2012

Estimating Non-Response Bias in a Web-based Survey of Technology Acceptance: A Case Study of Unit Guide Information Systems

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Abstract

Surveys are mostly challenged by response rates. Among the various types of survey research, web-based (internet-based/electronic/online) surveys are commonly used for data collection for a geographically diverse population. In surveys with high/low response rates, non-response bias can be a major concern. While it is not always possible to measure the actual bias due to non-response there are different approaches and techniques that help to identify reasons of non-response bias. The aims of this paper are twofold. (1) To provide an appropriate, interesting and important non-response bias case study for future web-based surveys that will provide guidance to other Information Systems researchers. The case-study concerns an online-survey to evaluate a technology acceptance model for Unit Guide Information systems (UGIS). (2) To discuss how non-response bias in a web-based technology acceptance study of an information system (UGIS in this case) can be contained and managed.

Keywords

Non-Response Bias, Web-based Survey, Response Rate, Wave Analysis, Unit Guide Information System (UGIS).

INTRODUCTION

Non-response is a major challenge facing studies using surveys as a method of data collection. A general view expressed by researchers using survey instruments is that when the survey response rate is considerably high, there is no need to worry about the probability of non-response bias. However, statisticians and other experts in the survey method (e.g. Barriball and While, 1999) recommend that researchers should conduct a non-response bias analysis, regardless of how high or how low the response rate is achieved. Response rates can be influenced by a number of factors, among which the mode of administration (face to face, by phone, by mail, web-based) is most important. A general decline in survey participation rates has been documented over time by business, education, health and IT professionals leading to increased concerns about the recruitment and external validity of surveys with low response rates. If response rates to a survey are low, there are chances that the sample from which data are collected is unrepresentative and bias exists due to non-response. In such cases, external validity of the instrument is threatened and valid conclusions from the data cannot be drawn (Barriball and While 1999).

Among the various types of survey research, web-based (internet-based/electronic/online) surveys are commonly used for data collection for a geographically diverse population. According to Solomon (2001, pp 1) “Web-based surveying is becoming widely used in social science and educational research. The Web offers significant advantages over more traditional survey techniques however: there are still serious methodological challenges with using this approach”. The key benefits of web-based surveys are global reach, low collection and administration costs, huge scope for recruitment, rapid collection times, convenience, increased flexibility of tailoring questionnaires to respondent groups, ease of data entry and analysis, question diversity, ease of follow up and required completion of answers (Berrens et al. 2003; Evans and Mathur 2005; Fleming and Bowden 2009; Marta-Pedroso et al. 2007; Olsen 2009; Parks et al. 2006; Windle and Rolfe 2011). These benefits need to be viewed against limitations.

Currently researchers have concerns regarding the *reliability* and *validity* of web-based surveys. Reliability is the degree to which the instrument (survey) will give the same measurement irrespective of who uses it (i.e. the researcher) or when or where the reading is taken (assuming the quantity of interest does not vary over space and time). The term validity refers to the degree to which a measuring instrument (survey) measures what it is intended to measure. The concerns to researchers are with particular regard to: sample size limitations, privacy, poor response rates, confidentiality, as well as non-response bias (the bias that results when respondents differ in meaningful ways from non-respondents) (Dillman and Bowker 2001; Fleming and Bowden 2009; Marta-Pedroso et al. 2007; Olsen 2009; Shannon et al. 2002; Solomon 2001; Windle and Rolfe 2011). Non-response bias is discussed further in the next section. Hansen et al. (2007) also argue that there is currently little information available on non-response bias in web surveys.

Methods are available for survey researchers to deal with the problem of non-response. While it is not always possible to measure the actual bias due to non-response, there are different approaches, methods, strategies and techniques that help to identify reasons of non-response bias.

Solomon (2001) and Rogelberg and Stanton (2007) suggest techniques such as: personalised email cover letters, publicize the survey, design carefully, provide incentives, manage survey length, follow up reminders, pre notification of intent to survey, monitor survey response, simple survey formats and provide survey feedback to lower non-response rates. Dillman (2000) described these approaches in his so-called Tailored Design Method; a method to maximize both quantity and quality of responses. These approaches are sometimes successful, but none of them guarantee the total absence of non-response.

