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Information Security and Internet Banking Interface Utility:

Is Information Integrity the Missing Link?

by

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Abstract: Information Security mechanisms have been increasingly considered as prescriptive of adequate utility of the Internet Banking Interface. Although Information Integrity has been considered as propelling the relationship between Information Security and Utility of the Internet Banking Interface much of the evidence remains anecdotal or speculative. In this context, a systematic framework to test the postulated "Information Security-Information Integrity-Internet Banking Interface Utility" chain is proposed. To this end, considering the responses from a sample of retail Internet Banking users, the mediating role of Information Integrity in the Information Security – Internet Banking Interface Utility is empirically tested and substantiated, using Structural Equation Modeling.

Keywords: Internet Banking, Information Security, Information Integrity, Structural Equation Modeling, Utility

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INTRODUCTION

Customers seem to be apprehensive while sharing sensitive information such as credit card or debit card numbers over the Internet. Unless they are convinced that the information they reveal are protected and not misused, they will not try to carry out any financial transaction. Organizations on the other hand, take lot of measures in order to build the confidence of the customers. For instance, banks in India such as ICICI Bank, HDFC Bank have implemented https (hypertext transfer protocol Security) in their Internet Banking Interface, to make transactions more secure in their Interface and build confidence among its customers.

Technological Interfaces provided through the Internet like the Internet Banking Interface are disruptive in nature as they provide an environment of uncertainty as well as new venues of creating value to the customers. Consider an example of a person who wants to transfer some money from personal bank account to a friend's bank account. In traditional brick and mortar model of Banking, the person had to go to the bank to carry out the transaction. The transaction would be realized in front of the Banking official and the person would have got confirmation of the realized transaction. Also the presence of the Banking official would have boosted the confidence of the person. But the traditional model had a constraint on time as the bank will follow stipulated working hours. The person did not have the flexibility of time to carry out the transaction. On the other hand, Internet Banking Interface provides a unique combination of real-time processing and the convenience of location and time. In this model of Banking, the person could carry out transfer of funds instantaneously, without visiting the bank. This could be the value proposition of the Internet Banking Interface. Also various online services such as online ticket purchase, mobile recharge services, and bill payment services could be provided through the Internet Banking Interface.

However, there are risks or uncertainties associated with the Internet Banking Interface. For Instance, during the fund transfer transaction through the Internet Banking Interface, there could be risks of revealing sensitive information.

All the arguments discussed above suggest that Security mechanism is essential for a customer to adopt Internet Banking and derive utility from the same.

However while the organization focus on the different aspects of security, the same priority is not associated with the Integrity of the information. It is safely assumed that the information can be protected from tampering with secure methods of accessing the same. But then the information if not presented to the user in the same form or currency will create a sense of discomfort and distrust even if the security mechanism is fool-proof.

Hence, it is also important to know how customers understand Security mechanism and translate their perceptions about Security mechanisms to perceptions of the Internet Banking Interface utility.

In what follows, the review of literature on Information Security, Information Integrity and Interface Utility is provided and theoretical foundations of the research model are developed. Then hypotheses are presented and tested. The research results and implications are discussed.

LITERATURE REVIEW

Information Security

Perceived Security is defined as a threat that creates an event with the potential to cause economic hardship to data or network resources in the form of destructions, disclosures, modification of data, denial of service and fraud. The security threats may also be classified based on confidentiality, integrity and availability. Information security also refers to the customer's fear that their online transactions are not secure and about the ability to control the way their personal information are gathered and used. Consumer's security fears can be categorized in three ways that is the fear of identity, theft and fraud, negative perception of merchant's security practices and hesitation during the checkout process. It is defined as the subjective probability with which consumers believe that their personal information will not be viewed, stored or manipulated during the transit or compromised.

Information security technique takes a risk management approach that will enable information professionals to contribute to information security management featuring the controls needed to protect information assets against external and internal threats. It is usually regulatory as to reduce criminalization of acts against information security.
Instances of unethical use of IT have become a major security concern. Hacking, spoofing and phishing all fall within the scope of breaching or threatening security.

Information Integrity

Information integrity being defined as the representational faithfulness of information to the true state of the object that the information represents, where representational faithfulness is composed of four essential qualities or core attributes: completeness, timeliness, accuracy and format.

