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# Intention to use and Adoption of IT Innovations in Organizations: A Meta-Analytic Examination of the Moderating Role of Innovation Type and Socio-Economic Context

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# Intention to use and Adoption of IT Innovations in Organizations: A Meta-Analytic Examination of the Moderating Role of Innovation Type and Socio-Economic Context

*Completed Research Paper*

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## Abstract

*Present paper conducts a meta-analysis of the innovation features that influence the intention to use and adoption of information technology (IT) innovation in the organizations. Previous studies that assessed the influence of innovation features on intention to use and adoption have found inconsistent results and thus created confusion among academicians and practitioners. Present study consolidates the findings of previous studies using meta-analysis to reveal the key factors behind organizations' intention to use and adoption of IT innovations. The study takes a step further by also determining the moderating role of innovation type (product vs. service innovations) and socio-economic context (developing vs. developed countries) on the relationships of innovation features with intention to use and adoption of IT innovations. It also provides multiple insightful theoretical and practical implications.*

**Keywords:** IT innovation, intention to use, adoption, innovation type, socio-economic context

## Introduction

In order to ensure the survival and growth of an organization, it is necessary that significant resources are invested in the innovation of products and processes (Knott, 2012). Various scholars have assessed the impact of Information Technology (IT) innovation on multiple organizational processes, profitability, and consumer satisfaction (Mithas et al., 2012, 2016). Although organizations increasingly enhance their effectiveness and efficiency with the innovations in IT; however, intention to use and adoption of the innovations continue to be their important consideration. Prior literature builds consensus on the impact of innovation features suggested by Rogers' innovation diffusion theory (relative advantage, compatibility, complexity, trialability, and observability) on organizations' intention to use and adoption of the innovation (Sabherwal et al., 2006). Knowledge of these factors and their impact on intention to use and adoption of IT innovation in an organization can help the practitioners to more effectively implement an IT.

## *Diffusion of Innovations Theory*

Diffusion of innovations (DOI) refers to the introduction of new products, technologies, and ideas in an organization (Rogers, 2003). Scholars have frequently used the DOI theory to study the adoption and use of IT innovations, both at individual as well as organizational levels (Moore and Benbasat, 1991; Rogers, 2003). This theoretical framework has been widely tested and applied to study the diffusion of new technologies (Engel et al., 1995). For example, scholars have applied the DOI theory to identify the determinants of adoption of electronic-business (Ilin et al., 2017), Internet marketing (Shaltoni, 2017), accounting information system (Azmi et al., 2016), augmented reality (Chandra and Kumar, 2018), cloud computing (Safari et al., 2015), and social media (Ainin, 2015). Hence, DOI theory has been consistently used in several empirical studies.

The DOI theory does not emphasize on bringing changes in the user organizations. Rather it treats change as the reinvention of idea, behavior or object to meet the emerging needs of the organization. Rogers (1983) revealed five inherent features of an innovation that determine its diffusion. These features are *relative advantage, compatibility, complexity, trialability,* and *observability*. However, there is no consistency in the findings of past empirical studies on IT innovation diffusion. For example, Safari et al. (2015) found complexity not to be a relevant factor affecting the adoption of cloud computing in firms, while Deng et al. (2009)'s study observed that complexity significantly influences the adoption of short messaging services in the organizations. Similarly, Thong (1999) advised not to be much concerned about relative advantage, compatibility, and complexity for the adoption of information systems in small organizations. On the contrary, Deng et al. (2009) and Azmi et al. (2016) recommended to pay special attention to these factors as they found these factors to be significantly relevant.

Although it is not unusual to find mixed results in the domain of social and behavioral science research, the inconsistency in prior results generates confusion among researchers and practitioners regarding the efficacy and relevance of DOI theory, especially in the context intention to use and adoption of IT innovations in organizations. Conflicting findings of single research studies are typically attributable to the uniqueness of context within which these studies are conducted. To overcome this limitation inherent in a single research study, we aimed to conduct a meta-analysis of the impact of five innovation features on intention to use and adoption of IT innovations by the organizations. By carrying out a meta-analysis, we can statistically consolidate the findings of existing studies and offer conclusive evidence regarding the common truth behind them (King and He, 2005).