In our literature review we have identified that there are both psychological and mechanical reasons for low response rates with web-based surveys. Psychological reasons include: people may have forgotten about it; they may be so busy that they do not want to take the time to fill the survey out; some people find surveys a disruption to their personal lives; or the survey is too long. Mechanical reasons may include lack of internet access, concerns with security and data integrity, and technical problems and other reasons of unwillingness or inability to participate in the survey. Given these issues and generally low response rates with self-administered surveys, nonresponse bias is a significant concern and particularly salient for web-based research (Dillman 2000; Hansen et al. 2007). This issue becomes more critical when the research is conducted in the technology acceptance of information systems in the educational domain (given the newness of such systems) where one can expect even lower response rates than from a business, medical or household population. Single figure response rates from industrial surveys are quite common, which force the researchers to struggle for justification of such results (Hikmet and Chen 2003). Low response rates tender the survey results to be unsuitable to derive conclusions that could be representative of the population of concern. Thus, low response rates limit the conduct of a national study in fields (e.g. business, education, health, etc.) where low response rates are expected.

Considering the limitations of web-based surveys together with the complexity of technology acceptance of information systems, achieving high response rates in web-based survey is challenging. Under these conditions the researchers in this field have to demonstrate clearly that the data collected is representative of the general population and the statistical findings can be attributed to the population.

The aims of this paper are twofold:

(1) To provide an appropriate, interesting and important non-response bias case study for future web-based surveys that will provide guidance to other Information Systems researchers. The case-study concerns an online-survey to evaluate a technology acceptance model for Unit Guide Information systems (UGIS).

(2) To discuss how non-response bias in web-based technology acceptance study of an information system (UGIS in this case) can be contained and managed.

The outline of the paper is as follows. First we briefly present background and motivation for our case study. Next we look more at non-response bias and methods to estimate the non-response bias. Then we present our methodology and results followed by conclusion.

BACKGROUND

Unit Guide Information Systems is a new type of information system that is emerging in many Australian Universities. A Unit Guide (UG) outlines the unit content, its learning objectives, assessments and rules governing the teaching and learning in that unit. Additionally they tend to include other components such as teaching staff details and teaching activities and learning resources. They may be known under another name such as course/unit outlines, study guides, course guides, unit plan, course finder, syllabus, learning guide or course/unit catalogue. In addition to capturing and structuring the aforementioned content, a key motivation for UGIS is to support the management of Graduate Attributes (GA) and Curriculum Mapping. *Graduate Attributes* are the qualities, skills and understandings such as communication skills, critical thinking, team work, creativity, ethics and social responsibility. The *curriculum mapping* segment ensures correspondence between learning outcomes (LOs), learning activities (LAs) and assessment tasks across an entire program of study. While most institutions have systems in place to handle UG, use of centralised computer-based UGIS is just emerging.

From the development team's viewpoint, a successful software project is often considered to be one that is within budget and on time. Even if the software meets the specified functional and non-functional requirements and performs well in testing and usability studies, if the software is not accepted by its end users, the original goals of the client will not be achieved. Technology acceptance has been studied for nearly two decades since Davis first proposed the Technology Acceptance Model (TAM) in 1986. Since then, several attitude-intention based theories have been used to explain different technology acceptance scenarios, including the theory of reasoned action (TRA) (Ajzen and Fishbein 1975; Ajzen and Fishbein 1980), the theory of planned behaviour (TPB) (Ajzen 1991), the technology acceptance model (TAM) (Davis 1986; Venkatesh and Davis 1996; Venkatesh and Davis 2000; Venkatesh et al. 2003), the social cognitive theory (SCT) (Compeau and Higgins 1995a; Compeau and Higgins 1995b; Compeau et al. 1999) and model for PC utilization (MPCU) (Thompson et al. 1991; Triandis 1977).

The Theoretical Model

The theoretical basis for our research draws on constructs from (Davis, 1986) TAM (Technology Acceptance Model) and extends it with constructs from Social Cognitive Theory (SCT) (Bandura, 1986) and the Model of PC Utilization (MPCU) (Triandis, 1977). The selection of these constructs was based on characteristics, requirements, issues and other features identified in the literature as relevant to the domain of unit guides and curriculum mapping. We adapted the constructs intention to use, attitude, perceived usefulness and perceived ease of use from TAM; social influence from MPCU and anxiety and self-efficacy from SCT for this study. Table 1 shows the summary of constructs with their code names and definitions.