Interface Utility

Fishbein and Ajzen (1975) developed a theory on the relationships between different types of beliefs. The direct experiences with a given object result in the formation of descriptive beliefs about that object. Beliefs that go beyond directly observable events may be called inferential beliefs. At the descriptive end of the continuum, a person's beliefs are directly tied

to the stimulus situation, and at the inferential end, beliefs are formed on the basis of these stimuli as well as residues of the person's past experiences; the continuum may be seen as involving minimal to maximal use of such experiential residues. For instance, when a person tries to carry out a transaction at a particular website, the beliefs regarding the look of the website, the placement of information and the various interaction options found at the website would constitute the person's descriptive beliefs about the website.

Any information technology product has two aspects. They are technology features and quality information. Technology features are the secondary characteristics of technology which enhance the performance of the primary function of the technology (Garvin (1986)).The primary function of information technology is to store, process and deliver quality information . In case of technological Interfaces through the Internet, web site features (Palmar (2002)) and information integrity (Flowerday et al.(2005)) are the two important aspects. Security, privacy, risk and trust were identified as the concerns in adopting transactional websites like Internet Banking in other studies (Pikkarainen et al.(2004), Sun and Han(2002), Tan and Teo(2000)). The Security mechanism suggests the provision of authentication and access control procedures as to provide Security to data and transaction. Information Integrity suggests that the integrity of the information is maintained if the information is accurate, complete, consistent, timely and precise.

According to Zeithmal(1988), value or utility is what the consumer gets(benefits) for what is given(Cost/Sacrifice). Davis (1989) described Usefulness as benefit and Ease of Use as cost while discussing the theory of Cost Benefit Paradigm.

However, Information Security mechanisms seem to be less apparent to the users compared to Information Integrity while deriving utility from the Interface. Information Security mechanisms may also influence Information Integrity as the Security mechanisms ensure that information is not changed by unauthorized access. Moreover, Information integrity may influence the utility of Internet Banking Interface as the direct benefit of the Interface for the user is instantaneous access to updated information about the transactions. This indicates that Information Integrity may be mediator between the Information Security mechanisms and the utility of the Interface which needs to be tested.

Literature gap

There hasn't been a conscious research attention in distinguishing the concept of information security and information integrity .There are different takes on security and integrity from different perspectives.The relationship between information security and value has been not given adequate explanation

THEORETICAL FRAMEWORK AND DEVELOPMENT OF HYPOTHESIS

To achieve these objectives, a research model was developed based on the conceptual framework. . The conceptual framework builds on the systems theory and TAM3 model .

TAM3 model posits that the output Quality is a determinant of perceived usefulness or utility. Systems theory emphasizes on the processes

Research Objectives

1. To distinguish the concepts of information security, information integrity and utility of the system/interface

2. To study the relationship among the concepts of information security, information integrity and utility

Research Hypotheses

According to Bolar (2014), a positive perception is created in the mind of customers when the information provided on the website is accurate, current and well organized as per customer requirement. The customer should be able to get all the information from the website. This argument also finds support from various studies (Venkatesh and Bala (2008), Loiacono et.al (2007), Liao et.al (2006), Venkatesh et al. (2000).

This forms the basis for formulating the following hypotheses

H1: Positive perception about information security positively influence the positive perception about information integrity

H2: Positive perception about information integrity positively influence the positive perception about utility

H3: Positive perception about information security positively influence the positive perception about utility

H4: The influence of security on utility is mediated through information integrity

