Rogers' Innovation Adoption Attributes: A Systematic Review and Synthesis of Existing Research

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Abstract

A systematic approach is adopted to review the literature, followed by a meta-analysis of articles on Rogers' innovation- attributes. All publications from 1996-2011 are extracted; 226 relevant innovation articles are studied to showcase the informative trends pertaining to Rogers' five attributes - eight features of ideal innovation-attribute study (approach, dependent variable, study type, instrument, measure, attributes, innovations, adopting unit), and antecedents-descendants of Rogers' innovation attributes. These findings, limitations and future research suggestions are presented.

Keywords: Adoption, Innovation, Meta Analysis, Systematic Review, Everett Rogers

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Introduction

Everett M. Rogers first shed light on the *Diffusion of Innovations* theory in 1962. Regarded as the inventor of this theory, he described the process of diffusion to be the communication of an innovation amongst the members of a social system, through certain channels over time (Rogers, 2003). Rogers in his book identified five attributes of innovations – Relative advantage, Compatibility, Complexity, Trialability, and Observability. According to him, the perception of these attributes by the individuals helped in explaining the different rates of adoption. Therefore, it is critical to understand the effects of these attributes as they largely influence the adoption decisions of any innovation. Also, it is important to synthesize the findings from these attributes, as different types of studies from different fields impose a threat of repetition. Redundancy creeps in when many people end up producing similar kind of work. As Rogers (2003) mentions in his book, no more of the similar diffusion research is needed, and the challenge is to move beyond the models of the past to recognize their shortcomings for broadening the conceptions of the diffusion of innovations theory. With this review, we try to explore if this suggestion made by Rogers' was paid any heed, or repetition still continues to prevail in the literary publications on innovations.

Rogers, in introducing the last edition of his book from 2003, mentions that the earlier four revisions of his book, each almost a decade apart, were the turning points in the growth of the diffusion field. With each book, he reviewed the then advances in the field of innovations and their diffusions, and brought to light important revelations on the factors that accelerate or impede the process of diffusion. Given that he is no more, and studies, even today consider the set of attributes introduced by him as an important set of innovation attributes, our study decided to review the usage of these attributes. More importantly, after him, there has been no recent review made on the publications in this field. Thus, with our review, we try to fill this gap by compiling the advances in innovations across different fields that can be used as a quick reference by the scholars across different disciplines.

Mallat et al. (2006) state that the *diffusion of innovations* theory is multidisciplinary theory which has frequent usage in the IS adoption research. Ramdani and Kawalek (2007) state that - it is hard to imagine for the small to medium scale enterprises to operate without some use of IS. They cite various other authors to reiterate that the adoption of IS innovations is one of the most widely studied areas, owing to the fact that IS has become an integral part of almost every aspect of organizational functioning. Venkatesh et al. (2003) emphasize that the increase in information technology and computers in organizations has been dramatic; almost a decade ahead of their study, IT and IS in the last few years have experienced an even more dramatic growth and spread. They further explain to say that for an organization to benefit from increased productivity, such technologies and systems have to be accepted by the employees of the organization. Drawing further from their work, it can be deduced that the growth of IS and IT has been studied using various models and varied conclusions have been derived from such studies. Jasperson et al. (2005) also emphasize on work systems becoming highly IT-enabled. They argue that organizations need to deploy aggressive tactics to encourage the use of IT-enabled work. We extend the same argument to the information systems to reiterate the need to understand the factors that influence the acceptance of such systems. Today's researchers have a choice of variety of models to study various innovations belonging to different disciplines (Venkatesh et al., 2003). Considering how information systems and technologies have become the vital operating elements of today's organizations, the need to explain the user acceptance of new technologies, and the factors influencing the acceptance of such technologies, increases. This in turn calls for reviewing the relevant studies and synthesizing the findings from such already existing literature.

From the managerial perspective, to better steer the diffusion of a given innovation, it is important for the managers to understand the influence of innovation attributes on an innovation. In doing so, it will be impractical for them to run through hundreds of studies on Rogers' attributes. Instead, one study compiling the effects of these attributes, enabling them to compare and contrast the factors affecting their innovation from a similar listed type of innovation, will prove to be very convenient and practical. Our study will serve as a handy reference guide. On the other hand, our review can also be seen to be of use from the researchers' perspective - the new investigators (Ph.D. students, new researchers) from different disciplines, who may not necessarily be well acquainted with the field they are planning on divulging in, may find our review useful; before beginning work, they might want to look at a start point/source to get an overview of the research area of their interest. Literature on different innovations and their diffusion across different disciplines is vast, which needs to be synthesized and compacted to be of quick use in such scenarios. This is where our review should succeed in extending itself as quick guide to assist such investigators in the early stages of their work.

The literature suggests that although there are reviews on the diffusion of innovation theory and the innovation attributes, their scope is quite limited. A few examples of such reviews are as follows - Greenhalgh et al. (2004) address the issue of spreading and sustaining innovations in the health service industry through an extensive systematic review. In addition to Rogers' authoritative review, each of the five attributes are delved into, and explained in further detail on the basis of a review of the then recent empirical studies of service innovations in healthcare. Adams et al. (2006) exploit the literature pertaining to organization's management of innovation processes across seven categories, with no specific attention being paid to the innovation attributes. Another paper reviews previous research on the acceptance of technology based innovation from the inside and outside of the food domain (Ronteltap et al., 2006). The attributes influencing an innovation-adoption are divided into innovation features and consumer characteristics, and studied in detail. However, Rogers' attributes of innovation were not studied as a part of this review. Legare et al. (2008) provide an updated systematic review on the perceptions of health professionals on implementing shared decision making in clinical practice. Rogers' attributes are addressed in terms of barriers and facilitators in implementing the decision making process; Keupp et al. (2011) chose to focus on a systematic review of articles published on systematic management of innovation. They identified the dependent and independent variables employed by the articles that used a quantitative measurement model.

The aforementioned articles are evidences showing, none of the reviews succeed in providing a longitudinal view across each of Rogers' innovation attributes. Our review focuses attention on recognizing the antecedents and descendants of these five innovation attributes. Therefore, the aim of our study is to undertake a systematic review and meta-analysis of the existing literature, in order to collate and synthesize the findings related to each of the five innovation attributes. To help achieve this aim, three key objectives have been formulated. The first being, to identify the antecedents of all five attributes. The second is to identify the dependent variables for every attribute. The last being, to estimate the effect size and significance for each attribute based on conservative averaging.

The following section will provide a detailing on the methodology followed for this review, after which, the subsequent section will focus on the findings from this study. Discussions based on these findings will appear immediately after, followed by the recommendations and conclusions from this systematic review.

Methodology

In order to achieve the proposed aim, a combination of bibliometric analysis and literature review methods, was deemed appropriate for analysing and synthesising findings related to Roger's innovation-adoption attributes. Such methods have been previously utilised to review literature on a number of topics including, expert systems (Watson and Mann, 1988), executive information systems (Friend, 1986), knowledge discovery (Zurada and Karwowski, 2011), knowledge management (Dwivedi et al., 2011) and business model (Joo, 2002). This research follows the similar approach for undertaking review of existing research on the use of innovation-adoption attributes.

Description of the sample used for the current review

This review sought its entire focus on Rogers (2003) theory on diffusion of innovation, and the five innovation attributes recognized by him in his book. The fifth edition of his book was chosen to be the basis point for our review. To conduct this review, it was essential to gather all the studies that had cited this theory in their works. It was considered appropriate to collate all studies citing the latest edition of this book, which was the fifth edition of the book from 2003. However, an interesting observation was made in the course – it was seen that studies citing this fifth edition of Rogers' book also happened to cite the fourth edition of the same book from 1995. This issue was then given a little more attention and it was found that there was no significant difference between the fourth and fifth editions. Studies preferred citing the fourth edition (1995) of this book even after the release of the fifth (2003). Considering this, a decision was made to extract all publications citing Rogers' diffusion of innovation, from the year 1996 onwards until mid of the year 2011 (which is the time when our review began). ISI web of knowledge and Google scholar were the search engines used to extract the publications. As a result of which, 2073 publications were extracted.

Preliminary Screening - The retrieved publications were sorted according to their type. This typically required categorizing them as - journals, articles, conference proceedings, papers, books, HTML, thesis and citations. This was followed by recording the details of each of the publication in an excel format, which was essentially done by listing the titles of individual studies along with their year of publication and author(s) names. For the review purposes, it was necessary to create a database housing all the publications available for download. Only 1365 articles were downloadable. From the statistical perspective, a record of the number of publications citing each of these downloaded publications was also made. With this, the preliminary screening was marked completed.

