisfaction, Store clientele, Value-price, and Special sales that may influence customer satisfaction and dissatisfaction. Among

them he concluded that Sales persons, Store sales, Product satisfaction, Value price relationship, and Store environment were most influential variables of retail customer satisfaction.

Rogers (1998) investigated customer satisfaction of visitors to history museum stores in relation with customer demographic and nostalgia proneness. This research aimed at measuring the level of customer satisfaction, identifying the attributes responsible for satisfaction.

Priporas (2002) in his thesis viewed that customer satisfaction had been recognized as a major success factor in keeping and developing the clientele base. The purpose of this study was to explore relationship between store image and consumer satisfaction for a food retail sector amidst entrance of foreign retailers in Greece.

While, Ting & Chen (2002) looked the relationship between store attributes and customer satisfaction differently and viewed that though there were researches showing a linear relationship between quality attributes of a store and customer satisfaction, there might be a non-linear relationship between them. Ting et al. investigated in same line on hypermarket customers and found that most quality attributes and customer satisfaction is asymmetrical and non-linear.

2. RESEARCH AIMS AND HYPOTHESIS

Through literature review, two conclusions can be drawn. Firstly, it can be concluded that increasing number of retail stores in India creating a competitive challenge for retailers. And secondly, world over, store attributes are the key tools used to measure the level of satisfaction. Purpose of this study is to identify the store attributes by summarizing the list of store attributes used in previous researches through literature review and investigating its relationship with customer satisfaction in context with retail stores in India.

The above said purpose led to the formulation of the following research hypothesis: H_a: Store attributes influence the customer satisfaction with the retail store. The testing of this hypothesis will lead to know whether store attributes influence customer satisfaction and if yes, what are those store attributes influencing customer satisfaction.

NULL HYPOTHESIS

H_o: Store attributes do not influence the customer satisfaction with the retail store.

3. METHODOLOGY

The total number of 280 respondents was surveyed using Mall Intercept Surveys (Burns & Bush, 1998). Literature review suggests that for any survey related to measuring behavioral aspects of customer related to store, Mall Intercept Survey may be used to reduce the non- response. Mall Intercept Survey is collection of data from the respondents who are customers of the retail store and at the time of survey, customers are inside the store for purchasing (Burns & Bush, 1998).

Three large multiple supermarkets: Big Bazaar and Wal-Mart in National Capital Region, Wal-Mart in Chhattisgarh, and Big Bazaar in Ranchi were chosen for collecting data under mall intercept survey. A five point likert scale structured questionnaire was used to collect the data from respondents. Through this questionnaire, the respondents' expectations and experiences were measured under ten dimensions of store attributes.

After thorough review of literature, ten dimensions of store attributes have been finally selected to consider in this research study summarized in following table 1.

TABLE: 1 LIST OF STORE ATTRIBUTES DIMENSIONS

Sl.	Dimension of Store Attributes	Sl.	Dimension of Store Attributes
1.	Range of Merchandise	2.	Quality of the merchandise
3.	Price of merchandise	4.	Facilities and Services
5.	In-store Convenience	6.	Sales Personnel
7.	Post-purchase Service	8.	Store Atmosphere
9.	Location Convenience	10.	Sales Promotion schemes

Correlation analysis was used to establish the relationship between store attributes and customer satisfaction that is the gap between the perception and expectation of customers towards a retail store. And then, multiple regression analysis was used to establish the relation in terms of strength of relationship between store attributes and customer satisfaction.

4. DATA ANALYSIS: FINDINGS

Measuring customer satisfaction The weighted gap between perception and expectation with respect to attributes of the store ispresented below as follows.

TABLE 2 RESPONDENTS' SATISFACTION W.R.T. STORE ATTRIBUTES

Store Attributes	Weighted Gap Score (Customer Satisfaction)
Range of Merchandise	-0.14
Quality of Merchandise	-0.05
Price of Merchandise	-0.09
Facilities & Services	-0.06
In-store Convenience	-0.01
Sales Personnel	-0.03
Post-purchase Services	-0.09
Store Atmosphere	-0.05
Location Convenience	-0.05
Sales Promotion Schemes	-0.05
Overall Weighted Gap Score	**-0.06**

*Based on five-point Likert-scale

As evident from findings, gap score with every attribute is negative indicating customershave shown dissatisfaction in case of all attributes. The weighted gap score is calculated after considering the point allocated by the respondents to the attributes based on the importance they feel the attribute is. After treating the points allocated by respondents based on the importance they feel, values of the weighted gap scores are affected but with much lesser changes in their value. The least dissatisfaction value is of In-store Convenience (Weighted Gap = -0.01) followed by

Sales Personnel (Weighted Gap = -0.03). Highest level of dissatisfaction is reported in case of Range of Merchandise (Weighted Gap = -0.14) followed by Post-purchase Services (Weighted Gap = -0.09).

HYPOTHESIS TESTING

To test this hypothesis, Pearson's correlation coefficient has been calculated and then regression analysis is used. Pearson's r is calculated to find out the relation between variables and regression analysis is used to measure the slope of influence of retail attributes on customer satisfaction.

Pearson's Correlation (r) First of all, in order to proceed with correlation analysis, value of gap between perception and expectation with store attributes is calculated and then subsequently its relationship with weighted customer satisfaction is established with respect to respective store attribute to examine whether store attributes influence the customer satisfaction. The value of Correlation coefficients Pearson's r with every case is calculated to find out the relation between them.

When the Pearson's r is valued at significance level less than .05 (2-tailed), there is significant relationship between the variables and if more than .05 (2-tailed), the relationship between variables is weak. The Pearson's r value and significance value between total weighted customer satisfaction and store attributes is presented in following table 3.

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TABLE 3 CORRELATION BETWEEN SATISFACTION AND STORE ATTRIBUTES

		Weighted Customer Satisfaction	Gap in Range of Merchandise	Gap in Quality of Merchandise	Gap in Price of Merchandise	Gap in Facilities and Services	Gap in In-store Convenience	Gap in Sales Personnel	Gap in Post-purchase Services	Gap in Store Atmosphere	Gap in Location & Convenience	Gap in Sales Promotion Schemes
Weighted Customer Satisfaction	Pearson (r)	1										
	Sig. (2-tailed)	.										
Gap in Range of Merchandise	Pearson (r)	.594 (**)	1									
	Sig. (2-tailed)	.000	.									
Gap in Quality of Merchandise	Pearson (r)	.699 (**)	.589 (**)	1								
	Sig. (2-tailed)	.000	.000	.								
Gap in Price of Merchandise	Pearson (r)	.710 (**)	.374 (**)	.534 (**)	1							
	Sig. (2-tailed)	.000	.000	.000	.							
Gap in Facilities & Services	Pearson (r)	.395 (**)	-.068	.019	.312 (**)	1						
	Sig. (2-tailed)	.000	.256	.750	.000	.						
Gap in In-store Convenience	Pearson (r)	.751 (**)	.529 (**)	.621 (**)	.460 (**)	.221 (**)	1					
	Sig.	.000	.000	.000	.000	.000	.					