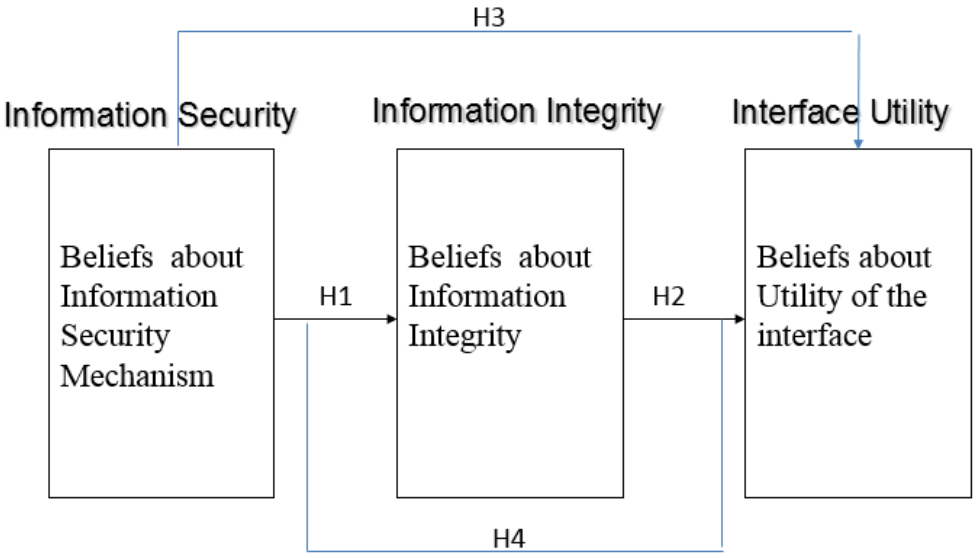

Figure 1 *Research Model*

DATA COLLECTION AND METHODOLOGY

Internet Banking was considered to be information intensive rather than product intensive. This suggested that users were not distracted from the aesthetic element associated with service or product. Also Internet Banking was meant for financial transactions and not for any entertainment purpose. So the technology was inherently utilitarian and not for enjoyment. Only people who were serious about getting the benefits would have used the technology. Hence the study in the context of Internet Banking was considered appropriate

The study was conducted in the context of Internet banking in India. Internet Banking sites could be considered as one of the rising delivery channels for seeking information and conducting transactions. The survey research approach was undertaken. The users of Internet Banking constituted the sampling unit for the survey.

A structured questionnaire was designed for the purpose of collecting information and was administered online. Most of the items on the questionnaire were adapted from past literature.The items for information integrity ,information security and utility was adapted from Bolar (2014), Flowerday and Solmes(2005).

The online questionnaire was developed using Google Docs Form Application Template. The advantage of using Google Docs Form Application Template is that the responses are immediately stored along with a time stamp in a spreadsheet database which can be only accessed by the researcher who developed the questionnaire.

Initially, the link to the questionnaire was emailed to a mailing list of known people. They were also requested to forward the mail to the people whom they know who are using online shopping sites. Again the link to the questionnaire was e-mailed to mailing list provided by known people to whom link was sent initially giving their reference. This type of sampling is called snowball sampling which is often used in case of hidden populations where the

sampling frame does not exist and there is a concern for individual privacy (Heckathorn, 1997).

The content of the mail sent consisted of

1. a brief introduction of the researcher
2. the description of the purpose of the research
3. a request to submit responses at the link of online questionnaire

A mailing list was developed from various forwards of emails sent to the researcher which often contains the list of email addresses of people unknown to the researcher. The content of the email had background information about the researcher, purpose of the mail so that the email was not treated as any forward or any spam mail. Responses were also received offline on the paper-based questionnaire from known Internet users.

Information was received from 262 respondents over a period of four months. The responses were downloaded as an Excel spreadsheet document .The standard scores of all the study variables was calculated for all the 150 respondents .The respondents were filtered to 250 respondents based on standard scores so as to achieve the skewness and kurtosis of each variable within the range of ±2. This was done to remove outliers and achieve distribution close to normal. The profile of the 250 respondents is shown below

Characteristics	Frequency	Percent
Age Group		
>40	20	8.0
18-25	35	14.0
26-30	116	46.4
31-35	57	22.8
36-40	22	8.8
Monthly household income		
Below Rs. 20000	20	8.0
Rs.20000- Rs.30000	54	21.6
Above Rs.30000	176	70.4
Gender		
Female	63	25.2
Male	187	74.8
Years of Experience of using Internet Banking sites		
Less than a year	34	13.6
1-2 years	46	18.4
More than 2 years	170	68.0
Total	250	100.0

From the profile data, it can be inferred that the typical respondent of this survey is a male youth with monthly family income above Rs. 30000 and with more than 2years of Internet banking experience. The respondent had to provide their responses with respect to only one Internet banking site, which they use often.

The questionnaire was developed incorporating the descriptions about the constructs. The questionnaire was pretested at two stages. During the first stage, a pilot study was conducted with a group of doctoral scholars of a university with whom the researcher could interact and discuss the difficulties in answering and overall feedback on the questionnaire design. During the second stage, a quick sort procedure was carried out with two academicians and two industry experts to get consensus on the questions developed and the constructs to which they belong. Ambiguous questions were either removed or reworded. The vagueness of some relevant questions was reduced by supplementing it with additional information and instances.