Secondary Screening - To proceed with the review, it was important to segregate publications that had not only cited Rogers' diffusion of innovations theory, but also mentioned the five innovation-attributes of our interest in their respective works. Performing such a search yielded 1115 publications which had used one or more of these five attributes. The next aim was to study these 1115 papers in detail to examine whether these attributes were essentially utilized as innovation attributes, or had been simply mentioned in the paper. This filtering fetched 177 articles from 126 journals, and 49 proceedings from 18 conferences, resulting in a total of 226 relevant publications to be studied under this review. The methodology has been schematically laid out in figure 1.

Codes and Trends followed in the current review

This review will follow a coding procedure adopted from Tornatzky & Klein's meta-analysis (1982). One coder was assigned for studying and allocating the specific codes for all of the 226 shortlisted publications. Minor changes and additions were made to the original coding

procedure following the authors' discretion. The coding procedure was split across the following categories and the individual studies were scored under each of these categories, which essentially make up the seven features of an ideal innovation study (Tornatzky & Klein, 1982)

(a) *Approach*: Further broken down into three subcategories, the approach used was to distinguish studies as- *Predictive*: the effects of innovation attributes were measured before the targeted population's adoption decision; *Retrospective*: the innovation attributes were measured post the adoption decision of an innovation; *Literature Review*: the innovation attributes were discussed and analysed on the basis of prior studies available in that field of interest; *In-Progress*: only the abstract and methodology have been made available in such publications, and the study has not yet reached completion.
(b) *Nature of dependent variable*: Breaking down into two subcategories, the dependent variable was classified as - *Adoption*: the dependent variable was either accepted, or rejected; *Adoption and Implementation*: the dependent variable measured both, the adoption decision and the post implementation parameter(s).
(c) *Study Type*: Identified under four subcategories, the studies were - *Descriptive*: merely following a model, with no data construction; *Qualitative*: gathering an in-depth understanding of the respondents through interviews/observations/respondents' comments; *Quantitative*: testing of the proposed theoretical model against a statistical or computational technique; *Qualitative & Quantitative*: adopting both qualitative & quantitative procedures for data acquisition.
(d) *Instrument*: These were listed under eight subcategories – Survey, Questionnaire, Secondary Data, Case Study, Theory, Interview, Focus Group, Experiments. Most studies chose to deploy a combination of the here listed instruments.
(e) *Measure*: The assessors of innovation attributes were categorized as - *Decision Makers*: the attributes were assessed by the decisive authorities; *Expert Judges*: the assessment was done by the area experts; *Cost and Profit*: secondary data was used to assess innovation attributes; *Inferred*: the authors used their discretion to arrive at suitable conclusions; *Employees*: the employees of an organization rate attributes; *Consumers/Users*: the consumers or users of a technology provide for the required assessment.
(f) *Number of Attributes*: The number of innovation attributes used in a study.
(g) *Number of Innovation s*: The number of innovations considered in a study.
(h) *Adopting Unit*: The adopters were recognized either as *individuals* or as *organizations*.

Our meta-analysis focuses only on adoption and behavioural intention as the dependent variables, and therefore it was decided to look beyond the use of these two variables, to explore the usage of the other probable dependent variables. In this regard particular attention will be invested towards the IS studies - in identifying the mostly used dependent variables that are explained by any of the five Rogers' attributes in the IS studies; and in also learning about the different types of instruments used in these IS studies. The reliabilities of the instruments used in the IS studies will then be discussed.

Analysis of the findings from the current review

This review will use a meta-analytic approach to synthesize the findings. As Egger (1997) suggests, meta-analysis is that statistical procedure that integrates the findings from various independent studies, to provide for an objective appraisal of the available evidences, while aiding in explaining the heterogeneity between the findings from those independent studies.

The findings will be presented along all features of an ideal innovation study for all of the five innovation attributes. This will help in providing a longitudinal view across these attributes of interest. It will essentially encourage identifying any similarities or differences in the patterns, that these attributes will exhibit across all of the listed features. The antecedents and descendants for each of the innovation attributes will be gathered. The statistical analysis will involve analysing the frequency of usage of these antecedents and descendants for every innovation attribute, along with the beta values and significance levels (p value) associated to each.

Findings

Findings specific to the features identified for an ideal innovation-attribute study

Approach – Table 1 (here) is descriptive of the approach followed in the innovation studies, across the five innovation attributes. As evident from the statistics, a higher proportion of studies across all of the five attributes were retrospective. Most trialability studies were predictive in nature (14.18%). Almost equivalent proportion of the studies for attributes – relative advantage, compatibility and complexity, are predictive.

An illustration of a predictive study is – Dereli et al (2011) propose a buyer-seller collaboration, whereby the customers present their subjective opinion on the Rogersian characteristics via surveys, which is later processed and fused with the old data to arrive at a better estimate of the environment, particularly the value of innovativeness. Another kind of predictive study is that which perceives technology adoption across user groups to provide with a framework for predicting technology adoptions (Jurison, 2002). Their study began with an office integrated system implementation, and ran over a three-year evaluation period. Self-administered questionnaires were used to measure the end user perceptions. Due to the implementation aspect involved, this study cannot be considered predictive in its truest sense. Owing to the fact that the suitability of the system was assessed over the evaluation period and then the management decisions of acquisition and the extent of acquisition were made, this study was concluded *predictive*.

Most relative advantage studies were retrospective by nature (78.24%). To illustrate, Shih (2008) studied how the innovation characteristics significantly affected the continued use of a Chinese online portal. Questionnaires were distributed to the students of a Taiwanese university to delve into the usage patterns and preferred services of the potential users of the portal. The studies that reviewed previous literature could not be segregated into predictive or retrospective categories, and hence were listed separately. A very small percentage of articles accounted for the studies *yet in progress*.

Dependent Variable – Table 2 (here) is representative of preferred dependent variables across innovation studies. Evidently most studies have used adoption as the dependent variable, and the proportion of studies using this variable are almost the same across all the five attributes. An example of this is the study by Lu et al. (2008) on the determinants that influenced the adoption decision of a wireless mobile data service in China. However, a very small percentage of studies chose to deal with the implementation aspect of an innovation. Ovretveit et al. (2007) studied a Swedish healthcare implementation that was achieved within a year to improve the quality through an effective information technology system. They discussed factors that helped and hindered the implementation process, and also the success of that implemented system.

Study Type – Table 3 (here) shows that a large portion of the studies followed a quantitative approach (Damanpour and Schneider, 2009; Jan and Contreras, 2010) in their data collection processes. It is interesting to note that the range of percentages rank similarly across all of the five innovation attributes. Ranking second are the studies that were wholly descriptive in nature (Greenhalgh et al., 2004; Grol et al., 2007). Ranging between 10% and 12% are all studies with a qualitative approach. The least accounting category was a combination of qualitative and quantitative studies.

Instrument – Ranging in similar proportions are the data collection instruments, across all attributes (Table 4 here). *Questionnaires* stand out to be the most preferred instrument, followed by *theory* and *surveys*, respectively. For instance, Carter and Belanger (2005) administered questionnaires to 106 citizens at a concert for an e-government study; Greenhalgh et al. (2004) adopts a theoretical approach to review the diffusion of innovations in service industries, and Klein (2004) uses field study that was adopted using a survey technique to examine the electronic supply chain initiatives adopted by the U.S. medical practices.

Measure – Table 5 (here) is an informative profile of the people who rated the innovation attributes in the individual studies. Statistics reveal that most studies had consumers/users of that innovation to rate the attributes. These studies were mostly those that dealt with the *internet related* or *mobile related* innovations, aiming at an individual adopting unit. Following closely were the authors who chose to infer the usage of these innovation attributes. These studies had a large proportion coming from the innovations such as *IS/IT* and *internet related innovations*, which were mostly aimed at organizations as the adopting units.

Number of Attributes – The statistics in table 6 (here) show that most studies preferred to use about six to nine attributes, and none of the studies led their studies on only one attribute.

Number of Innovations – Table 7 (here) shows that most studies concentrated on a single innovation. The next largest group was of studies that used no particular innovation in their work. This category included works that were either literature reviews or were concentrated upon discussing diffusion in specific sectors/areas (Ramdani and Kawalek, 2007; Chang et al., 2010).

Adopting Unit – Most studies that considered an *organization* to be the adopter unit formed the largest chunk (Table 8 here). Some organizational examples are - E-Government (Carter and Bélanger, 2005), Education (Liao and Lu, 2008), and Healthcare (Grol et al., 2007). Those that chose *individuals* to be adopting unit, formed the next biggest group. For example - Household broadband (Choudrie and Dwivedi, 2004), Mobile services (Lu et al, 2008), and Online shopping (Zhou et al, 2007). The least accounting category that focussed on no adopter unit was mostly made up by the studies that were typically reviews of the existing literature in different fields of interest.