Table 1: Constructs with their code names and definitions

Construct	Code Name	Definitions
Perceived Usefulness	PU	Refers the degree to which a person believes that using UGIS would enhance his/her job performance.
Perceived Ease of Use	PEOU	Refers to the degree to which a person believes that using UGIS would be free of efforts.
Attitude towards using UGIS	ATT-UGIS	Refers to the individual's positive or negative feelings to use UGIS.
Intention to use UGIS	INT-UGIS	Refers to individual's intention to use UGIS.
UGIS specific Anxiety	UGIS-S-ANX	Refers to the feeling or tendency that is associated with a person's interaction with using the UGIS.
UGIS specific Self-Efficacy	UGIS-S-SE	Refers to the personal confidence in using the UGIS.
Social Influence	SI	Refers to the degree to which a teaching staff/academic/unit convenor perceives that their colleagues, Head of Departments-HODs, Deans believe he/she should use UGIS.

We are interested to understand the factors affecting the acceptance of UGIS, which is salient only in mandatory settings. As a research tool, in order to study the acceptance of UGIS and similar information systems, surveys are a useful tool for assessing the attitudes and intentions of academics (unit convenors for this research). It is often difficult to get a representative sample of busy professionals to participate in a survey research (Hansen et al. 2007) since mail surveys, telephone surveys and face-to-face interviews would be too costly and time consuming (Dillman 1978; Evans and Mathur 2005; Hikmet and Chen 2003). These difficulties are also true for busy academics.

NON-RESPONSE BIAS

One way of reaching more people is through using an online or web-based survey, which is more cost effective compared to other methods of data collection. In this paper, we look at non-response bias in two steps in a web-based survey. First is the amount of non-response and second is the bias. Bias is the difference between a survey estimate and the actual population value (between the respondents and non-respondents).

Respondents' characteristics = population characteristics +/- non-response bias

The above equation is explained as follows, if there is non-response bias (in other words non-response bias is equal to zero) then our sample is representative of the population. Therefore our aim is to minimise non-response bias as much as possible to achieve a representative sample.

Nonresponse bias refers to the bias that exists in the data because respondents to a survey are different from those who did not respond or responded late. The best way to avoid non-response bias is ensure a representative random sample by improving response rates by using methods such as writing an effective cover letter, providing clear instructions to fill the survey, polite/gentle reminders, emphasizing the confidentiality of the material, reducing size of the survey (if possible), incentives, multiple modes of data collection, flexible scheduling, and interviewer training.

Evaluation of the bias is not always possible as the true value of the population or population characteristics are not always known. Wherever a true population value is known, the difference between the value computed from the survey data and the true population value can be considered an estimate of the bias related to the survey estimate.

Definition and Essentials for Non-Response Bias Analysis

The most familiar understanding of non-response is the degree to which a researcher does not succeed in obtaining the responses from all potential respondents included in the sample. Although this is a commonly used and apparently straightforward definition, it is vague and unclear. Cranford et al. (2008) suggest that there are many possible sources of non-response and it is important that these are fully considered by researchers according to their mode of survey administration.

Barriball and While (1999) distinguished between three types of non-response: *Non-coverage*: when the sampling frame omits some units of the survey population either accidentally or deliberately. *Unit non-response*: when no information is collected from a sampled unit due to, for example, refusal or non-contact. *Item non-response*: when the sampled unit agrees to participate in the study but information on all the areas under investigation is not collected because, for example, the sampled unit refuses or is unable to answer a particular question or the researcher fails to ask the question by mistake.

A non-response bias analysis is the process that results in determining the extent of estimated non-response bias, and identification of possible sources of non-response bias on estimates. There are different ways in which non-response bias analyses are useful. Non-response bias analyses serve as indicators of the quality of the data collected, and help to identify potentially biased estimates. Such analyses can help to encourage data users, as well as the organisation/ team collecting and releasing data, of the quality of the data available.

Methods in Literature to Estimate the Non-Response Bias

Non-response bias can be estimated and/or corrected in various ways. For this paper, in Table 2, we have summarised all available methods to estimate the non-response bias from (Rogelberg and Stanton 2007). There is no one conclusive approach, as each approach has its own strengths and limitations.

Table 2: Summary of Non-Response Bias Methods/Techniques

S #	Technique	Overview
1	Archival Analysis	Compare respondents to non-respondents on variables contained in an archival database
2	Follow-up Approach	Resurvey non-respondents
3	Wave Analysis	Compare late respondents to early respondents
4	Passive Non-response Analysis	Examine the relationship between passive nonresponse characteristics and standing on the key survey topics being assessed
5	Interest-level Analysis	Assess the relationship between interest in the survey topic in question and standing on the key survey topics being assessed
6	Active Non-response Analysis	Assess percentage of purposeful, intentional, and a priori nonresponse using interviews
7	Worst-case Resistance	Use simulated data to determine robustness of observed findings and relationships
8	Benchmark Analysis	Use measures with known measurement properties and normative data so that observed data can be cross-referenced
9	Demonstrate Generalizability	Replicate findings, use a different set of research methods

Survey researchers may use a single method or more than one method to examine the effects of non-response bias in their data. The choice of method/technique can affect the magnitude of the non-response bias estimate because each of these methods/techniques rely on a different assumption. The method used for this case study and its underlying assumption is discussed next.