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
	(2-tailed)											
Gap in Sales Personnel	Pearson(r)	.520(**)	.329(**)	.381(**)	.299(**)	.099	.422(**)	1				
	Sig. (2-tailed)	.000	.000	.000	.000	.097	.000	.				
Gap in Post-purchase Services	Pearson (r)	-.035	-.449(**)	-.317(**)	-.263(**)	-.009	-.219(**)	-.098	1			
	Sig. (2-tailed)	.555	.000	.000	.000	.876	.000	.103	.			
Gap in Store Atmosphere	Pearson (r)	.094	-.256(**)	-.159(**)	.004	.152(*)	-.134(*)	-.285(**)	.508(**)	1		
	Sig. (2-tailed)	.117	.000	.008	.951	.011	.025	.000	.000	.		
Gap in Location & Convenience	Pearson (r)	.437(**)	.184(**)	.146(*)	.262(**)	.292(**)	.226(**)	.379(**)	-.064	-.078	1	
	Sig. (2-tailed)	.000	.002	.014	.000	.000	.000	.000	.284	.193	.	
Gap in Sales Promotion Schemes	Pearson (r)	.521(**)	.352(**)	.337(**)	.260(**)	.099	.288(**)	.193(**)	.069	-.087	.047	1
	Sig. (2-tailed)	.000	.000	.000	.000	.097	.000	.001	.251	.147	.435	.

* Correlation is significant at the 0.05 level (2-tailed).   ** Correlation is significant at the 0.01 level (2-tailed).

As found, the significance value in all cases is .000 (significance level = .01, 2-tailed), which is much lower than .05 except two cases that is post-purchase services and store atmosphere, where the value is higher than .05. The values in case of post-purchase services (Pearson correlation = -.035, Sig. = .555) and in store atmosphere (Pearson correlation = .094, Sig. = .117) at significance level at .05, 2-tailed.

The output of this analysis can be interpreted as that except two attributes post-purchase services and store atmosphere; gap between perception and expectation with all other eight attributes are having relation with overall weighted customer satisfaction.

5. REGRESSION ANALYSIS

To further examine this relationship, a multiple regression analysis is conducted. Multiple regression analysis between perception and expectation gap for all 8 store attributes and total weighted customer satisfaction is used for finding out the slope of influence of store attribute on customer satisfaction. The two store attributes "post-purchase services" and "store atmosphere" have been excluded from further consideration in regression analysis as correlation analysis resulted no correlation of these two attributes with customer satisfaction. The analysis results are presented in following table 4.

TABLE 4   REGRESSION ANALYSIS BETWEEN CUSTOMER SATISFACTION AND STOREATTRIBUTES

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.001	.001		-.473	.637
	Gap in Range of Merchandise	.014	.001	.247	16.324	.000
	Gap in Quality of Merchandise	.010	.001	.209	13.506	.000
	Gap in Price of Merchandise	.013	.001	.261	19.255	.000
	Gap in Facilities and Services	.007	.000	.173	14.297	.000
	Gap in In-store Convenience	.010	.001	.257	17.702	.000
	Gap in Sales Personnel	.008	.001	.130	10.197	.000

Gap in Location & Convenience	.009	.001	.152	12.977	.000
Gap in Sales PromotionSchemes	.010	.001	.173	14.413	.000

Dependent Variable: Total Weighted Gap in Expectation & Perception (Overall Customer Satisfaction)

As evident in above table, the p-values (significance) in all cases are much lesser than 0.05, indicating existence of significant relationship between the variables. As this analysis yielded a significant influence of store attributes on customer satisfaction, the following regression equation was produced.

$$WCS=(.014*GRM)+(.01*GQM)+(.013*GPM)+(.007*GFS)+(.01*GSC)+(.008*GSP)+(.009*GLC)+(.01*GPS)-.001$$

Where,   WCS= Weighted Customer SatisfactionGRM= Gap of Range of Merchandise GQM=

Gap of Quality of Merchandise GPM= Gap of Price of Merchandise GFS= Gap of

Facilities & Services GCS= Gap of In-store Convenience GSP= Gap of Sales

Personnel

GLC= Gap of Location Convenience

GPS= Gap of Sales Promotion Schemes

The regression equation produced by the multiple regression analysis clearly indicates that there is a significant influence of satisfaction with store attribute on customer's overallsatisfaction with the store.

Hence, based on above analysis of data collected from the sample, the Null hypothesis (H_o: Store attributes do not influence the customer satisfaction with the retail store) is rejected. Thus, it is concluded that store attributes influence significantly the customer satisfaction with the retail store.

6. CONCLUSION

Null Hypothesis 1 was examined using correlation analysis and regression analysis. The output of correlation analysis as significant value .000 (significance level = .01, 2-tailed) in case of establishing relationship of all store attributes with customer satisfaction, posit that customer satisfaction has strong relation with 8 out of 10 store attributes.

The output of regression analysis showed that there was a significant and positive regression coefficient between 8 store attributes and customer satisfaction with all coefficients at p< .05. Hence, the Null hypothesis was rejected and was concluded that store attributes influence significantly the customer satisfaction with the retail store.

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Martineau (1958) was the first researcher to work on store attributes (Erdem, Oumlil, & Tuncalp, 1999). He described store attributes as factors responsible for store image formation. Further, he opined that the store image leads to create personality of the store inthe mind of customers and customers' decisions are influenced by the picture of the entire store. The image of the store is formed in customer mind by some store attributes like: Layout and Architecture, Symbols and Colours, Advertising, and Sales personnel matched with various patterns of consumer behaviour.

Through literature review, Kunkel & Berry (1968) understood that store image has increased notably in past decades but the rate of knowledge has not progressed accordingly. Kunkel et al. opined that a man selects a store for buying based his experiences while shopping in a store. Work in this area carried out by developing a behavioural concepts (influenced by societal and subculture norms) of store images (formed by 12 store attributes: Price ofMerchandise, Quality of Merchandise, Assortment of Merchandise, Fashion of Merchandise, Sales personnel, Location convenience, other convenience factors, Services, Sales Promotion,Advertising, Store Atmosphere and reputation on Adjustments).

Lindquist (1974-75) conducted a survey of empirical and hypothetical evidence for defining the meaning of image. He summarised the image-related attributes found or hypothesised by 26 scholars in the field of defining store image through store attributes. He found that following attributes were mentioned by a certain percentage of the scholars: Merchandise Selection or Assortment (42%), Merchandise Quality (38%), Merchandise Pricing (38%), Locational Convenience (35%), Merchandise Styling, Fashion (27%), Service, General (27%) and Salesclerk Services (27%).