Findings specific to the antecedents and descendants of the five innovation-attributes

Out of the available 226 studies, those studies that provided the binomial probabilities in terms of both, the β values and p-values were identified (Table 9 here). The p-values for all studies, with respect to each attribute, have been aggregated to arrive at an averaged significance level for each. While a great proportion of relative advantage (19.44%) and compatibility (19.11%) studies provided for statistical results of our interest, a very small proportion of the trialability (4.96%) and observability (3.52%) studies presented such results.

After averaging the p-values, they were found to be significant for the relative advantage, compatibility and complexity studies, but insignificant for the trialability and observability studies.

Relative Advantage

According to Rogers (2003) *relative advantage* can be defined as the degree to which an innovation is considered better than the idea that it is superseding. Examples of some IS studies with respect to this attribute have been summarized here – Lee and Kim (2007) study the factors affecting the implementation of internet based information systems; they observed that the staff's appreciation for the relative advantage of the new system had a direct impact on the implementation and performance of that system. Kishore and McLean (2007) in investigating the software reuse infusion posited that relative advantage has a positive influence on the infusion behaviour.

Out of the total 216 relative advantage studies, only 42 studies (Table 9 here) provided for statistical results that were of interest to us. These studies yielded 23 antecedents for relative advantage. The 'C' in the boxes represents the count of how many studies used that boxed attribute as an antecedent or descendant (figure 2 here). There were nine such attributes, whose p-values were not available in the studies that used them, and hence NA was assigned against the p-value for those attributes. Awareness was the only attribute for which the p-value was zero, and also the one with the highest β value of 0.449 among all the antecedents. Except for antecedents falling under these two cases, all the remaining antecedents were found to be statistically significant with relative advantage. While most of the antecedents were used only by one study each, six attributes (Complexity, Compatibility, Perceived Ease of Usefulness, Voluntariness, Image, and Membership) were used by two or more studies. The Rogers' attributes that were present as antecedents to relative advantage were *compatibility* and *complexity*, and *compatibility* also ranked to be the most frequently used antecedent overall, with 7 studies.

To better understand the usage of some of these descendant attributes, we provide the following exemplifications – The distinctions of adoption, implementation and assimilation seeks clarity with Wu and Chuang's (2009) classification scheme which defines the diffusion stages as – (a) *adoption* classified for initiation, comprehension, earliness of adoption, and adoption; (b) *implementation* classified for adaptation, acceptance, and implementation; and (c) *assimilation* classified for routinization, infusion, and assimilation. Some studies prefer to use *adoption* and *adoption intention* as different innovation attributes, where in the true sense they differentiate *adoption intention* i.e. the intention to adopt an innovation from *adoption* i.e. the actual adoption of that innovation (For instance, Liao and Lu, 2008). Similar is the case with *behaviour* and *behavioural intention* being used together. For instance, they are most commonly used in models like *unified theory of acceptance and use of technology* (Venkatesh et al., 2003) and *theory of reasoned action* (Taylor and Todd, 1997).

As evident from figure 2 (here), there were 11 descendents recorded for relative advantage. The p-values of all these descendants render them statistically significant. *Adoption Intention* (21 studies) and *Adoption* (20 studies) were the most frequently used descendents for this innovation attribute. *Adoption Intention* has the highest β value at 0.684. Going by the definition of relative advantage, since it is measured by the degree with which it supersedes an existing idea, this attribute holds much importance in the adoption stage of an innovation diffusion process. This idea is suitably supported by the high β values for both the attributes, adoption (β=0.506) and adoption intention.

Compatibility

Compatibility is defined as the degree to which an innovation is perceived of being consistent with the existing values, past experiences and needs of the potential adopters (Rogers, 2003). This attribute is therefore positively related to any innovation adoption decision. A few IS specific studies discussing this attribute have been summarized here: Huh et al. (2009) study the acceptance behaviour of hotel information systems in upscale hotels, wherein, they conclude that compatibility is a significant predictor of attitude; Slyke et al. (2008) study the risks of scale reuse within the IS field –in discussing compatibility, they state that most IS researchers focussed on that dimension of compatibility which related to the current work style (as defined by Moore and Benbasat).

Figure 3 (here) shows that it has a total of 9 antecedents, all of which are statistically significant except for the *environmental complexity* attribute. The C values indicate that the frequency of usage of all the antecedents is very low, with only a study each using them in their respective works. *Perceived ease of use* has the highest β value of 0.532 and is also significant, which in effect means that it has a fairly strong impact on *Compatibility*.

Compatibility has 15 descendants to it. A good number of attributes were used in two or more studies (Adoption Intention, Adoption, Attitude, Perceived Usefulness, Perceived ease of use, Relative Advantage, Behavioural Intention, Perceived benefits, Complexity, Belief). *Adoption* attribute is nearly significant with a p-value of 0.058. Except for one case, each of NA and zero p-values, the remaining 13 descendants are all significant. It is very interesting to note that the *perceived ease of use* again has the highest β value of 0.694, but this time as a descendant of compatibility. It is also significant with a p-value of 0.023. These numbers to a good extent support the definition of compatibility, as the adopters are more inclined to experience a favourable degree of consistency of a new idea with the existing ideas, only when there is an ease in using or adopting the new idea/innovation. *Adoption Intention* is the most frequently used descendant with 25 studies using it. After *perceived ease of use,* it is this descendant that has the next highest β value at 0.594. *Complexity* was the only Rogers attribute that was present as a descendant to compatibility.

Complexity

Rogers (2003) describe complexity as the degree to which an innovation is considered as difficult to understand and use. The implication that follows is a higher degree of complexity renders an equally higher degree of difficulty in understanding and using any given innovation. Complexity thus becomes negatively related to an innovation adoption decision.
Chang et al. (2010) point that some companies regard a certain degree of perceived complexity as a weapon deterring the rivals; they put up this argument to explain the positive effect of perceived complexity on the inter-organizational systems use. Kelly et al. (2006) in studying an adoption model for the complex network based IS standard, consider complexity in terms of the structural complexity of the system, and the complexity of the technical knowledge required, which overall is posited as a possible barrier to adoption. This innovation attribute has 9 antecedents, all of which are statistically significant. Except for *compatibility,* all others have been used only in one study each. *Product Intelligence* has the highest β value amongst all the antecedents (Figure 4 here).

On the other hand, there are 12 descendants to complexity, two of which are statistically insignificant (Adoption, Attitude). *Implementation* has the highest β value at 0.371. Both

Adoption and *Adoption Intention* are the most frequently used descendants with 15 and 12 studies respectively and also, both have negative β values.

Trialability

Rogers (2003) present trialability as the degree to which new ideas or innovations are experimented for a limited time period. Few IS related illustrations for trialability as an innovation attribute, have been summarized here - Teo and Lim (1996) explore the trialability attribute with respect to both, opportunity and accessibility in trying different PC applications. Turner and Turner (2002) in studying the uptake of computer supported co-operative working found that lack of trialability contributed to the lack of uptake. Figure 5 (here) shows that *perceived ease of use* is only one antecedent to Trialability, which has only been used by a single study. Its β and p-values indicate that it is statistically significant. This innovation attribute has seven descendants, out of which *adoption* is the most frequently used (5 studies), and the only one that is statistically insignificant. *Adoption, Adoption Intention, Behavioural Intention,* and *Attitude* are the descendants that have been utilized in three or more studies. *Perceived Behavioural Control* has the highest β value at 0.483, followed by *Compatibility* at 0.204.

Observability

Rogers (2003) describe observability as the degree to which the results of an innovation become clearly visible to the potential users of that innovation. Ramdani and Kawalek (2007) in reviewing the IS innovations-adoption research mention observability as a component of result demonstrability. Result demonstrability in itself is regarded as an individual innovation attribute, introduced by Moore and Benbasat (1991) for the IS field to study different technological adoptions. Out of the shortlisted studies, it was found that this innovation attribute had zero antecedents, and four descendants. Figure 6 (here) indicates that out of these four attributes, both *adoption* and *adoption intention* were found to have negative beta values and the two were also statistically insignificant. Also, these were the only two attributes that were used in more than two studies. *Behaviour*, although significant, had a negative β value. *Attitude* was the only descendant with a positive β value, and it was also found to be significant.

Discussion

This section aims to discuss the findings from this study across the ideal features, and the antecedents and descendants of Rogers' five innovation attributes.