The format and sequences of items in the questionnaire are suitably modified to reduce the common method bias in responses. Common method bias is systematic measurement error which can happen if the responses are not exactly the true responses of the respondents but due to the way the questionnaire items are sequenced. As discussed in Podsakoff et al. (2003), the problems of social desirability implicit theory and illusory correlations can be sources of common method bias. In this study, the questionnaire layout was developed based on the suggestions given by Podsakoff et al. (2003) such as creating psychological separation between the predictor and the criterion variables. For instance, the questionnaire was divided into four sections namely A, B, C and D. Each section starts with explanation of the section and instructions to the respondents. The respondent cannot answer the questions of a particular section unless all the questions of the preceding section have received responses. However the respondent can go back to an earlier section and make changes in the earlier recorded responses. The layout of the questionnaire thus creates a psychological separation between the items of the predictor and criterion constructs and keeps the focus of the respondent on limited number of questions of a particular theme. This reduces the formation of implicit theory and illusory correlations. Apart from reducing common method bias, the Harmon's single factor test was used to assess common method bias as suggested in Malhotra et al. (2006). According to Harmon's single factor test, when a factor analysis is carried out using the questionnaire items, if a single factor emerges from unrotated factor solution then there is a likelihood of common method bias

DATA ANALYSIS AND INTERPRETATION

Principal Component Analysis with Varimax rotation method was used in obtaining factors The KMO measure of the sampling adequacy is 0.8 and the Bartlett's Test of sphericity is significant justifying the use of principal component analysis as shown in Table 1.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.879
Bartlett's Test of Sphericity	Approx. Chi-Square	1.252E3
	Df	45
	Sig.	.000

As a result, 3 factors were extracted from 10 questionnaire items which explained 72.78 % of total variance. The measure of internal consistency, Coefficient Alpha, was also computed for the items with the given factor. Coefficient Alpha for each of the factors was closer to 0.7 or greater which is acceptable according to the recommendation from Nunnally (1978).

Table 2. *Results of the exploratory factor analysis and reliability analysis*

	Component		
	Information Integrity	Information Security	Interface Utility
Measure of Internal Consistency (Indicator of Convergent Validity) Cronbach Alpha	0.856	0.784	0.845
Construct Reliability	0.864	0.792	0.852
Statements/Items	**Factor Loadings**		
The transaction information is complete.	.808		
The transaction information is accurate.	.793		
The transaction information is up to data.	.788		
The transaction information is consistent.	.714		
I believe that unauthorized access to my account details is not allowed through the Internet Banking Interface		.849	
I believe that my account details are not disclosed to others in any way through Internet Banking Interface		.813	
I believe that my identification is verified while conducting Banking transactions through the Internet Banking interface		.727	
I save a lot of time by conducting banking transactions through the Internet Banking Interface			0.842
I can conduct Banking transactions quickly through the Internet Banking Interface			0.822
I can conduct Banking transactions effectively through the Internet Banking Interface			0.750

Confirmatory factor analysis of Structural Equation Modeling was carried out to verify the measurement model. As shown in Table 3, the data fits the measurement model according to recommendations from Hair *et al.* (2007).

Table 3. *Model fit indices of Measurement and Structural Model*

Model fit Indices	**Recommended Value***	**Measurement/ Structural Model**
Chi-square to degree of freedom ratio (CMIN/df)	**3.000 or below**	1.405
Goodness of fit index (GFI)	**0.900 or above**	0.965
Adjusted goodness of fit index (AGFI)	**0.800 or above**	0.941
Normed fit index (NFI)	**0.900 or above**	0.965
Comparative fit index (CFI)	**0.900 or above**	0.989
Root mean square of error approximate (RMSEA)	**0.070 or below**	0.040

Since the factors obtained represented the constructs in the research model, Confirmatory Factor Analysis (CFA) was carried out to confirm that the items logically and systematically represented the constructs in the research model. AMOS 16.0 Software was used to carry out the CFA. To assess the convergent and discriminant validity of the constructs, the average variance extracted (AVE) by the items within the construct and shown in Table 4. According to Hair et al. (2006),

i. AVE estimates should be 0.5 or greater to suggest adequate convergent validity.
ii. AVE estimates for two factors should be greater than the square of the correlation between the two factors to indicate discriminant validity.