There are studies related to store selection based on consumer perceptions, which are formed or influence by store attributes. Joyce & Lambart (1996) found that consumers' perceptions about the store image are likely to be influenced by the types of stores visited repeatedly in past and attributes of these stores such as Color, Lighting, Signage, Clientele, Salespeople.

Sinha & Banerjee (2004) tried to know the factors of retail store selection based on the consumers' perception developed by visiting various types of stores and their observation about various services and physical parameter of these stores. Treblanche (1999) identified the determining factors of store attributes influencing consumer perception about a store as: Types of Customer, Store Location, Price levels, Services offered, Merchandising Mix, and Advertising and Physical facilities.

CUSTOMER SATISFACTION

Miller (1976) had an insight to the stores customers' satisfaction in terms of customerdiscontent. This article primarily investigated the possibilities of identifying segments of discontented customers.

Westbrook (1981) used some range of non product related factors and identified eight variables Sales personnel, Store environment, Merchandising, Services, Product satisfaction, Store clientele, Value-price, and Special sales that may influence customer satisfaction and dissatisfaction. Among

them he concluded that Sales persons, Store sales, Product satisfaction, Value price relationship, and Store environment were most influential variables of retail customer satisfaction.

Rogers (1998) investigated customer satisfaction of visitors to history museum stores in relation with customer demographic and nostalgia proneness. This research aimed at measuring the level of customer satisfaction, identifying the attributes responsible for satisfaction.

Priporas (2002) in his thesis viewed that customer satisfaction had been recognized as a major success factor in keeping and developing the clientele base. The purpose of this study was to explore relationship between store image and consumer satisfaction for a food retail sector amidst entrance of foreign retailers in Greece.

While, Ting & Chen (2002) looked the relationship between store attributes and customer satisfaction differently and viewed that though there were researches showing a linear relationship between quality attributes of a store and customer satisfaction, there might be a non-linear relationship between them. Ting et al. investigated in same line on hypermarket customers and found that most quality attributes and customer satisfaction is asymmetrical and non-linear.

8. RESEARCH AIMS AND HYPOTHESIS

Through literature review, two conclusions can be drawn. Firstly, it can be concluded that increasing number of retail stores in India creating a competitive challenge for retailers. And secondly, world over, store attributes are the key tools used to measure the level of satisfaction. Purpose of this study is to identify the store attributes by summarizing the list of store attributes used in previous researches through literature review and investigating its relationship with customer satisfaction in context with retail stores in India.

The above said purpose led to the formulation of the following research hypothesis: H_a: Store attributes influence the customer satisfaction with the retail store. The testing of this hypothesis will lead to know whether store attributes influence customer satisfaction and if yes, what are those store attributes influencing customer satisfaction.

NULL HYPOTHESIS

H_o: Store attributes do not influence the customer satisfaction with the retail store.

9. METHODOLOGY

The total number of 280 respondents was surveyed using Mall Intercept Surveys (Burns & Bush, 1998). Literature review suggests that for any survey related to measuring behavioral aspects of customer related to store, Mall Intercept Survey may be used to reduce the non- response. Mall Intercept Survey is collection of data from the respondents who are customers of the retail store and at the time of survey, customers are inside the store for purchasing (Burns & Bush, 1998).

Three large multiple supermarkets: Big Bazaar and Wal-Mart in National Capital Region, Wal-Mart in Chhattisgarh, and Big Bazaar in Ranchi were chosen for collecting data under mall intercept survey. A five point likert scale structured questionnaire was used to collect the data from respondents. Through this questionnaire, the respondents' expectations and experiences were measured under ten dimensions of store attributes.

After thorough review of literature, ten dimensions of store attributes have been finally selected to consider in this research study summarized in following table 1.

TABLE: 1 LIST OF STORE ATTRIBUTES DIMENSIONS

Sl.	Dimension of Store Attributes	Sl.	Dimension of Store Attributes
1.	Range of Merchandise	2.	Quality of the merchandise
3.	Price of merchandise	4.	Facilities and Services
5.	In-store Convenience	6.	Sales Personnel
7.	Post-purchase Service	8.	Store Atmosphere
9.	Location Convenience	10.	Sales Promotion schemes

Correlation analysis was used to establish the relationship between store attributes and customer satisfaction that is the gap between the perception and expectation of customers towards a retail store. And then, multiple regression analysis was used to establish the relation in terms of strength of relationship between store attributes and customer satisfaction.

10. DATA ANALYSIS: FINDINGS

Measuring customer satisfaction The weighted gap between perception and expectation with respect to attributes of the store is presented below as follows.

TABLE 2 RESPONDENTS' SATISFACTION W.R.T. STORE ATTRIBUTES

Store Attributes	Weighted Gap Score (Customer Satisfaction)
Range of Merchandise	-0.14
Quality of Merchandise	-0.05
Price of Merchandise	-0.09
Facilities & Services	-0.06
In-store Convenience	-0.01
Sales Personnel	-0.03
Post-purchase Services	-0.09
Store Atmosphere	-0.05
Location Convenience	-0.05
Sales Promotion Schemes	-0.05
Overall Weighted Gap Score	**-0.06**

*Based on five-point Likert-scale

As evident from findings, gap score with every attribute is negative indicating customers have shown dissatisfaction in case of all attributes. The weighted gap score is calculated after considering the point allocated by the respondents to the attributes based on the importance they feel the attribute is. After treating the points allocated by respondents based on the importance they feel, values of the weighted gap scores are affected but with much lesser changes in their value. The least dissatisfaction value is of In-store Convenience (Weighted Gap = -0.01) followed by

Sales Personnel (Weighted Gap = -0.03). Highest level of dissatisfaction is reported in case of Range of Merchandise (Weighted Gap = -0.14) followed by Post-purchase Services (Weighted Gap = -0.09).

HYPOTHESIS TESTING

To test this hypothesis, Pearson's correlation coefficient has been calculated and then regression analysis is used. Pearson's r is calculated to find out the relation between variables and regression analysis is used to measure the slope of influence of retail attributes on customer satisfaction.

Pearson's Correlation (r) First of all, in order to proceed with correlation analysis, value of gap between perception and expectation with store attributes is calculated and then subsequently its relationship with weighted customer satisfaction is established with respect to respective store attribute to examine whether store attributes influence the customer satisfaction. The value of Correlation coefficients Pearson's r with every case is calculated to find out the relation between them.

When the Pearson's r is valued at significance level less than .05 (2-tailed), there is significant relationship between the variables and if more than .05 (2-tailed), the relationship between variables is weak. The Pearson's r value and significance value between total weighted customer satisfaction and store attributes is presented in following table 3.