The ideal features

These seven ideal features (plus one sub feature that was added in our review) have been adopted from Tornatzky and Klein (1982), who provided for a guideline that potentially intended to summarize the problems of the existing literature by attempting to explain the limitations and instability of such research results. This section will discuss the findings from the current review in direct relation to these adopted guidelines.

All of Rogers' five attributes were used mostly in studies that followed a retrospective approach in comparison to the predictive approach. The *relative advantage* studies ranked the highest in this category with 78.24% retrospective studies. Most literature reviews discussed more of o*bservability* (11.26%) and *trialability* (9.92%) in comparison to the remaining three attributes. According to Tornatzky and Klein, an ideal study should be predictive in order to prevent the perceptions of innovation attributes from being based on an innovation's adoption

or rejection decision. They suggest for the measurement of these attributes to be done before the adoption. The findings from this review suggest that a majority of the shortlisted studies do not meet this criterion of an ideal innovation study, as they are mostly *retrospective*.

Again, *adoption* was the most preferred dependent variable, with percentages all above 90% across all of the innovation attributes. *Observability* studies ranked the highest in this category with 94.36%. Tornatzky and Klein state that an ideal study should make a consideration for both adoption and implementation as dependent variables. They reason that the evaluation of the degree of implementation aids in assessing the variability in the behaviour after the actual adoption. Much evidently, our findings indicate that the shortlisted studies fail to comply with this criterion as well, as most studies focus only on *adoption*. It is worthy to mention here that Tornatzky and Klein, in their study only used *instrument* as one of their ideal features, but our study chose to break this feature in two. In order to provide more statistical clarity, our review added another sub feature to *instrument,* which was *study type*. Both these features will be discussed in conjunction here. A greater percentage of the studies were *quantitative* by nature across all of the five attributes. The trend remaining the same across all attributes, the second largest group in this category was that of studies which used a *descriptive* approach. While *compatibility* ranked the highest in studies using quantitative data, mostly *observability* studies were those which were descriptive. Tornatzky and Klein suggest for an ideal study to be made up of quantitative data as this type of data contributes significantly as opposed to the qualitative data or theoretical studies. *Questionnaires* were the most commonly used data collection instrument, with percentages ranging between 30 and 40 across all of the five innovation attributes. After which, with percentages between 20 and 30 were studies which used a theoretical approach in their works. While *relative advantage* ranked the highest with *questionnaires*, *observability* did with *theory*. Most studies in our review were found to have utilized quantitative methods such as questionnaires, surveys, secondary data and the like for their data collection purposes. Thus the findings from our review are completely in line with this criterion of an ideal innovation study.

There is an almost tie between the percentages of studies that used consumers/users of an innovation to rate that innovation, and percentages of studies which had the authors inferring the influence of these innovation attributes of an innovation in question. This case of a tie has been the same across all of the five attributes. While most *relative advantage* and *compatibility* studies had the consumers/users rate the innovation attributes, most *complexity, trialability, and observability* studies were inferred by the authors. According to Tornatzky and Klein, replicable measures of innovation attributes and the data directly collected from the participants were considered more accountable than restricting to only inferring these innovation attributes. This in effect means that this review's findings do not meet this criterion of an ideal innovation study. All five attributes comprised of studies opting to study an innovation alongside other innovation attributes, eventually making up a study comprising of more than these five attributes. Most of these studies included six to nine attributes. *Complexity* studies were highest in this category with almost 49% studies using six to nine attributes. Tornatzky and Klein claim that in order to gain a thorough understanding of an innovation, and to allow for a comparison of the included attributes, an ideal study should essentially incorporate more than one attribute. The findings from this study show that none of the studies across any attribute used only a single attribute in their works, thus rendering this category to align in a complete fit with criterion of an ideal study.

All attributes continued to carry a similar trend with respect to the number of innovations studies as well. More than 85% of the studies across all attributes studied a single innovation.

Contrary to which Tornatzky and Klein suggested that to permit for generalization across multiple innovations, an ideal study should study different innovations at once. Therefore this category fails to meet the requirements of an ideal study. The last ideal feature discusses the adopting unit of any innovation study. Most of our shortlisted studies aimed at organizations as the adopting units of an innovation. This was found to be in accordance with Tornatzky and Klein's idea, which was for an ideal study to be developed in an organizational context, in order to enable the inference of implications for the organizational innovation processes. Out of the seven ideal features, findings from our review complied with three features and varied from the remaining four features that make up an ideal innovation attribute study.

Now moving our attention to the choice of attributes that the studies in the past have made, during our study we traced the following interesting observations – Out of the Rogers' five innovation attributes, two attributes, observability and trialability were the least used. Some of the reasons behind their retarded utilization were found in the following studies: Trialability didn't fit very well as an innovation attribute with some specific studies and was hence regarded irrelevant; for instance, a study in the Egyptian context on the adoption of ISO 9000 standards, reasoned that ISO 9000 was a whole system innovation which could not be pretested in parts (Hashem and Tann, 2007). Same was the case with observability – A study on the adoption of distributed work arrangements (DWA) considered observability as a matter of least concern to the management as the impact of DWA was long term and the extent of their adoption was also very limited; they also eliminated trialability under the reason that DWA entailed considerable organizational restructuring and in that, it was impossible to reverse its effects (Sia et al., 2004). Another study on e-commerce adoption extended an interesting argument for observability being less used; they discussed the probable reason for it to be less used as it being made up of two constructs, visibility and result demonstrability. They continue to explain that the two constructs were contrasting, while result demonstrability dealt with the tangibility and use of an innovation, visibility pertained to the apparentness of the innovation (Slyke et al., 2004). Interestingly, a banking study by Tan and Teo (2000) rendered observability irrelevant in the internet banking scenario, as the critical nature of banking is privacy; they argued that observation of internet banking won't be possible unless a conscious attempt to observe is made. Observability has received considerable criticism in the literature; Tanakinjal et al. (2010) in their study on mobile marketing point out that Moore and Benbasat (1991) argued that observability had been complexly defined by Rogers (1983), and Tornatzky and Klein (1982) emphasized that it was unclear if the definition for observability was referring to cost, or to compatibility.

On the other hand, a few studies reasoned the non-usage of trialability on basis of the level of diffusion of an innovation; for example – Li et al. (2011) explained that the use of their online sales channel was at a level where most of the SMEs were well informed of it being in use by most of their peer organizations. They reiterated Rogers' idea of trialability being of use only where early adopters were present, and peer adopters were not found. Li et al. (2011) successfully justified the presence of many peer adopters in their context and concluded that the aspect of trialability was of no use for their study. Along similar lines, Rijsdijk et al. (2007) in their study on product intelligence, cite Plouffe et al. (2001) to state that observability and trialability were less significant in comparison to Rogers' other three attributes, and also that observability and trialability became insignificant where the consumers with an already gained experience of using an innovation were involved. Apart from the studies that validated the non-inclusion of these attributes, there were also studies that plainly omitted the use of these two attributes, without justifying their omission (Verma et al., 2005; Sooknanan and Melkote, 2006; Suki, 2010).

Another very interesting and important observation made was, many studies chose to cite the meta-analysis by Tornatzky and Klein (1982) to justify their usage of only three of Rogers' attributes out of the total five. The three attributes, relative advantage, compatibility, and complexity were mostly the only attributes that were chosen to be studied. Some examples are – M'Chirgui and Chanel (2006) in their study on the adoption of moneo electronic purse stated that Tornatzky and Klein (1982) confirmed that relative advantage, compatibility and to a lesser extent complexity were the most important predictors of adoption, and hence, they use only these three attributes from Rogers' DOI theory for their study. Another study on public management reforms (Boyne et al., 2005) took a similar stand on these three attributes by making a remark that the meta-analysis by Tornatzky and Klein isolated these three attributes, out of the thirty that they had considered, as the ones having the most consistent statistical relationships with adoption. Lai (1997) went in to make a strong statement that Tornatzky and Klein with their meta-analysis concluded for only these three attributes to be relevant to the adoption-diffusion studies. There were many studies citing Tornatzky and Klein to conclude that these three attributes were consistently related to adoption and use behaviour (Agarwal and Prasad, 1997; Agarwal and Prasad, 1998; Agarwal and Prasad, 2000; Teo and Pok, 2003; Truman et al., 2003; Carter and Belanger, 2004; Alomari et al., 2009). There were also studies that cited many other studies apart from just Tornatzky and Klein to reason for their choice of only studying these three attributes as innovation attributes - Taylor and Todd (1997), for instance, state that innovation literature (which included important citations such as Rogers, 1983; Tornatzky and Klein, 1982; and Davis, 1989) is a proof of the consistent influence of these three attributes on the attitude and adoption behaviours. Yi et al. (2006) in their study on acceptance of IT innovations also cite many studies from the literature (Agarwal and Prasad, 1998) to conclude that these three attributes were the only key innovation characteristics. Along the same lines, Rokhman (2011) took a slightly different view in their study on e-government; they made citations from earlier studies on e-government to state that all the previous e-government studies used these three attributes out of the total five available, and hence their choice of the same three innovation-attributes.