Table 4: AVE and square of correlation

Constructs	Sec	Infi	Util
Sec	0.564		
InfI	0.316	0.616	
Util	0.304	0.517	0.660

Note: Diagonal elements are AVE.; Non-diagonal elements are square of correlation between constructs.

Table 5. *Path Analysis*

Hypothesis	**Paths**	**Standardized Estimates**	**p-value**
H1	**Infi <- Sec**	**0.563**	**0.0000**
H2	**Util <- Infi**	**0.599**	**0.0000**
H3	**Util <- Sec**	**0.233**	**0.0005**

Table 6. *Model fit indices of alternate models*

Model fit Indices	Recommended Value*	When Security and Integrity are single constructs	Only Mediation model	Both Direct and Indirect Path
(CMIN/df)	3.000 or below	5.333	1.599	1.405
(GFI)	0.900 or above	0.860	0.959	0.965
(AGFI)	0.800 or above	0.774	0.933	0.941
(NFI)	0.900 or above	0.857	0.958	0.965
(CFI)	0.900 or above	0.879	0.984	0.989
(RMSEA)	0.070 or below	0.13	0.049	0.040

To test the mediating effect of Information Integrity in the relationship between Information

Security Mechanism and Internet Banking Interface Utility, procedure prescribed Baron and Kenny (1986) was followed. A structural model was constructed for this purpose. According to Baron and Kenny(1986),

- the relationship between the independent variable and the mediating variable should be significant as shown in Table 5a.
- the relationship between the independent variable and the dependent variable should be significant as shown in Table 5b.
- the relationship between the mediating variable and the dependent variable should be significant and the direct relationship between independent variable and the dependent variable will become either insignificant or the influence of the independent variable on the dependent variable is reduced as shown in Table 5c.

Table 7. *Baron and Kenny Approach to test Mediation*

First Equation	Paths	Standardized Estimates	p-value
	Infi <- Sec	0.558	**0.0000**

Second Equation	Paths	Standardized Estimates	p-value
	Util <- Sec	0.550	**0.0000**

Third Equation	Paths	Standardized Estimates	p-value
	Infi <- Sec	0.563	**0.0000**
	Util <- Infi	0.599	**0.0000**
	Util <- Sec	0.233	**0.0005**

Moreover using the Sobel's test for the indirect path, Z statistic = 4.832 is statistically significant at 1% significance level that is the indirect path (mediation path) is significantly different from zero.

According to Zhao et al.(2010), it is suggested that mediation effect holds if the indirect path is significant. Since in this case both direct and indirect paths are significant and in the same direction (positive), the mediation effect is complementary. This indicates that there could be other mediating variables other than Information Integrity in the relationship of Security mechanism and Internet Banking Interface Utility.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be made

- Information Integrity is more important than security mechanism

  Information Integrity mediates the influence of Information Security Mechanism over Internet Banking Interface Utility. This suggests for the designers of the Interface to reflect the reason of any Security mechanism in Information Integrity. This means that the Security mechanisms should be designed in such a way that they all translate

immediately into information quality requirements rather than an island procedure. One possible instance is that the authorization checks to access the account should be different from the authorization check for manipulation. Each step where there is a change in the account details, there should be an ask of authorization or at least a notification.

- Security mechanism should facilitate/enable information integrity else it can create inconvenience

  The techniques of Security mechanisms need not follow only one way. For instance, transfer of funds should ask for the password (which is usually remembered) as well as for the debit card number (which is usually possessed). This will complement the transaction and assure Information Integrity even if transactions are carried out through different ways viz. Internet Banking an Debit Card

- Time-line for updation of records should be met as announced

The following suggestions can be made

- Move Recording Facility with Time Stamp
- On demand display of transaction information for clarifying doubts
- Continuous audit of transactions should take place (Time Stamp should be placed)
- Too many security protocols should be avoided

Finally, as indicated earlier, there could be other mediating variables which need to be identified and tested.

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APPENDIX

Questionnaire items

Information Integrity (Never to Always (1-5) Scale)

1. The transaction information is up to date.
2. The transaction information is accurate.
3. The transaction information is complete.
4. The transaction information is consistent.

Internet Banking Interface Utility (Strongly Disagree to Strongly Agree (1-5) Scale)

1. I can conduct Banking transactions quickly through the Internet Banking Interface.
2. I save a lot of time by conducting Banking transactions through the Internet Banking Interface.
3. I can conduct Banking transactions effectively through the Internet Banking Interface.