There are some meta-analytic review studies that have examined the impact of innovation characteristics on the adoption of IT innovation in organizations. For example, Hameed and Counsell (2014) measured the effect of innovation features on the adoption of IT in organizations. Similarly, Weigel et al. (2014) conducted the meta-analysis of a joint framework of antecedents to IT adoption, created by synthesizing the DOI theory and theory of planned behavior. However, these studies did not examine *both* - intention to use and adoption of IT innovations in organizations. *Intention to use* generally indicates perceptions of use intention by organizations that have not yet adopted the innovation. An organization intends to use an innovation if it predicts future use of that innovation (Venkatesh and Davis, 2000), and is an important perceptual consideration for the organizations looking to adopt novel technologies. Prior studies have also reported that potential adoptors' perceptions of use intention are key to understanding the innovation diffusion patterns (Kim et al., 2010; Lu et al., 2011). On the other hand, *adoption* of IT innovations pertains to an organization's decision to use the innovation for the first time. Zmud (1982) defined adoption as the "organizational mandate for change." It is important to examine intention to use as well as adoption of IT innovations as different characteristics of innovation may influence intention to use and adoption differently. A clear understanding of this issue would make the theory more precise. Future research in the field of IT innovations could build on this understanding to anticipate how their choice of dependent variable, i.e., intention to use or adoption of innovation, would contextualize their examinations.

Conflicting findings in prior IT innovation research could also indicate the likelihood of unexplored factors moderating the relationships of innovation features with the intention to use and adoption of IT innovations (see Azmi et al., 2016; Deng et al., 2009; Thong, 1999). For example, service innovations and product innovations (Green et al., 2002, Rubalcaba et al., 2010) may also display varying behaviors in terms of their intention to use and adoption (Deng et al., 2009; Safari et al., 2015). Similarly, adoption of technology is affected by various environmental factors, such as economic context within which an organization exists (Chandra and Kumar, 2018; Hameed and Counsell, 2012; Hameed et al., 2012; Rujirawanich et al., 2011; Zhu et al., 2006). In other words, features of innovation influential in one economic context, may be irrelevant or less influential in a different economic context.

Based on the above-mentioned background, examination of key contingency effects may resolve the inconsistency among prior findings. Hence, we examine the moderating impact of two key contingencies – *innovation type* and *socio-economic situation*. Specifically, we examine if the influence of innovation features on intention to use and adoption varies for different types of IT innovation, i.e., product innovation and service innovation. We also examine if socio-economic condition of the country, represented by the developed versus developing economy, affects the relationships of innovation features with the organizational intention to use and adoption of IT innovations. By conducting this contingency examination, our study would inform both researchers and practitioners about which innovation features that they should focus more on, when examining the intention to use and adoption of a novel IT product versus an IT service in a specific economic context.

Thus, present study makes some unique contributions. First, this study examines the impact of innovation features on two constructs, namely intention to use and adoption. As discussed above, both the constructs are different and hence, features of innovation may have a varying influence on both. Second, it improves the precision of prior findings by investigating the impact of innovation type and socio-economic context as moderating variables. Finally, it updates the timeline of the last meta-analysis on diffusion of IT innovations, which was conducted five years ago (see Weigel et al. 2014). Given the extremely fast pace of technology adoption as well as obsolescence, both the nature and the number of IT innovations has changed in the last few years. Highly complex IT innovations are emerging, and organizations are also becoming more open to adopt them. Given such paradigm shifts, it is imperative to examine the applicability of Roger's (2003) theory to the current innovation landscape.

## Theory and Hypotheses Development

### *Relative Advantage*

Literature explains relative advantage as the degree to which an organization perceives an innovation to be superior to an idea it substitutes. Organizations assess it in terms of economic advantage, convenience, social prestige, satisfaction, or anything that is important for them (Rogers, 2003). Scholars argue that the enhanced relative advantage augments the likelihood of quick implementation of an innovation (Azmi et al., 2016; Deng et al. 2009). However, contrary to the expectation, Thong (1999) found the insignificant impact of relative advantage on the adoption of IT in small businesses. Additionally, researchers claimed that new technology may incur hidden costs associated with its adoption in the organizations. These hidden costs may include costs of implementation, recruitment and re-training of the existing staff, and upgradation of the software and hardware infrastructure to accommodate the innovative technology (Lin and Chen, 2012). Yet, other studies have reported a positive and significant relationship between relative advantage of an innovation and organizational-level intention to use and adopt it (Kasperavičiūtė-Černiauskienė and Serafinas, 2018; Ilin et al., 2017; Ruangkanjanases and Techapoolphol, 2018; Kim et al., 2017). Given the existence of mixed findings in the literature, it would be interesting to explore the influence of relative advantage on intention to use and adoption. Therefore, we propose:

*H1a: Relative advantage of IT innovation has a positive influence on intention to use it.*

*H1b: Relative advantage of IT innovation has a positive influence on its adoption.*

### *Compatibility*

The extent to which an innovation is consistent with the previous experience, values, and the needs of its potential users is referred as compatibility (Rogers, 2003). Organizations usually resist the implementation of an innovation if there is a lack of compatibility of the innovation with the existing systems and processes resulting in hindrance in its usage (Premkumar et al., 1994). Therefore, more an innovation is compatible with the needs and existing practices, it is more likely that organizations will implement it (Rogers, 2003).