THE CASE STUDY

The data for this study was gathered by a web-based questionnaire survey from thirty nine (39) Australian universities. Within each university, Learning and Teaching Associate Deans and Head of Schools were identified as the contact persons for this study. The Four hundred (400) contact email addresses were obtained from the publicly available university web pages. We used an indirect recruitment method and asked the 400 Learning and Teaching Associate Deans and Head of Schools (they are the channel to reach our sample) to pass on the survey instrument to the academics and unit convenors in their faculties/department. A personalized email to the contact persons were sent explaining the purpose of the study and were asked to distribute the survey within their respective faculties/departments/schools. Each contacted person received a copy of the following documents:

- A Recruiting Email – containing the link to the survey.
- An Information & Consent Form following the survey questions. This explained the nature of the research, and emphasized the confidentiality of their responses.

Our survey consisted of 41 questions that were initially pilot tested. If we did not receive any response from a specific university then we assumed that Learning and Teaching Associate Deans or Head of Schools did not pass on our invitation to their academics. Therefore, we sent three follow up emails to these people and asked them to pass on our invitation to their academics. The survey population was highly educated and probably similar in their computer usage skills. This is important, since research has shown that, in other applications such as web-based personnel recruitment (Hinton 2003), the tendency for internet use depends on access to and capacity to use the technology. Our sample provides a good setting for assessing the kinds of individuals who will choose web based questionnaire completion over a postal survey. The target users of the survey were academics such as Professor, Associate Professor, Senior Lecturer and Lecturer.

METHOD

Web-based Survey Instrument

The survey instrument consisted of an online questionnaire. The questionnaire was designed, developed and administered in Qualtrics (Qualtrics Labs 2009). In the present study, the question items and response categories were designed so as to motivate the respondents to participate in the research study. The researchers made the highest effort to keep the questions simple, easy to read, and unambiguous, thereby enabling the respondent to comprehend the questions easily, reducing their chances to misunderstand the questions, and keeping their interest alive in the survey. The software provider (Qualtrics) also collects survey responses and tabulates the data in spread sheet and summary/report format.

The questionnaire design and development followed a time intensive procedure. It has been developed to take into consideration a number of factors: (1) Utilizing non-technical wording of the questions. (2) Limiting the type of possible responses. (3) Maximizing the response options available. (4) Ensuring the confidentiality of the respondent. Questions were a mix of multiple-choice, rating scale and open-ended formats, and questions were presented in the following sequence: information and consent form, demographic information, UG tool information, UG tool evaluation followed by other considerations about UG tools/templates.

Assumption

The underlying assumption behind this case study is that every subject in the study population has a position on the response continuum that ranges from ‘will never respond’ to ‘will always respond’. Non-respondents will be determined on the side of ‘will never respond’. Subjects who require more reminders before they participate would have been non-respondents if the data collection had finished before they responded. Therefore, late respondents most resemble non-respondents and late respondents can be used as a proxy for non-respondents in estimating non-response bias. This assumption has been called the continuum of resistance model (Lahaut et al. 2003).

Sample and Procedure

For this case study, we have used the Wave Analysis technique to evaluate the non-response bias. We have chosen the Wave Analysis technique because it is: (1) a widely used method (2) inexpensive (3) less time consuming (4) low in data requirements (5) reasonable and coherent within our case study context.

Wave analysis technique is also called the Linear Extrapolation Method (Armstrong and Overton 1977). The extrapolation method is based on the assumption that subjects (persons contacted through the survey) who respond less readily are more like non-respondents. *Less readily* has been defined as answering later. Armstrong and Overton (1977) suggests three different types of extrapolations within the linear extrapolation method such as successive waves, time trends and concurrent waves. The technique that best fits our case study is extrapolation carried over *successive waves* of the questionnaire. Here, *wave* refers to the response generated by a stimulus, e.g., a reminder or a follow-up postcard. Persons who respond in later waves are assumed to have responded because of the increased stimulus and are expected to be similar to non-respondents.