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TABLE 3 CORRELATION BETWEEN SATISFACTION AND STORE ATTRIBUTES

		Weighted Customer Satisfaction	Gap in Range of Merchandise	Gap in Quality of Merchandise	Gap in Price of Merchandise	Gap in Facilities and Services	Gap in In- store Convenience	Gap in Sales Personnel	Gap in Post-purchase Services	Gap in Store Atmosphere	Gap in Location & Convenience	Gap in Sales Promotion Schemes
Weighted Customer Satisfaction	Pearson (r)	1										
	Sig. (2-tailed)	.										
Gap in Range of Merchandise	Pearson (r)	.594 (**)	1									
	Sig. (2-tailed)	.000	.									
Gap in Quality of Merchandise	Pearson (r)	.699 (**)	.589 (**)	1								
	Sig. (2-tailed)	.000	.000	.								
Gap in Price of Merchandise	Pearson (r)	.710 (**)	.374 (**)	.534 (**)	1							
	Sig. (2-tailed)	.000	.000	.000	.							
Gap in Facilities & Services	Pearson (r)	.395 (**)	-.068	.019	.312 (**)	1						
	Sig. (2-tailed)	.000	.256	.750	.000	.						
Gap in In-store Convenience	Pearson (r)	.751 (**)	.529 (**)	.621 (**)	.460 (**)	.221 (**)	1					
	Sig.	.000	.000	.000	.000	.000	.					

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
	(2-tailed)											
Gap in Sales Personnel	Pearson(r)	.520 (**)	.329 (**)	.381 (**)	.299 (**)	.099	.422 (**)	1				
	Sig. (2-tailed)	.000	.000	.000	.000	.097	.000	.				
Gap in Post-purchase Services	Pearson (r)	-.035	-.449 (**)	-.317 (**)	-.263 (**)	-.009	-.219 (**)	-.098	1			
	Sig. (2-tailed)	.555	.000	.000	.000	.876	.000	.103	.			
Gap in Store Atmosphere	Pearson (r)	.094	-.256 (**)	-.159 (**)	.004	.152(*)	-.134(*)	-.285 (**)	.508 (**)	1		
	Sig. (2-tailed)	.117	.000	.008	.951	.011	.025	.000	.000	.		
Gap in Location & Convenience	Pearson (r)	.437 (**)	.184 (**)	.146(*)	.262 (**)	.292 (**)	.226 (**)	.379 (**)	-.064	-.078	1	
	Sig. (2-tailed)	.000	.002	.014	.000	.000	.000	.000	.284	.193	.	
Gap in Sales Promotion Schemes	Pearson (r)	.521 (**)	.352 (**)	.337 (**)	.260 (**)	.099	.288 (**)	.193 (**)	.069	-.087	.047	1
	Sig. (2-tailed)	.000	.000	.000	.000	.097	.000	.001	.251	.147	.435	.

* Correlation is significant at the 0.05 level (2-tailed).   ** Correlation is significant at the 0.01 level (2-tailed).

As found, the significance value in all cases is .000 (significance level = .01, 2-tailed), which is much lower than .05 except two cases that is post-purchase services and store atmosphere, where the value is higher than .05. The values in case of post-purchase services (Pearson correlation = -.035, Sig. = .555) and in store atmosphere (Pearson correlation = .094, Sig. = .117) at significance level at .05, 2-tailed.

The output of this analysis can be interpreted as that except two attributes post-purchase services and store atmosphere; gap between perception and expectation with all other eight attributes are having relation with overall weighted customer satisfaction.

11. REGRESSION ANALYSIS

To further examine this relationship, a multiple regression analysis is conducted. Multiple regression analysis between perception and expectation gap for all 8 store attributes and total weighted customer satisfaction is used for finding out the slope of influence of store attribute on customer satisfaction. The two store attributes "post-purchase services" and "store atmosphere" have been excluded from further consideration in regression analysis as correlation analysis resulted no correlation of these two attributes with customer satisfaction. The analysis results are presented in following table 4.

TABLE 4 REGRESSION ANALYSIS BETWEEN CUSTOMER SATISFACTION AND STOREATTRIBUTES

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.001	.001		-.473	.637
	Gap in Range of Merchandise	.014	.001	.247	16.324	.000
	Gap in Quality of Merchandise	.010	.001	.209	13.506	.000
	Gap in Price of Merchandise	.013	.001	.261	19.255	.000
	Gap in Facilities and Services	.007	.000	.173	14.297	.000
	Gap in In-store Convenience	.010	.001	.257	17.702	.000
	Gap in Sales Personnel	.008	.001	.130	10.197	.000

Gap in Location & Convenience	.009	.001	.152	12.977	.000
Gap in Sales PromotionSchemes	.010	.001	.173	14.413	.000

Dependent Variable: Total Weighted Gap in Expectation & Perception (Overall Customer Satisfaction)

As evident in above table, the p-values (significance) in all cases are much lesser than 0.05, indicating existence of significant relationship between the variables. As this analysis yielded a significant influence of store attributes on customer satisfaction, the following regression equation was produced.

$$WCS = (.014 * GRM) + (.01 * GQM) + (.013 * GPM) + (.007 * GFS) + (.01 * GSC) + (.008 * GSP) + (.009 * GLC) + (.01 * GPS) - .001$$

Where,   WCS= Weighted Customer SatisfactionGRM= Gap of Range of Merchandise GQM=

Gap of Quality of Merchandise GPM= Gap of Price of Merchandise GFS= Gap of

Facilities & Services GCS= Gap of In-store Convenience GSP= Gap of Sales

Personnel

GLC= Gap of Location Convenience

GPS= Gap of Sales Promotion Schemes

The regression equation produced by the multiple regression analysis clearly indicates that there is a significant influence of satisfaction with store attribute on customer's overallsatisfaction with the store.

Hence, based on above analysis of data collected from the sample, the Null hypothesis (H_o: Store attributes do not influence the customer satisfaction with the retail store) is rejected. Thus, it is concluded that store attributes influence significantly the customer satisfaction with the retail store.

12. CONCLUSION

Null Hypothesis 1 was examined using correlation analysis and regression analysis. The output of correlation analysis as significant value .000 (significance level = .01, 2-tailed) in case of establishing relationship of all store attributes with customer satisfaction, posit that customer satisfaction has strong relation with 8 out of 10 store attributes.

The output of regression analysis showed that there was a significant and positive regression coefficient between 8 store attributes and customer satisfaction with all coefficients at p< .05. Hence, the Null hypothesis was rejected and was concluded that store attributes influence significantly the customer satisfaction with the retail store.

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INDIAN RURAL MARKET – OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Indian Rural Marketing has always been complex to forecast and consist of special uniqueness. However many companies were successful in entering the rural markets. They proved with proper understanding of the market an innovative marketing idea, it is possible to bag the rural markets. It is very difficult for the companies to overlook the opportunities they could from rural markets. As Two – Thirds of Indian population lives in rural areas, the market is much unexpected for the companies to be successful in rural markets. They have to overcome certain challenges such as Pricing and Distribution.

The present paper has been covered to know the rural market status in India, the identification of different Rural Marketing Strategies, to highlight the Opportunities and Challenges of rural marketing in India, to analyze RuralMarketing Strategies Adopted by stated business houses.