There are ample evidences available in the literature supporting a positive and significant relationship between compatibility of multiple types of IT and organizational level intention to use and adopt them (Yuen et al., 2018; Adams et al., 2017; Huang and Hsieh, 2012; Shaltoni, 2017). However, it is worth mentioning that an existing highly compatible IT system may also be perceived to have large capacity for information processing (Wiederhold, 1992). This enhanced degree of existing capacity might negatively affect the intention to use and adoption of the innovation (Wu et la., 2013; O'Callaghan, 1992). There are scholars who reported no significant impact of compatibility on adoption of IT in small organizations (Thong, 1999) and building information modeling in Chinese construction industry (Chen et al. 2019). Further, Wu et al. (2013) found inverse relationship between the compatibility of existing systems and the firm's intention to adopt cloud computing. Thus, based on the mixed findings about the relationship between compatibility and intention to use and adoption of the IT innovation, it is imperative to examine the influence of compatibility on use intention and adoption of IT innovation. We therefore hypothesize:

*H2a: Compatibility of IT innovation has a positive influence on intention to use it.*

*H2b: Compatibility of IT innovation has a positive influence on its adoption.*

### Complexity

Complexity refers to the extent to which an innovation is perceived to be difficult to use and understand. Previous studies establish that complexity negatively influences the adoption of internet usage and it is the opposite of ease of use (Cheung et al., 2001). Ease of use refers to the extent to which organizations perceive the innovation to be easy to understand and operate. An innovation simpler to use and understand, is more likely to be implemented than the ones requiring new skill sets to be developed by the users (Rogers, 2003). Thus, there exists a negative but significant relationship between complexity of IT systems and organizational level intention to use and adopt them (Henderson et al., 2012; Christou, 2010; Azmi et al., 2016). At the same time, scholars reported no significant impact of complexity on the adoption of e-procurement in small and medium enterprises (Hassan et al., 2017), internet marketing in emerging industrial markets (Shaltoni, 2017), and cloud computing in small and medium enterprises (Safari et al., 2015). Therefore, it would be interesting and useful to examine the impact of complexity on intention to use and adoption of IT innovation. Hence, we hypothesize:

*H3a: Complexity of IT innovation has a negative influence on intention to use it.*

*H3b: Complexity of IT innovation has a negative influence on its adoption.*

### Trialability

Trialability refers to the extent to which an innovation can be tried out by the user organization on a limited basis. Every innovative technology poses some uncertainty which impacts its implementation rate (Ramdani et al., 2013). Trialability enables the prospective adopters to lessen the perceived risk arising as a result of using an innovation. It is a means for them to lower the uncertainty they feel toward an unfamiliar technology (Rogers, 2003). Gallaugher and Wang (2002) discovered that the accessibility of the trial versions augments the market value of a product which further smoothens its adoption. Several previous studies discovered a positive and significant relationship between trialability of multiple types of IT and organization level intention to use and adoption of IT innovation (Ismail, 2012; Chauhan et al. 2018; Setiowati et al., 2015). However, some past studies argued that trialability does not have any significant impact on intention to use and adopt IT innovations (Premkumar et al., 1994; Tornatzky and Klein, 1982). Although it seems that the organizations perceiving IT to be trialable are more likely to have intention to use and adopt it, however inconsistent results of existing studies motivate us to test the relationship of this innovation feature with the intention to use and adoption. Therefore, we hypothesize:

*H4a: Trialability of IT innovation has a positive influence on intention to use it.*