For this case study, there were three mailing periods: Wave 1: the first mailing of the online questionnaire accompanied by an information and consent form; Wave 2: 5 weeks later a reminder was sent to those who had not yet responded and Wave 3: subjects who had not responded in the second wave, received another reminder with the same online questionnaire. The questionnaire in each mailing period used the same questions on acceptance of unit guide tools/templates. The subjects of the study were contacted via email from December 2011 and April 2012. Table 3 shows the three waves of invitations.

Table 3: Summary: Waves of invitations and cumulative responses

Waves	**# of Responses**	**Cumulative Response**
Initial Responses	83	83
Reminder 1	2	85
Reminder 2	99	184
Total	184	184

The number of responses after Reminder 1 is just 2, which are quite close to the initial response period, so we have added the number of responses after reminder 1 to the initial responses. Now, according to our assumption for this study, we have 2 waves on our respondents that is; wave 1 = respondents and wave 2 = late respondents/non-respondents.

Measures and Analysis

The outcome measure of this study was predicting the acceptance of UGIS. Questionnaires/responses received before and after sending Reminder 2 were compared based on three demographic variables: gender (male/female), state (NSW, VIC, QLD, SA, WA, ACT, TAS and NT) and position of the academics (above senior lecturer, senior lecturer, lecturer and below lecturer). Differences in the waves (wave 1 = respondents and wave 2 = late respondents/non-respondents) were analysed. Statistical significance was estimated by Chi-square tests. A p-value less than equal to 0.05 was considered statistically significant.

RESULTS

Response Rates: Demographic Characteristics of the Sample

A total of 184 responses were collected for this case study. After being screened for usability and reliability, 134 responses were found to be complete and usable. To check the sample is representative of the population, we compared gender distribution of our sample to gender distribution of the population. We found that in our data set we had higher proportions of female academics than male academics, where as a sector there are more males than females in academia.

The analysis in Table 4 shows that the proportions of the female and male academics in our survey are statistically significantly different than Australian HE systems as a whole (chi-square = 15.2, degree of freedom = 1, p value = 0.000097).

Table 4: Summary: Gender

Gender	**Survey**	**Australian HE**	**Total**
Female	79	18424	18503
Male	55	25137	25192
Total	134	43561	43695

The following Table 5 shows that the case study sample is representative of the Australian HE institutions based on the academic levels (chi-square = 3.7, degree of freedom = 3, p value = 0.293).

Table 5: Summary: Position of Academics

Position	Survey	Australian HE	Total
Above Senior Lecturer	36	10538	10574
Senior Lecturer	34	10162	10196
Lecturer	43	14441	14484
Below Lecturer	17	8420	8437
Total	130 (Missing Data = 4)	43561	43691

Table 6 shows the proportions of academics from Australian States in our survey are similar to the academics in Australian HE system (chi-square = 13.7, degree of freedom = 7, p value = 0.057).

Table 6: Summary: State wise

State	Survey	Australian HE	Total
NSW	50	13792	13842
VIC	40	11769	11809
QLD	11	7239	7250
WA	10	4209	4219
SA	9	3194	3203
ACT	11	1929	1940
TAS	3	1042	1045
NT	0	387	387
Total	134	43561	43695

Response Rates: By State and Faculty

Table 7 shows the breakdown of the 400 individuals who were sent invitations, showing how many from each state and how many universities in each state were included. In column 4 we have included 2008 numbers of academic persons in each state to get an idea of the total population. Column 5 indicates how many complete responses we received from each state. The overall rate is the number of responses for the state as a percentage of the number of invitations for that state. However, that does not clarify how many responses were the result of one individual passing on the invitation. Faculty responses are the number of faculties within a university and state that had one or more responses. This is an indicator of how many of the original 400 recipients actually passed our survey on. This allows us to calculate the faculty response rate. The final column is the average of the overall and faculty response rates. We see that measuring the response rate using overall or faculty unique responses the response rate is between 34-37% nationally.