However, there were also studies that used the Tornatzky and Klein's meta-analysis not only to filter from Rogers' attributes, but to conclude on a slightly modified new set, like - Zhu et al. (2006) in their study on the determinants of the post adoption digital transformation for European companies, reasoned that Tornatzky and Klein found relative advantage, compatibility and cost to be the most frequently identified factors to determine the innovation diffusion in organization. They therefore chose to eliminate complexity alongside observability and trialability. Another quick observation made was, when it came to complexity, many studies (Teo and Pok, 2003; M'Chirgui and Chanel, 2006; Kishore and McLean, 2007) very conveniently addressed and studied it as *ease of use* (reasoning for it to be the opposite of complexity).

Meta-Analysis and the Antecedents and Descendants of the five innovation attributes

Our review performed a meta-analysis of the findings from the shortlisted studies, describing the correlation of the five innovation attributes with adoption. We calculated the binomial probabilities to arrive at the significance of the gathered findings across each of these five attributes. While three of these attributes (*relative advantage, compatibility, and complexity*) were found to be statistically significant, two attributes (*trialability and observability*) were found to be statistically insignificant. The antecedents and descendants include both Rogers' attributes and the new attributes associated with Rogers' five attributes. Out of all five

attributes, *relative advantage* had the highest number of antecedents (23). Following close were both *compatibility* and *complexity* with 9 antecedents each. Out of the remaining two attributes, *trialability* had only one, and *observability* had zero antecedents. On the other hand, *compatibility* had the highest number of descendants (16). Following close were *complexity* and *relative advantage* with 12 and 11 descendants respectively. Falling least were *trialability* and *observability* with seven and four descendants respectively. Also, it would be of worth to mention that out of the total 226 shortlisted studies, 225 have used *compatibility* as an innovation attribute in their studies, followed closely by *relative advantage* (216) and *complexity* (209). The total number of studies and number of antecedents and descendants for all attributes suggest that three attributes, *relative advantage, complexity* and *compatibility* are more frequently used or more preferred attributes of study than the remaining two, *trialability* and *observability.*

Considering only Rogers' attributes into account, complexity and compatibility were used as antecedents to *relative advantage* and none as its descendants. Trialability was used as an antecedent to *compatibility* and complexity as its descendant. *Complexity* on the other hand had compatibility as its antecedent and relative advantage as its descendant. *Trialability* had none as its antecedent, but had compatibility as its descendant. Lastly, *observability* had none of the Rogers' attributes as either its antecedents or descendants. Moving our focus to the overall view, in terms of the dependent variables, the following important observations were made – many studies (Boyne et al., 2005; M'Chirgui and Chanel, 2006; Zhu et al., 2006; Hashem and Tann, 2007) chose to study the influence of these five attributes on *adoption as the dependent variable.* There were also instances of many studies choosing to study the effects of Rogers' innovation attributes on *adoption intention as the dependent variable* (Carter and Belanger, 2004; Sia et al., 2004; Slyke et al., 2004). More frequently, the studies focussed on the effect of *innovation attributes on adoption intention*, and then the effect of *adoption intention on the actual adoption*. There are also cases where studies focus on the effect of these *innovation attributes on attitude*, and then study the influence of *attitude on the adoption intention* (some examples are – Agarwal and Prasad, 2000; Vishwanath and Goldhaber, 2003). The effect of complexity and compatibility is also often studied on relative advantage as the dependent variable (Yang et al., 2006).

The β values for the antecedents of *relative advantage* fall in the range of -0.269 (communication) and +0.449 (awareness), and for its descendants in between -0.068 (diffusion) and +0.684 (adoption intention). β values for *compatibility's* antecedents ranged from -0.252 (communication) and +0.532 (PEOU), and its descendants ranged from -0.25 (consumer resistance) and +0.694 (PEOU). It can be seen that *perceived ease of use* has been used both as an antecedent and as a descendant for *compatibility*. *Complexity* has the β values for its antecedents in the range -0.42 (subjective knowledge) and +0.2 (product intelligence). In the case of its descendants, complexity has β between -0.31 (perceived benefits) and +0.792 (reuse intention). With only one antecedent, there can be no range of β values formed for *trialability,* but its descendants fall in the range of -0.146 (attitude) and +0.483 (perceived behavioural control). Similarly, no antecedents for *observability* leave no room for a β value range, but the descendants range between -0.25 (adoption) and +0.021 (attitude).

The antecedents that were used across two or more Rogers' innovation attributes are - product intelligence (3), environmental complexity (3), environmental variability (3), Perceived ease of use (3), communication (2), compatibility (2), capacity (2), data environment (2), development process agility (2), exposure (2), organizational scope (2) and subjective knowledge. The numbers within the braces are indicative of the number of attributes against

which they were used. Similarly the descendants used against multiple Rogers' attributes are – adoption (5), adoption intention (5), behaviour (5), attitude (4), behavioural intention (3), perceived implementation (3), belief (3), consumer satisfaction (3), commitment (2), perceived benefits (2), usefulness (2), assimilation (2), and relative advantage (2).

Dependent variables and Instrument types used in IS studies

Ramdani and Kawalek (2007) review the research on IS innovation-adoption. In their study they cite Rogers (1983) to state that in the IS context, trialability is discarded as a determinant of IS usage. They cite a number of studies to identify relative advantage as the most common characteristic promoting the adoption of IS innovations. They cite even more studies in rendering compatibility and complexity as significant determinants of IS innovations in small business contexts. Studies use *compatibility* as the dependent variable to study the influence of different attributes on this variable – Sia et al. (2004) in studying the operation of distributed work arrangements in complex environments found that complexity had a significant negative impact on compatibility. The same study can be used to give an example for relative advantage as the dependent variable. Complexity also had a negative influence on the relative advantage. Huh et al. (2009) in their study on information systems in hotels found that complexity had a significant effect on relative advantage as the dependent variable. Lee and Kim (2007) studied the influence of various independent variables on *implementation* (dependent variable) of the internet-based information systems. IS studies have also studied the effect of complexity, compatibility and relative advantage on *attitude* (dependent variable) (Agarwal and Prasad, 2000; Huang and Chuang, 2007). Cho and Kim (2001), on the other hand, in their work on object oriented programming languages, studied the influence of the same three Rogers' attributes on *assimilation* (dependent variable). The technology acceptance model is studied in the IS contexts wherein the effect of relative advantage and ease of use (opposite of complexity) are studied on *use* (dependent variable), and the effect of social influence is studied on *relative advantage* and *ease of use* as the dependent variables (Yang and Choi, 2001).

Moving focus to the instruments utilized in such IS studies it was seen that many followed the questionnaire approach. Some examples have been summarized here - Sia et al. (2004) used a seven point likert scale questionnaire - individual items were reliable (higher than 0.5). Composite reliabilities for each construct were also high (higher than 0.9). Average variances for constructs exceeded 80%. Thus the constructs were declared having adequate convergent validity and reliability. Huh et al. (2009) also used a seven point likert scale and had incorporated three competing theoretical models in their study – composite reliabilities were found to be above 0.6, standardized factor loadings on the latent constructs were found to be satisfactory, and finally the confirmatory factor model confirmed a good fit to the data. Huang and Chuang (2007) chose the survey method, where the reliability of their questionnaire was deemed acceptable using assessments from the computed Cronbach's alpha values (0.66-0.87). Cho and Kim (2001) chose to do a field survey by mailing questionnaires to various IS departments; the questionnaire was tested for satisfactory Cronbach's alpha values, which rendered the constructs adequate. Agarwal and Prasad also used the questionnaire survey approach and validated their instrument with Cronbach's alpha values (above 0.7 for all scales). Yang and Choi (2001) used the questionnaire approach in which they assessed the instrument and found it to be reliable. There were also a number of studies that took a theoretical approach for conducting literature reviews and meta-analyses (Turner and Turner, 2002; Kelly et al., 2006; Ramdani and Kawalek, 2007). There were also studies opting for the interview approach, for instance, Lee and Kim (2007) conducted face to face interviews in

their study on internet-based information systems. They also employed the questionnaire approach, where after the factor analysis and deletion of items, the constructs were found to be internally consistent and free of measurement errors. Another study on IS managers' adoption of computing paradigms used the interview approach to arrive at the factors that influenced the IS managers (Bajaj, 1998).