1. INTRODUCTION

The Indian rural market is an area of darkness to Indian corporate. Rural area is vast in size but amorphous in detail. And yet, the rural market represents the largest potential market in the country. With over 70% of India‟s population residing in rural areas, capturing these markets is becoming one of the most lucrative options for all sectors. In the wake of economic crisis, while the urban markets remain subdued due to cash crunch, rural economy has remained largely unaffected. A good harvest has further added to their respite. As a result, marketers are focused on small towns and villages with dedicated workforce. At present, rural consumers spend about USD 9 billion per annum on FMCG items and product categories such as instant noodles, deodorant and fabric, with the pace of consumptiongrowing much faster than urban areas. The fast moving consumer goods market in rural Indiais tipped to touch $100 bn (around Rs 45,735 crore) by 2025 on the back of "unrelenting" demand driven by rising income levels, according to a study by research firm The Nielsen Company. Also the Indian rural market is set to become a USD 100 billion opportunity for retail spending in the next fifteen years, "according to a statement released by the company. With urban markets getting saturated for several categories of consumer goods and with rising rural incomes, marketing executives are fanning out and discovering the strengths ofthe large rural markets as they try to enlarge their markets.

A survey by the National Council for Applied Economic Research (NCAER), India's premier economic research entity, recentlyconfirmed that rise in rural incomes is keeping pace with urban incomes. From 55 to 58 per cent of the average urban income in 1994-95, the average rural income has gone up to 63 to 64 per cent by 2001-02 and touched almost 66 per cent in2004-05. The rural middle class is growing at 12 per cent against the 13 per cent growth of its urban counterpart. Even better,the upper income class those with household incomes of over Rs. one million [$22,700] per annum is projected to go up to 21 million by 2009-10 from four million in 2001-02. It will have a 22 to 23 per cent rural component. Higher rural incomes have meant larger markets. Already, the rural tilt is beginning to show. In the country we have 0.6 million villages

out of which only 13 percent have population above 2000. The rural economy contributes nearlyhalf of the country''s GDP (ETIG 2002-03) which is mainly agriculture driven and monsoon dependant. More than 50 percent of the sales FMCG and Durable companies come from the rural areas. The McKinsey report (2007) on the rise on consumer market in India predicts thatin twenty years the rural Indian market will be larger than the total consumer markets in countries such as South Korea or Canada today, and almost four times the size of today''s urban Indian market and estimated the size of the rural market at \$577 Billion. It is no wonder that even MNCs have cottoned on to the idea of a resurgent rural India waiting to happen.

OBJECTIVES OF THE STUDY

- To know the Rural Market status in India
- To state different Rural Marketing Strategies
- To highlight the Opportunities and Challenges of Rural Marketing in India.
- To analyze Rural Marketing Strategies Adopted by stated business houses

DATE COLLECTIONSECONDARY DATA

Data is collected from various Published & unpublished Journals, Articles available in various websites, popular Journals, Text Books etc.

RURAL MARKET STATUS

The market scenario in the rural areas today is changing very rapidly. The boundaries of nation are disappearing, technological changes are taking place at the flash of an eye, standards are undergoing changes in no time and so are the fortunes of various organizations. Rural families have shown no intentions of cutting down their expenditures on weddings, pilgrimages, construction or consumption. They have their own set of aspirations and are willing to pay right price for right product. CEO''s of a rural marketing firm says "The rural India has cash in hand and is not bound by EMIs or loans. With the majority of ourpopulation based in tier-III, tier-IV cities and villages, it is the right time to penetrate into rural markets". The consumer in the village knows his math and doesn't merely want the cheapest product.

The way they define value is similar to the urban consumers." They have sufficient disposable income and are appreciating brands, customer service, aesthetics and products. There is a growing demand for television sets, two wheelers, cars etc. There are three fastest selling categories in rural market. - Rural-rural, i.e. products mainly used in rural markets eg. Tractors, seeds, fertilizers etc., Rural-urban , i.e. products like bicycle, transistors, soap, shampoo, battery, washing powder etc. and Urban- urban and the best penetration in this segment is mobile phones. Nokia have found that farmers are now getting more familiar with the handsets and it has become a tool of prosperity for them. Nokia has therefore, lined up various applications exclusively for non-urban population which will be providing entertainment, education and agricultural information to subscribers. The village folks previously have no televisions, but now they are skipping cables and going straight to DTH.

RURAL MARKETING STRATEGIES

Dynamics of rural markets differ from other market types, and similarly rural marketing strategies are also significantly different from the marketing strategies aimed at an urban or industrial consumer. This, along with several other related issues, have been subject matter of intense discussions and debate in countries like India and China and focus of even international symposia organized in these countries. Rural markets and rural marketing involve a number of strategies which includes following,

- Client & location specific promotion
- Joint or cooperative promotion
- Bundling of inputs
- Management of demand
- Developmental marketing
- Unique selling proposition
- Extension services
- Business ethics
- Partnership for sustainability.

OPPORTUNITIES FOR MARKETERS

UNTAPPED POTENTIAL

It offers a great chance for different branded goods as well as services for large number of customers. It is estimated by HLL that out of 5 lakh villages in India , only lakh has been taped so far , which goes on to indicate the market potentials of the rural market.

MARKET SIZE AND POTENTIAL

The size of India s rural market is stated as 12.2 % of the percentage of the old population this means 12.2% of the worlds consumers leave in rural India. In India, rural household farm about 72% of total household constitutes a huge market by any standard.

1) **INCREASING INCOME**

   Different programs undertaken have helped to improve the economic the economic situation of the rural areas. The increase in income is seen in both absolute values as well as in the increase in average number of days of occupation in a year.

2) **ACCESSIBILITY MARKETS**

   Though the road network has not developed to the best possible extent but a fire amount of development has been made in many regions, making these regions accessible from the urban region and making in easier for supplying products to these regions

3) **COMPETITION IN URBAN AREAS**

   The urban market is getting saturated and thus is enable to provide the much needed market to many companies and in search of greener pastures many of these companies are now targeting the rural market.

CHALLENGES OF RURAL MARKETING

The peculiarities of the rural markets and rural consumers pose challenges to the marketers in reaching them effectively. While making out a case for opportunities that are rapidly developing in rural markets, one should not underestimate the several daunting problems in planning for growth. Due to these problems marketing efforts are constrained in several ways. There are a large number of small villages which are not easily accessible because of all weather roads. Rural

consumers are far less homogeneous than urban consumers.

The main problems rural marketing is

1) TRANSPORTATION PROBLEMS

Transportation infrastructure is quite poor in rural India. Nearly 80 percentages of villages in the country are not connected by well constructed roads. Marketing activities require transportation facilities. Due to poor transportation facilities, farmers and marketers find it difficult to reach markets.

2) WAREHOUSING

In the rural areas, there are no facilities for public as well as private warehousing. Marketers face problem of storage of their goods.