*H4b: Trialability of IT innovation has a positive influence on its adoption.*

### Observability

Observability is the extent to which the results of an innovation are visible to others. It is more likely that organizations will implement the innovation if its outcomes are more visible because it reduces the uncertainty. Observability stimulates peer discussions of new ideas facilitating the implementation of innovation in the organizations (Rogers, 2003). It enhances the relative exposure of an innovation (Cheng and Cho, 2010). Scholars have noticed that when a specific IT is in extensive use and is more observable, organizations tend to have intention to use it and actually using it (Hasani et al., 2017; Shah Alam et al., 2018; Jamshidi and Hussin, 2018). Previous studies combining technology acceptance and DOI perspectives also claim that when the employees of an organization observe a technology to be easier, they perceive it easier to use (Huang 2004; Yang, 2007), however they may still perceive it to be less useful in facilitating their job performances in the organization (Lee et al., 2011). Contrary to the claims of previous studies, some scholars argue that observability can be treated as an external factor which may not always influence the adoption of technology because after the initial adoption, the effects of observability could be diminished with the continuous experience and get reduced over time (Karahanna et al., 1999). Therefore, there are mixed results provided by the literature about the influence of observability on intention to use and adoption of innovation. Hence, we hypothesize:

*H5a: Observability of IT innovation has a positive influence on intention to use it.*

*H5b: Observability of IT innovation has a positive influence on its adoption.*

## *Moderating Effects*

There are clear indications in previous research that effect of different innovation features may vary across different contexts. To ascertain key contextual variables, we reviewed relevant innovation literature, and studies included in our meta-analysis. Based on these two groups of literature, we identified innovation type and socio-economic context as two contingencies that could significantly moderate the relationships of innovation features with an organization's intention to use and adoption of IT innovations (Agrawal and Prasad 1997, Damanpour 1991, Gunday et al. 2011, Lee et al. 2011).

### Innovation Type

Prior literature distinguishes between different types of innovation including products and services (Gunday et al., 2011; Oke, 2007). Researchers have argued that it is important to consider different types of innovation when examining innovation adoption by organizations (Downs and Mohr, 1976; Rowe and Boise, 1974). Almost two decades ago, Damanpour (1991) reported the type of innovation to be insignificant as a moderator of determinants-innovation adoption relationship in a meta-analytical study. The authors examined product and process innovation; however, they did not differentiate between product and service innovation since service innovation has been traditionally grouped with product innovation. As service industry has grown and firms have added a service component to their operations, researchers have advocated that product and service innovations should be treated distinctly due to some fundamental differences between the two (Durst et al., 2015; Nijssen et al., 2006; Rubalca et al., 2010). Service innovations are characterized by intangibility and lower visibility compared to product innovations (Green et al., 2002, Rubalcaba et al., 2010). Such differences between product and service innovations may moderate the relationship of innovation features with the intention to use and adoption of IT innovation. Literature review reflects that product innovations have a better rate of adoption and speed as compared to service innovation because product innovations are considered to be relatively more observable and advantageous as compared to service innovations (Damanpour and Gopalakrishnan, 2001). For that reason, the relative advantage of an innovative IT product may be perceived differently compared to the relative advantage of a IT service innovation, resulting in different behaviors for intention to use and adoption. Similarly, innovative IT products may seem more triable compared to IT service innovations. Thus, we hypothesize:

*H6a: Innovation type will moderate the relationship between relative advantage and intention to use, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6b: Innovation type will moderate the relationship between relative advantage and adoption, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6c: Innovation type will moderate the relationship between compatibility and intention to use, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6d: Innovation type will moderate the relationship between compatibility and adoption, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6e: Innovation type will moderate the relationship between complexity and intention to use, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6f: Innovation type will moderate the relationship between complexity and adoption, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6g: Innovation type will moderate the relationship between trialability and intention to use, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6h: Innovation type will moderate the relationship between trialability and adoption, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6i: Innovation type will moderate the relationship between observability and intention to use, such that the relationship will be stronger for product innovations as compared to service innovations.*

*H6j: Innovation type will moderate the relationship between observability and adoption, such that the relationship will be stronger for product innovations as compared to service innovations.*

## Socio-Economic Context

Organizations are embedded within a specific socio-economic context (Zhu et al. 2006), the attributes of which can significantly affect the diffusion of IT innovation in a firm (Hameed and Counsell, 2014). For example, several external environmental factors such as consumer readiness, government support, and vendor support have been known to influence the adoption of IT innovation in organizations (Chandra and Kumar, 2018; Hameed and Counsell, 2012; Hameed et al., 2012). Given that IT innovations require significant investments, financial resources, and technological infrastructure, another factor that could affect diffusion of innovations is the economic context within which an organization is embedded (Rujirawanich et al., 2011).