Recommendations, Limitations, and Future Research Directions

The number of antecedents and descendants in total suggest that there is a considerable rise in the attributes that the studies have begun to incorporate, in order to study the diffusion of different types of innovations. It is therefore necessary to have a standard nomenclature in place, which in effect should introduce an element of ease in the review processes and enhance understanding of the utilized innovation attributes. Also, different studies use different terminologies for the same type of attributes. This only introduces redundancy and confusion in this field of literature. Therefore the need for a nomenclature is essential.

In order to better learn these innovation attributes, these innovation attributes should be broken down in accordance with their subjective perceptions. A degree of specificity needs to be introduced to assist in justifying the direction of measurement of these innovation attributes. For instance, if in the case of compatibility – compatible with what, could be specified; of relative advantage – the relativity to what, could be justified; of complexity – complex nature measured for which of the element(s) considered could be answered, and so on. Delving a little more into the sense of usage of these attributes should essentially shed light on a more meaningful relationship between the effects of these attributes and the innovation adoption.

The first limitation comes in with the search results for this review. 2073 publications for Rogers' diffusion of innovations theory were retrieved by the two deployed search engines. The downloadable articles were however restricted to only 1365 articles. This suggests that there were 708 articles which remained excluded from our review because their content was not downloadable. This is to mean that there could be a handful studies out of these 708, which could possibly be relevant to the current review but their unavailability prevented them from being studied under this review. The future research should target all of the potentially relevant studies by overcoming these material accessibility barriers, and avoid all possibilities of missing out on any of the review related studies. This review effectively focussed only on five of Rogers' innovation attributes across the 226 collated studies. The future research should concentrate on exploring and studying the other new attributes used in this field of innovation in relation to the adoption decisions of different adopting units. Increasing the scope beyond Rogers' attributes will also mean that there will be a remarkable increase in the number of studies relevant to the innovation attributes overall. Performing a meta-analysis on such extensive literature should positively aid in acquiring a broader insight into the varied level of influences of the different innovation attributes on an innovation adoption decision.

The meta-analysis for our study was directly adapted from the meat-analysis done by Tornatzky and Klein (1982). In doing so, the dependent variables that were paid attention to, were only behavioural intention and adoption. As identified in the discussion section, numerous IS studies have considered dependent variables other than the two aforementioned dependent variables. The future researchers may want to undertake a meta-analysis, wherein these other dependent variables (assimilation, compatibility, implementation, relative advantage, and so on) are explored and studied.

Conclusions

Summing up, this paper is a contributory effort providing a *systematic review* of the literature available on Rogers' theory of diffusion of innovations, since 1996 until the mid of year 2011. Based on the seven features of an ideal innovation study presented by Tornatzky and Klein's meta-analysis in 1982, a *meta-analysis* of the publications shortlisted for the current review has been undertaken. Each of the five Rogers' innovation attributes are analysed through their antecedents and descendants, collated from the studies relevant to our review. Some of the key conclusions from this review have been compiled in the paragraphs that follow.

Majority of the studies were *retrospective* by nature, concentrating only on the *adoption* of an innovation, with no focus on implementation or the post adoption behavior. Studies preferred using *quantitative* data, mostly from *surveys* and *questionnaires* and *consumers/users* were highly preferred to rate the effects and influences of the innovation attributes. Almost all studies chose to explore *multiple attributes*, with a high proportion of studies considering only *one innovation*, mostly in an *organizational* context.

The binomial probabilities revealed that the averaged p-values showed that relative advantage and compatibility were statistically significant and positively associated to the adoption of an innovation. On the other hand, complexity although statistically significant, was negatively associated to the adoption decision of an innovation. More revelations showed that trialability and observability had a statistically insignificant effect on adoption. In comparison to the other three attributes, a greater percentage of relative advantage and complexity studies presented meaningful statistical estimates. While relative advantage had the maximum number of antecedents, compatibility had the maximum number of descendants. Amongst all the antecedents and descendants across all five attributes, reuse intention had the highest β value of 0.792, and subjective knowledge has the lowest β value of -0.42. Product intelligence, environmental complexity, environmental variability, perceived ease of use, and communication were the most used antecedents of the innovation attributes. Adoption, adoption intention, and behaviour, on the other hand, were the most used descendants of the innovation attributes.

With respect to the IS studies, most of the studies preferred using the questionnaire approach for accumulating the data required for their studies. There were very few studies taking a theoretical approach or opting for interviews. These studies considered many different dependent variables like adoption, intention, attitude, compatibility, relative advantage, implementation, assimilation and others. A very common trend observed amongst these studies was, many of these studies cited Tornatzky and Klein (1982) or others to state that relative advantage, complexity and compatibility are the only three innovation attributes that are consistently related to both, adoption and use behaviour. On the aforementioned basis, most studies chose to eliminate trialability and observability from Rogers' attribute-set of five innovation attributes.

Finally, this review should assist in serving as a quick reference to reflect the prevailing trends of Rogers' five innovation attributes, which have been essentially discussed across eight ideal features, binomial probabilities, and the antecedents and descendants of the different innovation-attributes. The statistically deduced results should aid in providing the future researchers with a well constructed estimate of the past behavior of these five innovation attributes. This should help researchers to learn their behavioral pattern, and also provide for a direction to arrive at a predictive estimate of their probable behavior over time.

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TABLE 1
A PROFILE FOR THE APPROACH FOLLOWED IN INNOVATION STUDIES

Code	**Statistics**				
Approach	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
Predictive	11.57% [25]	11.55% [26]	11.48% [24]	14.18% [20]	12.67% [18]
Retrospective	78.24% [169]	77.33% [174]	77.51% [162]	74.46% [105]	75.35% [107]
Literature Review	7.87% [17]	7% [8]	8.13% [17]	9.92% [14]	11.26% [16]
In-Progress	2.31% [5]	3.11% [7]	2.87% [6]	1.41% [2]	0.7% [1]

TABLE 2
A PROFILE FOR THE DEPENDENT VARIABLES USED IN INNOVATION STUDIES

Code	**Statistics**				
Dependent Variable	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
Adoption	93.05% [201]	93.77% [211]	92.82% [194]	94.32% [133]	94.36% [134]
Adoption & Implementation	6.94% [15]	6.22% [14]	7.17% [15]	5.67% [8]	5.63% [8]

TABLE 3
A PROFILE FOR THE STUDY TYPE FOLLOWED IN INNOVATION STUDIES

Code	**Statistics**				
Study Type	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
Descriptive	29.16% [63]	28.88% [65]	29.18% [61]	34.75% [49]	37.32% [53]
Qualitative	12.5% [27]	10.66% [24]	11.96% [25]	10.63% [15]	11.97% [17]
Quantitative	56.94% [123]	59.55% [134]	57.41% [120]	53.19% [74]	50% [71]
Qualitative &	1.38% [3]	1.33% [3]	1.43% [3]	1.41% [2]	0.7% [1]

Quantitative					

TABLE 4
A PROFILE FOR THE INSTRUMENT USED IN INNOVATION STUDIES

Code	Statistics				
Instrument	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
Survey	16.2% [35]	20% [45]	17.7% [37]	7.021% [24]	14.78% [21]
Questionnaire	38.88% [84]	37.33% [84]	37.32% [78]	33.33% [47]	35.21% [50]
Secondary Data	1.85% [5]	1.77% [4]	1.91% [4]	2.83% [4]	2.81% [4]
Case Study	4.62% [10]	4.44% [10]	4.3% [9]	4.25% [6]	4.22% [6]
Theory	24.53% [53]	24% [54]	24.88% [52]	27.65% [39]	30.98% [54]
Interview	6.94% [15]	5.77% [13]	6.69% [14]	7.09% [10]	5.63% [8]
Focus Group	0.46% [1]	0.44% [1]	0.47% [1]	-	-
Experiments & Questionnaires	0.46% [1]	0.44% [1]	0.47% [1]	0.7% [1]	0.7% [1]
Interviews & Questionnaires	4.62% [10]	4.88% [11]	4.78% [10]	5.67% [8]	4.92% [7]
Interviews & Surveys	0.92% [2]	0.88% [2]	0.95% [2]	1.41% [2]	0.7% [1]
NA	0.46% [1]	0.44% [1]	0.47% [1]	-	-