3) PACKAGING

It is the first important step of product processing. If the packaging cost is high, it will increase the total cost of products. It is suggested that the marketers should use cheaper materials in packaging for the rural markets. For example, small polypack of refined oil is more popular than in containers of the same product due to its lowest cost. One more important factor is the size package e.g. the size of the package should be small.

4) MEDIA PROBLEMS

Media have lots of problems in rural areas. Television is a good medium to communicate message to the rural people. But due to non-availability of power, as well as television sets, majority of the rural population cannot get the benefits of various media.

5) SEASONAL MARKETING

The main problem of rural marketing is seasonal demand in rural areas, because 75 percent of rural income is also seasonal. For example, the demand for consumer goods will be high during the peak crop harvesting period, because this is the time at which the rural people have substantial high cash flow. Rural marketing depends upon the demand of rural people and demand depends upon income and consumer behavior.

6) LOW PER CAPITA INCOME

Per capita income is lower in rural areas compared to those in urban areas. Again, the distribution of rural income is highly skewed, since the land holding pattern, which is basic asset, it is skewed. Thus the rural population presents a highly heterogeneous spread in the villages.

7) LOW LEVEL OF ELECTRICITY

The literacy rate is low in rural areas compared to urban areas. This again leads to the problem of communication for promotion purpose. Print medium becomes ineffective and to an extent irrelevant in rural areas since its reach is poor.

Besides, for the purpose of optimally exploiting the opportunities at hand in rural areas, the marketers have to cope up the various challenges before them like educating the rural consumers about the requirements and uses of the products. The marketers should also make the rural consumers understand how their product is different from similar products offered by competitors. This leads to better involvement on part of buyer and fosters long lasting relationship between consumer and company. Trust is another key factor which has to be properly dealt with. Thus, one of the biggest challenges to be met out is to create trust among the rural folks regarding

the products. According to Sanjay Muthal, Managing Director, Nugrid Consulting, "Trust is another key factor rural consumers are suspicious of urban market thinking. Rural consumers only buy from people they identify with."

CORPORATE IN ACTION

LG India‟s strategy of targeting the rural and semi-urban markets has resulted in specific gains for the company. In a bid to consciously go deeper and farther into the hinterland, LG has set up 50 Central Area Offices (CAOs) in B class cities and 59 Remote Area Offices (RAOs), in C class towns, besides its 18 branch offices. This has helped in feeling the pulse of the consumer and being able to respond rapidly to their needs. On the basis of customer feedback, LG came out with a frost-free refrigerator for low-end customers without the FIR lamp and deodorizer (after consumer feedback showed that the rural consumer did not look for storage beyond two days). In a bid to acquire rural subscribers, most Indian telecom operators have started investing in infrastructure to roll out their services in these areas. Realizing this as a huge potential, small Indian handset manufacturing companies, including Micromax, Intex Technologies and Karbonn, have lined up a marketing spent of around Rs 100 crore for the financial year 2009-10. These companies are bullish about the Indian rural market in terms of the number of handsets being sold. As per analysts, almost 60% of thetotal net additions are from the rural area, which makes this market more lucrative for these small handset manufacturers.

Nokia, the world leader in mobile phones, introduced SMS alerts from Malyalam Manorama based on the feedback that newspapers don‟t reach a lot of villages and it has received a good response from the rural areas. Nokia has also lined up applications meant exclusively for the non-urban population, which provide entertainment, education (helping people learn English, for example) and agricultural information to subscribers. The first pilot of these applications, called Nokia Live Tools (NLT), was rolled out in January 2009 in five districts of Maharashtra. "Many of the applications in NLT help those without access to regular TV and newspapers, with information.

A vehicle density of 2.3%, the Indian rural market is suddenly the cynosure of all eyes. It is the global economic meltdown that is forcing auto companies to take a real hard look at this market. Overall, the rural market contributes less than 10% to the total sales of the industry currently. It is expected to see double digit growth this year, higher than overall category growth. Realizing the importance of opinion makers, companies such as Maruti Suzuki, Hyundai Motor India and General Motors India run special panchayat schemes in these markets. GM India, for instance, runs a panchayat scheme wherein it gives Rs 2,000 as incentive on every buy of a Spark. GM India has appointed a marketing firm, RC&M, to help it formulate its strategy for rural marketing. The company has around 45 outlets in B categorytowns. GM says since availability of finance is limited and the income pattern is seasonal, the number of cash purchases in rural areas is higher compared to urban areas, and therefore, this market has been relatively less affected by the credit crisis. Hyundai launched Ghar Ghar Ki Pehchaan, a scheme targeted at government employees in rural areas and members of gram panchayats. The company also has a marketing initiative, Hyundai Utsav, running in tier III cities and rural areas of Punjab and Andhra Pradesh. It looks to build the brand‟s visibility and creating awareness about the loans and schemes offered by the company.

After a two year long push into the hinterland, P&G has come up with a new addition to its marketing strategy in the form of a character called Sangeeta Bhabhi, a dedicated housewife. The personality was conceived to push P&G‟s leading brands, Tide and Head & Shoulders as a dual proposition called „kamyab jodi‟ (Successful Pair) in rural areas of the country. After much deliberation over the eight to nine categories that P&G operates in, marketers pickedthe detergent

brand Tide and shampoo Head & Shoulders as the focus in this particular rural initiative.

The two products, to be specifically created for India, are part of PepsiCo‟s innovation plank to introduce low cost, nutritional food products and drinks in the rural market. This project will be called Project Asha.

SUGGESTIONS

1) DEVELOP NEW PRODUCTS FOR THE RURAL MARKET

Product redesign from the beginning can be done. Marginal changes to existing product will not work effectively. Product must work in hostile conditions in noise, dust and electricity blackouts etc.

2) DISTRIBUTION NETWORK

It should be designed to reach highly dispersed rural markets as compared to highly dense urban markets.

3) MORE EFFECTIVE COMMUNICATION

There is a need to find out the appropriate media, which could reach the hearts of the rural masses. This is required as none of the media like television, print, radio etc has absolute reach to the rural masses.

4) PRICING
Products can be priced to build up volume in the rural market, especially for smaller pack size SKUs.

Marketing Research should be undertaken involving focus groups. Marketers should also build prototypes while strategizing for marketing.

4. CONCLUSION

The rural market is where the markets of the future are likely to be. Urban markets are becoming increasingly competitive for many products. In some cases they are even saturated. On the other hand, rural markets offer growth opportunities. Rural market is the market of the new millennium. Marketers will have to understand the rural customers before they can make inroads into the rural markets. The size of the rural market is fast expanding. The rural market is fascinating and challenging at the same time. It offers large scope on account of its sheer size. It is often said that markets are made, not found, this is especially true of the rural market of India. It is a market for the truly creative markets.