Table 7: Summary of Responses by State and Faculty

	State	# of Unis	Contacted	Academic Persons (2008 survey)	Total Responses	Overall Rate	Faculty Responses	Faculty Response Rate	Average Response Rate
1	ACT	2	15	1929	11	73%	4	36%	55%
2	NSW	11	185	13792	50	27%	21	42%	35%
3	NT	1	6	387	0	0%	0	0%	0%
4	QLD	8	40	7293	11	28%	3	27%	27%
5	SA	3	13	3194	9	69%	2	22%	46%
6	TAS	1	6	1042	3	50%	3	100%	75%
7	VIC	8	78	11769	40	51%	13	33%	42%
8	WA	5	57	4209	10	18%	3	30%	24%
	Total	39	400	43615	134	34%	49	37%	35%

We note two factors that may have affected the number of responses received and perhaps account for the large number of unusable/blank responses. Firstly, to recruit lecturers and unit convenors as participants, L&T Associate Deans and Head of Schools acted as a third party to pass on the invitation. Secondly, only a limited number of institutions have deployed UGIS. Part of our goal was to determine just what current UGIS contained. For some institutions/departments, curriculum mapping is achieved via the use of a spreadsheet that is not automatically integrated with the unit guide. Nevertheless, we wanted to capture the technology being used and the features that were currently being offered. We received numerous emails from academics who thought the study was very interesting and important. Some commented that they did not have such a tool but were interested to know more. The 50 individuals who did not complete the study may fall into this category.

Differences between Early Respondents and Late Respondents/Non-respondents

The following Table 8 gives data on the acceptance of unit guide information system between early respondents (wave 1) and late respondents/non-respondents (wave 2) from the study of unit guide information system.

Table 8: Comparison of Early Respondents and Late Respondents/Non-Respondents

	Early Respondents Wave 1 (n= 85)	% of wave 1	Late Respondents Wave 2 (n= 99)	% of wave 2
Gender				
Male	26	30.6	29	29.3
Female	33	38.8	46	46.5
Missing Data	26	30.6	24	24.2
State				
NSW	17	20.0	33	33.3
VIC	18	21.2	22	22.2
QLD	2	2.4	9	9.1
WA	5	5.9	5	5.1
SA	9	10.6	0	0.0
ACT	6	7.1	6	6.1
TAS	2	2.4	1	1.0
NT	0	0.0	0	0.0
Missing Data	26	30.6	23	23.2
Position				
Above Senior Lecturer	22	25.9	14	14.1
Senior lecturer	15	17.6	19	19.2
Lecturer	16	18.8	27	27.3
Below Lecturer	5	5.9	12	12.1
Missing Data	27	31.8	27	27.3

The gender (chi-square = 1.33, degree of freedom = 2, p value = 0.52) and the academic positions (chi-square = 6.92, degree of freedom = 4, p value = 0.14) of the early and late respondents in our survey are not statistically significantly different from each other. For gender and academic positions, the non-participation rate of late respondents was more similar to non-respondents, than to early respondents. Thus, this finding supports ‘the continuum of resistance model’. Although we found a statistically significant difference between the respondents’ states and whether they were an early or late to respondent to the survey (chi-square = 18.53, degree of freedom = 8, p value = 0.02), this result is not reliable since there are 5 cells with expected value of less than 5 and there are four cells with expected value of 5 which makes chi-square results suspicious. When we look at the number closely we observe that the states causing the significant difference are NSW, QLD and SA. More participants from NSW and Queensland responded later than expected and all participants from SA are early respondents. We could conclude that non-response bias was not a major concern in this study.

CONCLUSION

In this paper, we aimed to discuss how non-response bias in a web-based survey for an information system (UGIS in this case) can be contained and managed. To meet the goals, we have used the linear extrapolation/wave analysis technique to evaluate that late respondents to the acceptance of UGIS are more similar to early respondents. Thus, this finding supports our assumption of the continuum of resistance model.

We have also discussed in this paper that in surveys, it is helpful to have high response rates but high response rates do not guarantee low bias in responses. Low response rates magnify even greater the effects of the similarities/differences between respondents and non-respondents/late respondents. Once data have been collected for a survey, the analysis techniques discussed in the paper can help determine data quality and identify loop holes in the data. Non-response bias analyses form an integral part of the overall assessment of the quality of data. Non-response is an important issue in survey research since it can compromise the validity of the data set.

The findings presented in this paper demonstrate that it is possible for researchers to minimize non-response. We propose the following guidelines for the information system researchers to manage the non-response bias in web-based surveys. They should either try to maximize the response rate or completion rate and estimate the effect of non-response. The response rate or completion rates can be maximized by paying special attention to survey distribution plan (publicize the survey, provide incentives), communication plan (pre-notification letter, personalised email cover letters, follow up reminders, thank you notes) and questionnaire design (simple survey formats, length of questionnaire). If still the response rates are low, the information system researchers should estimate the effect of non-response bias by validating the responses regardless of response rate or completion rate. This can be done by analysing for non-response bias using any of the methods/techniques discussed in Table 2.

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