TABLE 5
A PROFILE FOR THE ASSESSORS USED IN INNOVATION STUDIES

Code	Statistics				
Assessors	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
Decision Makers	6.01% [13]	5.33% [12]	4.78% [10]	4.25% [6]	4.92% [7]
Expert judges	3.7% [8]	4% [9]	4.78% [10]	4.25% [6]	4.22% [6]
Cost & Profit	0.46% [1]	0.44% [1]	0.47% [1]	0.7% [1]	0.7% [1]
Inferred	32.87% [71]	34.22% [77]	37.4% [74]	36.87% [52]	39.43% [56]
Employees	19.9% [43]	19.55% [44]	20.09% [42]	18.43% [26]	16.19% [23]
Employees & Consumers	1.38% [3]	1.33% [3]	0.95% [2]	1.41% [2]	-
Consumers & Users	35.18% [76]	35.55% [80]	33.49% [70]	34.04 [48]	34.5% [49]

TABLE 6
A PROFILE FOR THE NUMBER OF ATTRIBUTES USED IN INNOVATION STUDIES

Code	Statistics				
Number of Attributes	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
One	-	-	-	-	-
Two to Five	30.55% [66]	28.88% [65]	30.58% [63]	35.46% [50]	30.28% [43]
Six to Nine	46.75% [101]	47.55% [107]	48.8% [102]	44.68% [63]	48.59% [69]
Ten or More	21.75% [47]	23.11% [52]	20.57% [43]	19.14% [27]	20.42% [29]
None	0.92% [2]	0.88% [2]	0.47% [1]	0.7% [1]	0.7% [1]

TABLE 7
A PROFILE FOR THE NUMBER OF INNOVATIONS USED IN INNOVATION STUDIES

Code	Statistics				
Number of Innovations	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
One	87.03% [188]	88% [198]	86.6% [181]	88.65% [125]	86.61% [123]
Two to Five	-	-	-	-	-
Six to Nine	-	-	-	-	-
Ten or More	-	-	-	-	-
None	12.96% [28]	12.44% [28]	13.39% [28]	11.34% [16]	7.88% [19]

TABLE 8
A PROFILE FOR THE ADOPTING UNITS USED IN INNOVATION STUDIES

Code	Statistics				
Adopting Unit	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
Individual	29.62% [64]	28.88% [65]	26.31% [55]	27.65% [39]	29.57% [42]
Organization	65.27% [141]	62.22% [149]	67.94% [142]	67.37% [95]	64.78% [92]
None	5.09% [11]	5.33% [12]	5.74% [12]	4.96% [7]	5.63% [8]

TABLE 9
A PROFILE OF STUDIES WITH β VALUES AND SIGNIFICANCE LEVELS

Code	Statistics				
Binomial Probabilities	**Relative Advantage (N=216)**	**Compatibility (N=225)**	**Complexity (N=209)**	**Trialability (N=141)**	**Observability (N=142)**
Number of Studies	19.44% [42]	19.11% [43]	13.87% [29]	4.96% [7]	3.52% [5]
β Value	13.88% [30]	13.77% [31]	10.04% [21]	4.25% [6]	2.81% [4]
p Value	0.021	0.033	0.071	0.26	0.51

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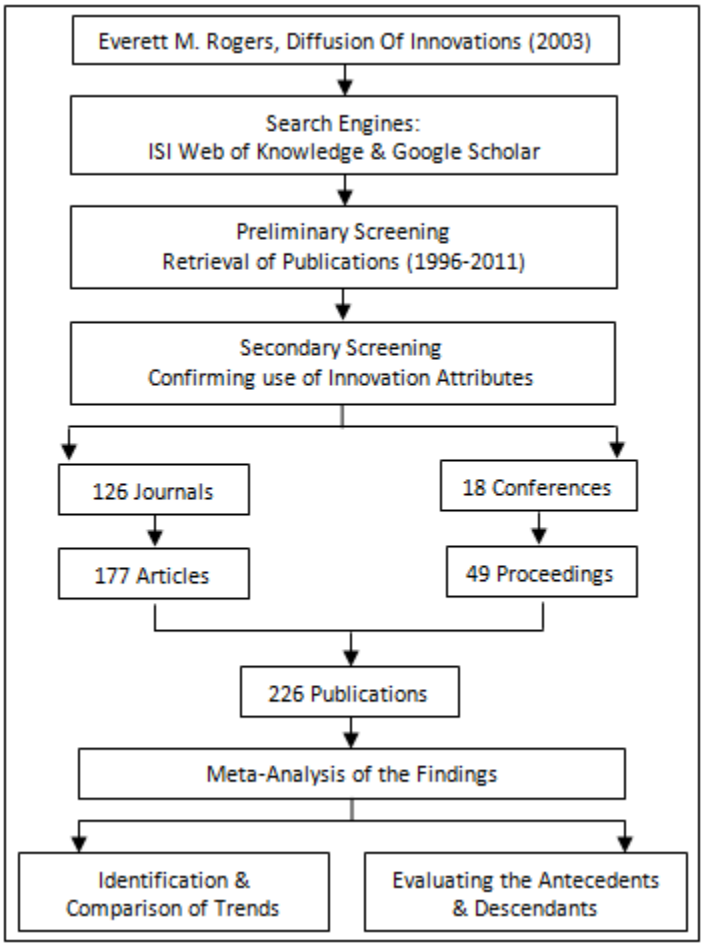