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SCOPE OF FUZZY LOGIC IN PRODUCTION AND OPERATIONS MANAGEMENT: A RECENT REVIEW

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ABSTRACT

Crisp set always defines the membership function as unity, so it is deterministic in nature. But in most of the cases, real life systems are non-deterministic in nature, so crisp set is not suitable to model them. Fuzzy set theory has been used to model systems that are hard to define precisely. Membership function lies in between zero and one in fuzzy logic. As a methodology, fuzzy set theory incorporates imprecision and subjectivity into the model formulation and solution process. Fuzzy set theory represents an attractive tool to aid research in production management, when the dynamics of the production environment limit the specification of model objectives, constraints and the precise measurement of model parameters. This paper attempts to review the applications of fuzzy set theory in production and operations management.

KEYWORDS: *Production Management, Operations Management, Fuzzy Logic, Membership Function.*

1. INTRODUCTION

Fuzzy Logic is a particular tool in soft computing which has been studied extensively over the past 30 years. Most of the early interest in fuzzy set theory pertained to representing uncertainty in human cognitive processes (see for example Zadeh (1965)). Kaufmann and Gupta (1988) reported that over 7,000 research papers, reports, monographs and books on fuzzy set theory and applications have been published since 1965. The bibliographies compiled by Gaines and Kohout (1977), Kandel and Yager (1979), Kandel (1986) and Kaufmann and Gupta (1988) address fuzzy set theory and applications in general. The bibliographies by Zimmerman (1983) and Lai and Hwang (1994) reviewed the literature on fuzzy sets in operations research and fuzzy multiple objective decision making respectively. Maiers and Sherif (1985) reviewed the literature on fuzzy industrial controllers and provided an index of applications of fuzzy set theory to twelve subject areas including decision making, economics, engineering and operations research. The purpose of this paper is to: (i) review the literature; (ii) classify the literature based on the application of fuzzy set theory to production and operations management and (iii) identify future research directions.

2. JOB SHOP SCHEDULING

A number of papers on fuzzy job shop scheduling have been published. A summary of the direction of research on fuzzy job shop scheduling is given in Table 1. McCahon and Lee (1990) studied the job sequencing problem when job processing times were represented with fuzzy numbers. The job sequencing algorithms of Johnson, and Ignall and Schrage were modified to accept triangular and trapezoidal fuzzy processing times. Makespan and mean flow time were used as the performance criteria in this work. The fuzzy sequencing algorithms are applied to job shop configurations involving n jobs and up to three workstations. McCahon and Lee (1992) modified the Campbell, Dudek and Smith flow shop job sequencing heuristic to accept fuzzy processing times.

Ishii et al. (1992) investigated the scheduling of jobs under two shop configurations when job due

dates were modeled with fuzzy numbers. Tsujimura et al. (1993) studied the three machine flowshop problems when job processing times were described by triangular fuzzy numbers. The optimal sequence was defined to be the sequence that minimizes the makespan. Ishibuchi et al. (1994) formulated an n job and m machine flowshop model with fuzzy job due dates. A nonlinear membership function was used to represent the grade of satisfaction with the completion time of a job. A scheduling objective of maximizing the minimum grade of satisfaction of a completion time was adopted.

TABLE 1. JOB SHOP SCHEDULING WITH FUZZY LOGIC

Contributor(s)	Machines Cardinality	Jobs Cardinality	Fuzzification
Roy and Zhang (1996)	15	20	Dispatch
Ishii and Tada (1995)	1	n	Precedence
Grabot and Geneste (1994)	3	6	Dispatch
Han et al. (1994)	1	5	Due Dates
Ishibuchi et al. (1994)	10	20	Due Dates
Tsujimura et al. (1993)	3	4	Processing Times
Ishii et al. (1992)	2	n	Due Dates
McCahon and Lee (1992)	4	4	Processing Times
McCahon and Lee (1990)	2	6	Flowtime

Han et al. (1994) considered the n job, single machine maximum lateness scheduling problem with fuzzy due dates and controllable machine speeds. The objective was to find an optimal schedule and job wise machine speeds which minimized the total sum of costs associated with dissatisfaction of all job completion times and job wise machine speeds. A linear membership function was used to describe the degree of satisfaction with respect to job completion times. Incremental machine speed costs are defined as the cost associated with electrical power and/or labor. A polynomial time algorithm was employed to obtain solutions. Grabot and Geneste (1994) used fuzzy logic to build aggregate dispatch rules in scheduling. The authors recommended that dispatch rules should be combined since individual dispatch rules are often dependent on the selected criterion of performance, the characteristics of the job shop, or the jobs themselves. Ishii and Tada (1995) presented an efficient algorithm for determining non-dominated schedules for the n job single machine scheduling problem when a fuzzy precedence relationship exists between jobs. Roy and Zhang (1996) also developed a fuzzy dynamic scheduling algorithm (FDSA) for the jobs m.

3. QUALITY MANAGEMENT

Glushkovsky and Florescu (1996) described how fuzzy set theory can be applied to quality improvement tools when linguistic data is available. The authors identified three general steps for formalizing linguistic quality characteristics: (i) universal set choosing; (ii) definition and adequate formalization of terms and (iii) relevant linguistic description of the observation.

Examples of the application of fuzzy set theory using linguistic characteristics to Pareto analysis, cause-and-effect diagrams, design of experiments, statistical control charts and process capability studies are demonstrated.

Chakraborty (1992, 1994) addressed the problem of designing single stage, Dodge-Romig lot tolerance percent defective (LTPD) sampling plans, when the lot tolerance percent defective, consumer's risk and incoming quality level are modeled using triangular fuzzy numbers. In the Dodge-Romig scheme, the design of an optimal LTPD sample plan involves solution to a nonlinear integer programming problem. Ohta and Ichihashi (1988) presented a fuzzy design methodology for single stage, two-point attribute sampling plans. An algorithm was presented and example sampling plans were generated when producer's and consumer's risk were defined by triangular fuzzy numbers. The authors did not address how to derive the membership functions for consumer's and producer's risk. Chakraborty (1988, 1994) examined the problem of determining the sample size and critical value of a single sample attribute sampling plan when imprecision exists in the declaration of producer's and consumer's risk. In the 1988 paper, a fuzzy goal programming model and solution procedure were described. Several numerical examples were provided and the sensitivity of the strength of the resulting sampling plans was evaluated. The 1994 paper detailed how possibility theory and triangular fuzzy numbers were used in the single sample plan design problem.

Gutierrez and Carmona (1995) noted that decisions regarding quality were inherently ambiguous and must be resolved based on multiple criteria. Hence, fuzzy multi criteria decision theory provided a suitable framework for modeling quality decisions. The authors demonstrated the fuzzy multiple criteria framework in an automobile manufacturing example consisting of five decision alternatives (purchasing new machinery, workforce training, preventative maintenance, supplier quality and inspection) and four evaluation criteria (reduction of total cost, flexibility, leadtime, and cost of quality).