Information Security Mechanism(Strongly Disagree to Strongly Agree(1-5) Scale)

1. I believe that my account details are not disclosed to others in any way through the Internet Banking Interface.
2. I believe that unauthorized access to my account details is not allowed through the Internet Banking Interface.
3. I believe that my identification is verified while conducting Banking transactions through the Internet Banking Interface.

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Professional Activities

Kartikeya Bolar has an overall experience of 13 years of teaching and research. Prior to joining TAPMI, he has taught across various B-Schools in the country like IBS Hyderabad and Xavier Institute of Management and Entrepreneurship Bangalore. He was a Visiting Scholar at the College of Business Innovation, University of Toledo, Toledo (OH). He was the best outgoing student of the School of Management, Manipal University.

He has conducted management development programs and workshops.

Programs Conducted:

1. *Workshop on "Structural Equation Modeling: Basics and Advances", 30th September and 1st October,2015.*
2. *ICICI Bank Leadership Program for Executives, May 2015, Sessions on "Technology Leadership"*
3. *Management Development Program for Army Officers in Logistics Management, 8th December – 20th December,2014, Sessions on "Functional Processes", "Reliability Centered Maintenance" and " Quantitative Methods in Logistics".*
4. *Workshop on "Structural Equation Modeling: Basics and Advances", 23rd and 24th September, 2013.*
5. *Workshop on "Multivariate Techniques: Basics and Applications", 27th and 28th June,2013.*
6. *Workshop on "Business Analytics", 17th April, 2013.*
7. *Workshop on "Advanced Structural Equation Modeling", 28th and 29th March, 2013.*
8. *Workshop on "Univariate and Multivariate Techniques: Basics and Applications", 6th ,7th and 8th March,2013.*
9. *Workshop on "Advanced Structural Equation Modeling", 6th and 7th December .2012.*
10. *Workshop on Creative Course Development and Delivery workshop for doctoral research scholars , 28th Feb,2012.*

He has also serves as Editor and Reviewer for Journal of Internet Banking and Commerce (ABDC –C and Scopus listed Journal). http://www.omicsonline.org/editor-profile/Kartikeya_Bolar

Research Areas

E-commerce Diffusion, Data Mining, Business Analytics and Technology Adoption

Publications

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2. *"A Framework of Learning Analytics for Course Design and Training Management", First International Conference on Business Analytics and Intelligence, IIM Bangalore, 11th -13th December, 2013*
3. *"End user acceptance of IT Interface in transaction based environment, Tenth AIMS International Conference, IIM Bangalore, 6th -9th January, 2013*
4. *"Role of IT Interface Characteristics in end user acceptance of IT Interface in transaction based environment", Indian Subcontinent Decision Science Conference, IBS Hyderabad, 28th -29th December,2012*
5. *"Meru Cabs: Past Perfect Present Tense" , International Case Study Conference, IBS Hyderabad, 14th -15th December, 2012*
6. *"Information Security and Internet Banking Interface Utility : Is Information Integrity the missing Link?", International Conference on Business and Finance, IBS Hyderabad, 6th -7th January ,2012*
7. *"Applications of social networking in International Collaboration, Multi-site Research, Knowledge Re-use and Data Configuration Management", International Association for Social Science Information Services and Technology Conference, Cornell University, Ithaca(NY), USA,1st -4th June,2010*
8. *"Acceptance of Disruptive Technologies", Midwest Decision Science Institute Conference, University of Toledo, Toledo(OH),USA, 22nd – 24th April,2010*
9. *"Relating Modularity, Service Quality and Perceived Value", Midwest Decision Science Institute Conference, University of Toledo, Toledo(OH),USA, 22nd – 24th April,2010*
10. *"Validity of Formative Measurements : Review and Insights", Midwest Decision Science Institute Conference, University of Toledo, Toledo(OH),USA, 22nd – 24th April,2010*
11. *"Modeling the public transport system for privatization", International Conference on Operations Research Applications in Infrastructure Development in Conjunction with annual convention of ORSI , Indian Institute of Science Bangalore, 27th -29th December 2005*
12. *"IT infrastructure for Banking Services", National Conference on infrastructure management: Emerging issues, Manipal Institute of Management Manipal, 16th -18th May 2003*
13. *"Firewall –A Network Security Concept", "Brain Wave" – State Level Technical Festival, Manipal Institute of Technology, 20th -21st March 2001*