Figure1. Methodology: A Schematic Representation

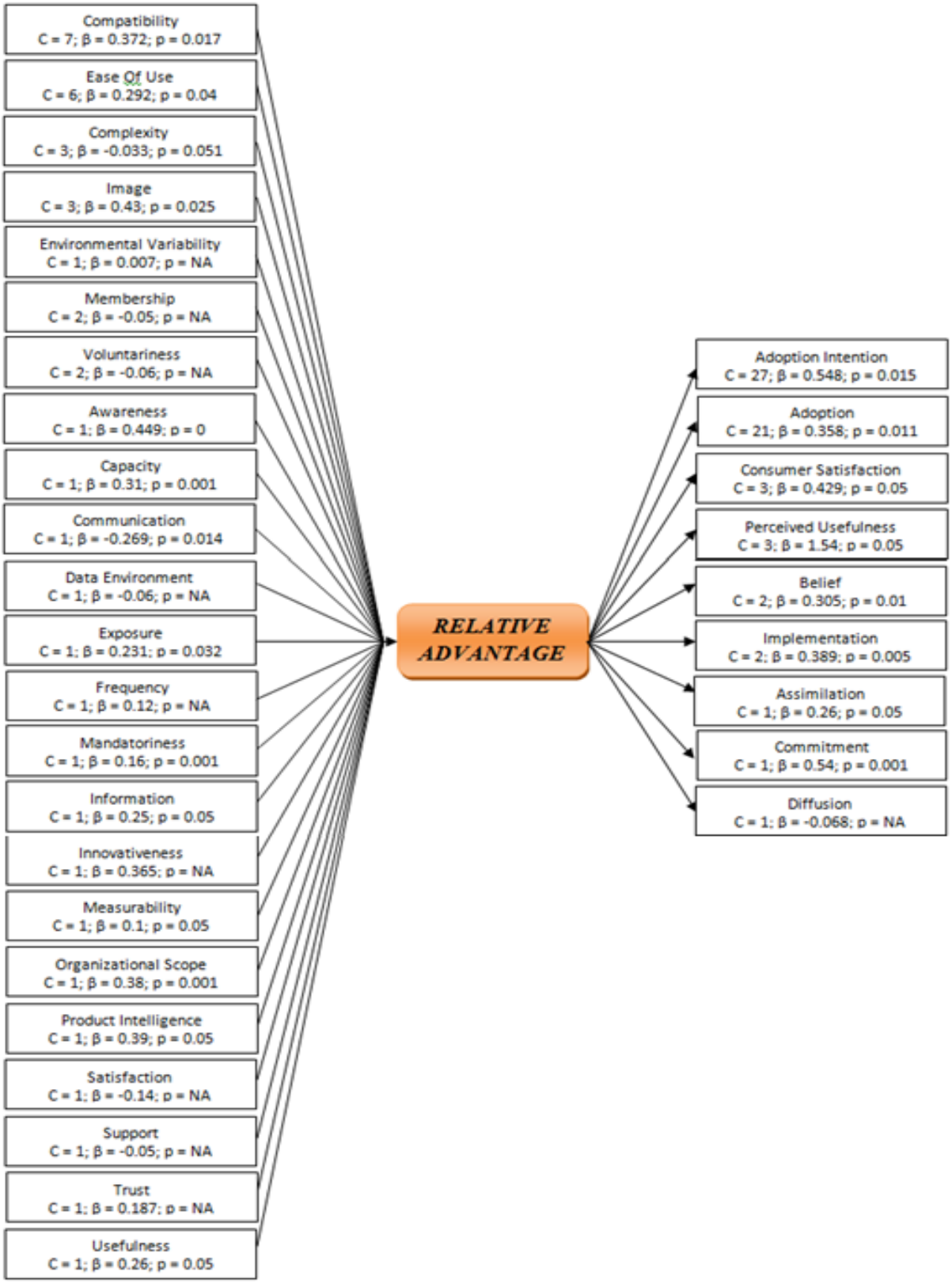

FIG 2: The antecedents and descendants for Relative Advantage

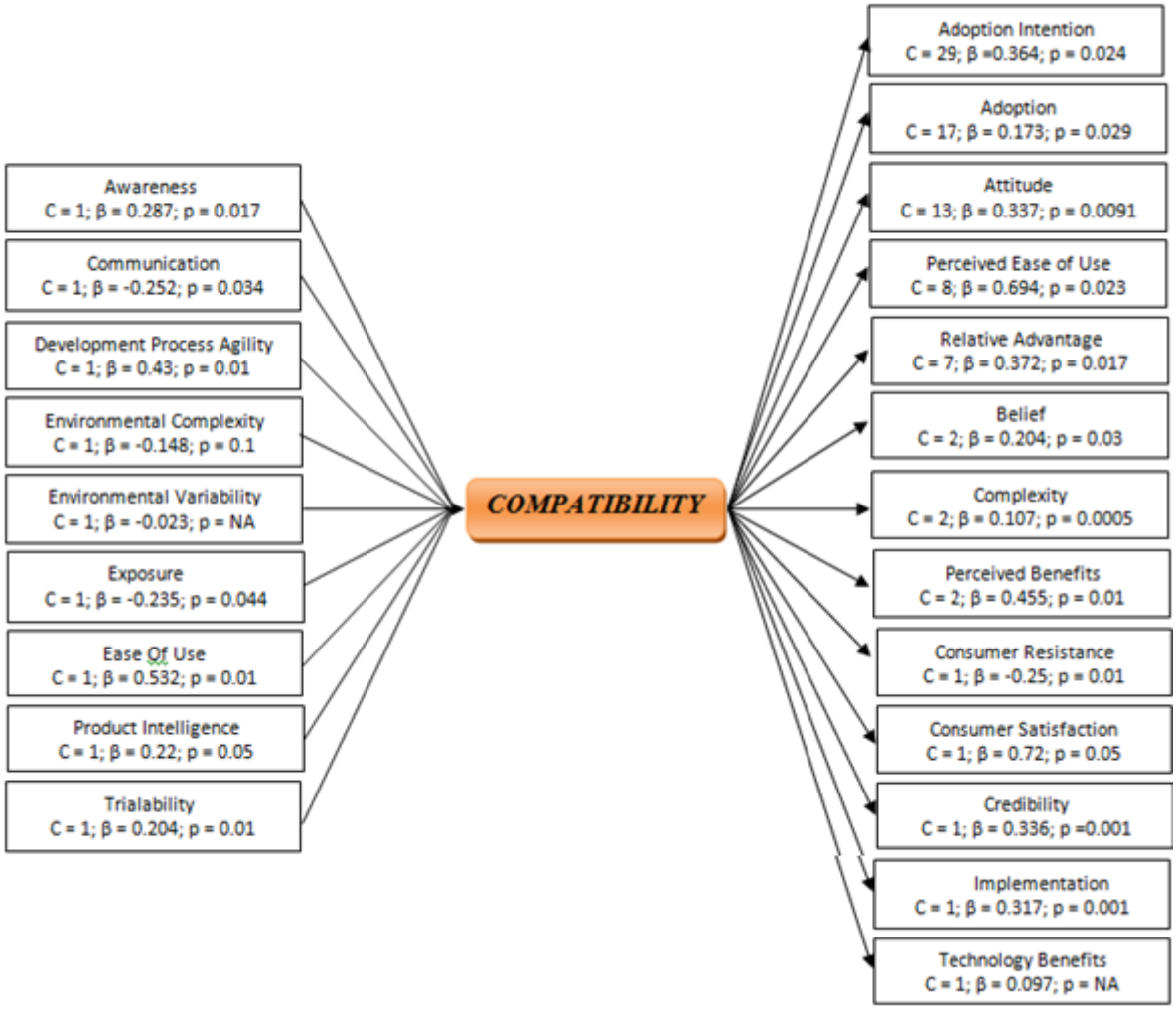

FIG 3: The antecedents and descendants for Compatibility

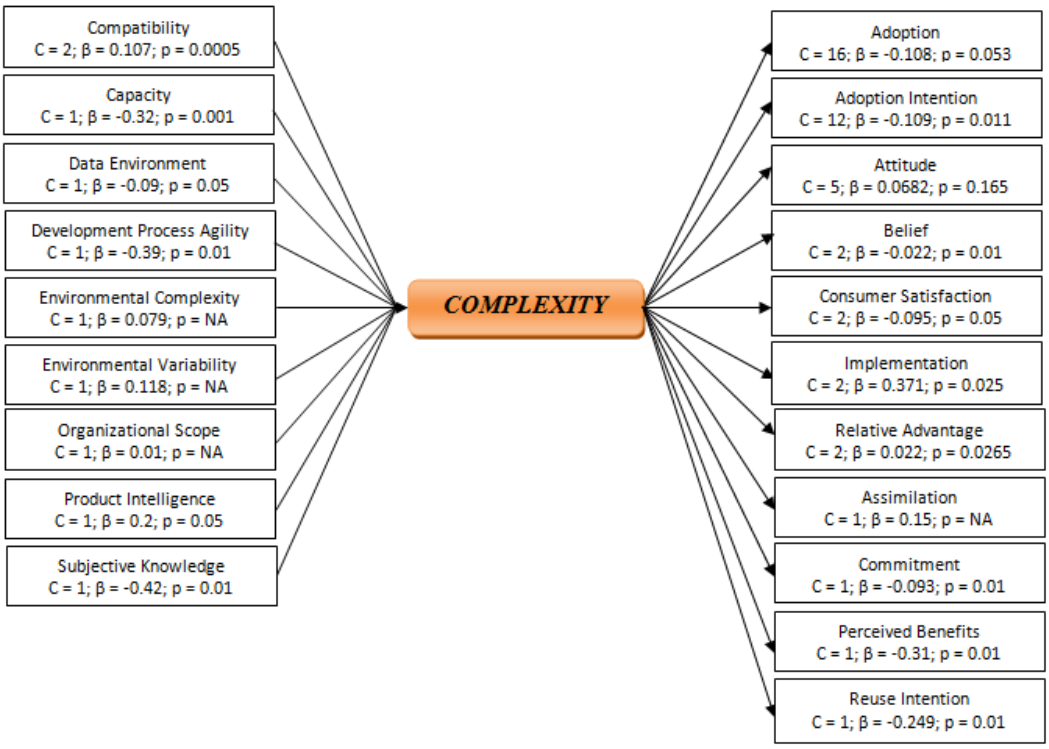

Figure 4: The antecedents and descendants for Complexity

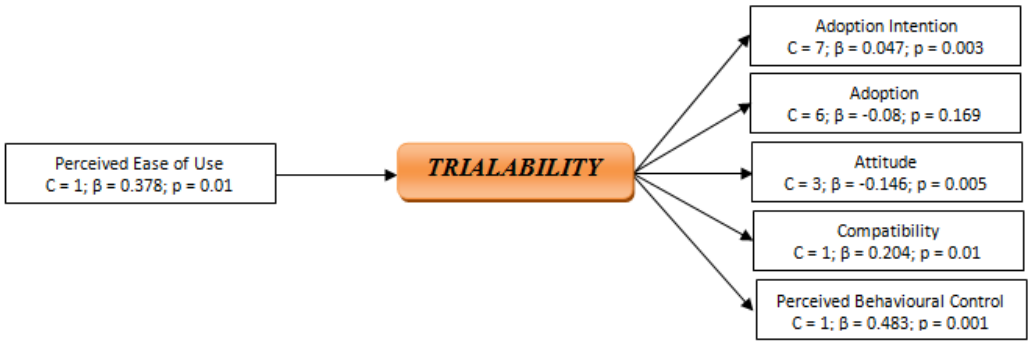

Figure 5: The antecedents and descendants for Trialability

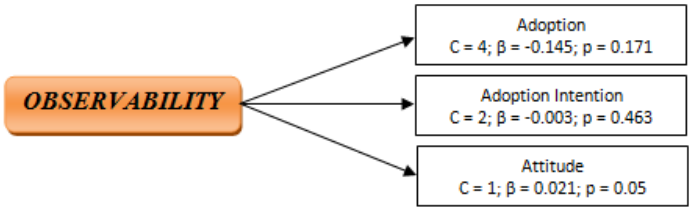

Figure 6: The antecedents and descendants for Observability