4. LOCATION AND LAYOUT

Mital et al. (1987) and Mital and Karwowski (1989) applied fuzzy set theory in quantifying eight subjective factors in a case study involving the location of a manufacturing plant. Linguistic descriptors were used to describe qualitative factors in the location decision, such as community attitude, quality of schools, climate, union attitude, nearness to market, police protection, fire protection, and closeness to port. Narasimhan (1979) presented an application of fuzzy set theory to the problem of locating gas stations. Fuzzy ratings were used to describe the relative importance of eleven attributes for a set of three location alternatives. A Delphi-based procedure was applied, and the input of decision makers was used to construct membership functions for three importance weights for judging attributes. Computations were summarized for the selection decision. The author concluded that the procedure presented was congruent to the way people make decisions. The procedure provided a structure for organizing information and a systematic approach to the evaluation of imprecise and unreliable information.

Darzentas (1987) formulated the facility location problem as a fuzzy set partitioning model using integer programming. This model was applicable when the potential facility points were not crisp and can best be described by fuzzy sets. Linear membership functions were employed in the objective function and constraints of the model. The model was illustrated with an example based on three location points and four covers.

Chung and Tcha (1992) addressed the location of public supply-demand distribution systems such as a water supply facility or a waste disposal facility. Typically, the location decision in these environments was made subject to the conflicting goals minimization of expenditures and the preference at each demand site to maximizing the amount supplied. A fuzzy mixed 0- 1

mathematical programming model was formulated to study both uncapacitated and capacitated modeling scenarios. The objective function included the cost of transportation and the fixed cost for satisfying demand at each site. Each cost was represented by a linear membership function. Computational results for twelve sample problems were demonstrated for a solution heuristic based on Erlenkotter's dual-based procedure for the uncapacitated facility location problem. Extension to the capacitated case was limited by issues of computational complexity and computational results were not presented.

Evans et al. (1987) introduced a fuzzy set theory based construction heuristic for solving the block layout design problem. Qualitative layout design inputs of 'closeness' and 'importance' were modeled using linguistic variables. The solution algorithm selected the order of department placement which is manual. The algorithm was demonstrated by determining a layout for a six department metal fabrication shop. Grobelny (1987) incorporated the use of 'linguistic patterns' in solving the facility layout problem. Linguistic patterns were statements, based on the fuzzy aggregated opinions of experts, which can be used as recommendations when solving a layout problem and as criteria for evaluating an existing algorithm. For example, if the flow of materials between departments is high, then the departments should be located close to each other. The linking between the departments and the distance between the departments represent linguistic (fuzzy) variables; the 'high' and 'close' qualifications represent values of the linguistic variables. The evaluation of a layout was measured as the grade of satisfaction as measured by the mean truth value, of each linguistic pattern by the final placement of departments. Both the 1987a and 1987b models were construction type algorithms based on a modification of Hillier and Conner's HC-66 layout algorithm.

Raoot and Rakshit (1993) formulated the problem of evaluating alternative facility layouts as a Multiple Criteria Decision Model (MCDM) employing fuzzy set theory. The formulation addressed the layout problem in which qualitative and quantitative factors were equally important. Linguistic variables were used to capture experts' opinions regarding the primary relationships between departments. Membership functions were selected based on consultation with layout experts. The multiple objectives and constraints of the formulation were expressed as linguistic patterns. The fuzzy MCDM layout algorithm was demonstrated for the layout of an eight department facility.

5. INVENTORY PLANNING

Kacprzyk and Staniewski (1982) addressed the problem of controlling inventory over an infinite planning horizon. An inventory system was represented as a fuzzy system, with the fuzzy inventory level as the output and fuzzy replenishment as the input. Demand and system constraints on replenishment were also fuzzy. An algorithm was presented to find the optimal time-invariant strategy for determining the replenishment to current inventory levels that maximizes the membership function for the decision. The algorithm was demonstrated using a numerical example. Singh and Mohanty (1991) characterized the manufacturing process plan selection problem as a machine routing problem. The routing problem was formulated as a multiple objective network model. Each objective was defined by a fuzzy membership function as a means of capturing the imprecision that exists when defining objectives. A dynamic programming solution procedure identifies the network path representing the best process plan. A dual-objective example was demonstrated for a component part requiring three machining operations. Two of the machining operations can be performed at alternative machining centers, resulting in a network model consisting of six nodes and eight branches. Cost and processing time per component were each represented by triangular fuzzy numbers.

Zhang and Huang (1994) used fuzzy logic to model the process plan selection problem when

objectives are imprecise and conflicting. Fuzzy membership functions were used to evaluate the contribution of competing process plans to shop floor performance objectives. The optimal process plan for each part was determined by the solution of a fuzzy integer programming model. A consolidation procedure, which uses a dissimilarity criterion, then selects the process plan that best utilizes manufacturing resources. The algorithm was demonstrated for a problem consisting of three parts and eight process plans. The algorithm was also tested against non-fuzzy algorithms found in the literature. In some circumstances, more reasonable solutions were achieved as a result of the algorithm's ability to deal with the fuzziness inherent in manufacturing process planning. Lee et al. (1990) introduced the application of fuzzy set theory to lot-sizing in material requirements planning. A modified version of the part-period balancing algorithm was presented. Uncertainty in demand was modeled using triangular fuzzy numbers. A numerical example for an eight period horizon and four sets of demand data was used to demonstrate the algorithm. The authors identified two advantages in using fuzzy numbers and membership functions to model demand. First, fuzzy set theory allowed both the uncertain demand and the subjective judgment of the decision maker to be incorporated into the lot-sizing decision. Second, fuzzy part-period balancing provides a richer source of data for the decision maker to use in terms of the membership values associated with the lot-sizes and costs. Lee et al. (1991) extended their 1990 treatment of the MRP lot sizing to include fuzzy modifications to the Silver-Meal, Wagner-Whitin, and part-period balancing algorithms. The authors argued that when demands of the master schedule are truly fuzzy, demand should be modeled using membership functions. The performance of the three fuzzy lot-sizing algorithms was compared based on nine sample problems.

6. CONCLUSIONS

Soft computing tools are data intensive. Artificial Neural Network, Genetic Algorithm, Fuzzy Logic, Ant-colony Optimization etc. are used widely in engineering and management disciplines. This paper attempted an extensive literature review and survey of fuzzy logic in production and operations management. Throughout the course of this study, it has been observed that (1) fuzzy set theory has been applied to most traditional areas of production management research, and (2) research on fuzzy set theory in production management research has grown in recent years. The appropriateness and contribution of fuzzy set theory to problem solving in production management research may be seen by paralleling its use in operations research. The research compiled in this review came from many journals and books and edited volumes. It also provides a basis for fuzzy set researchers to expand on the tool set for production and operations management problems. Only few topics like job shop scheduling, inventory, layout design, location selection and quality management are considered in this paper, while other topics like time series forecasting, material planning are left for future review.

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