Researchers have also advocated the examination of IT adoption and usage across national contexts to account for different socio-economic situations (Zhu and Kraemer, 2005; Zhu et al., 2006). Galindo and Mendez (2013) examined innovation and growth in developed countries and reported that monetary policy and social climate influence innovation. In another study, Zhu et al. (2006) applied the technology-organization-environment framework to examine how national economic environment influences diffusion of electronic-business innovations. The authors affirmed that the economic factors demand special attention in examining innovation diffusion. Similarly, Zhu and Kraemer (2005, p. 71) stated that "diffusion occurs unevenly across countries with different environments" and "the extent of diffusion depends on a variety of economic, social, and political factors."

Drawing upon the existing body of research, we argue that the relationship of innovation features with the intention to use and adoption of IT innovation will differ across socio-economic contexts. Literature review suggests that technology readiness is a stronger factor in developing economies versus developed economies. On that basis, it seems evident that relationship between innovation features and adoption will be stronger for developing economies (Zhu et al., 2006). To examine these contingency effects, we compare the hypothesized relationships across developing and developed countries, which are known to have significantly different socio-economic dynamics (WESP 2014). Hence, we propose:

*H7a: Socio-economic situation will moderate the relationship between relative advantage and intention to use, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7b: Socio-economic situation will moderate the relationship between relative advantage and adoption, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7c: Socio-economic situation will moderate the relationship between compatibility and intention to use, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7d: Socio-economic situation will moderate the relationship between compatibility and adoption, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7e: Socio-economic situation will moderate the relationship between complexity and intention to use, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7f: Socio-economic situation will moderate the relationship between complexity and adoption, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7g: Socio-economic situation will moderate the relationship between trialability and intention to use, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7h: Socio-economic situation will moderate the relationship between trialability and adoption, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7i: Socio-economic situation will moderate the relationship between observability and intention to use, such that the relationship will be stronger for developing countries as compared to developed countries.*

*H7j: Socio-economic situation will moderate the relationship between observability and adoption, such that the relationship will be stronger for developing countries as compared to developed countries.*

## Research Methodology

Research papers were mined from the prominent online databases, namely Scopus, ScienceDirect, EBSCO, Emerald, Google Scholar, SAGE, Taylor & Francis, and Web of Science. Search terms used for the extraction of research papers were "Diffusion of innovation," "adoption," "intention to use," "relative advantage," "compatibility," "complexity," "trialability," and "observability." The search resulted in the mining of a little over 3200 papers.

In the next step, mined research papers were manually screened based on their title and keywords so that apparently irrelevant research papers are removed. As a result, commentary, prefaces, duplicate, editorials, news, non-English, and review articles were filtered out. Thus, a total of 1765 research papers were left for further filtration.

Later, two researchers independently went through the abstracts of filtered research papers. It led to the elimination of qualitative papers, experimental papers, and the papers that were not principally focussed on the adoption and intention to use the IT innovation in organizations. A third researcher verified the elimination of each paper to make sure that only irrelevant papers were removed. Thus, a total of 165 research papers qualified this round.

Next, the full text of all the filtered research papers was read by two researchers to ensure: 1) the paper should have quantitatively assessed the relationship of at least one innovation feature with the intention to use and adoption of IT innovation, 2) the paper should have stated either correlation coefficient or another statistic (e.g., F-ratio and Student's t) that could be transformed into the correlation coefficient, and 3) the paper should have stated the sample size.

Thus, a total of 30 papers were shortlisted. The descriptive information such as authors, title, paper source, publication year, country, sample size, correlation coefficients, socio-economic context, innovation type, and innovation domain were recorded from these papers. Appendix provides the summary of these research papers. Meta-analysis can be carried out on 15 or more studies (Field 2001), so our sample of 30 papers satisfied this condition.

We used the correlation coefficient as the effect size measure for the present study. Effect size refers to the estimation of the strength of a phenomenon existing in a population (Cohen et al., 1983). The greater value of effect size depicts the greater extent of presence of a particular phenomenon. Following are the steps for meta-analysis (Hedges and Vevea, 1998; Lipsey and Wilson, 2001):

a) We computed the Fisher transformation of all the correlation coefficient values using following formula:

$$\text{Fisher transformation } (T_i) = 0.5 * \log \frac{1+r_i}{1-r_i}$$

b) Following formula was used for the calculation of Q-statistic. Q-statistic portrays the variability in the effect size values because of sample heterogeneity:

$$Q = \sum_{i=1}^{n} W_i * (T_i - \overline{T})^2$$

where,

$W_i$ = Sample size of $i^{th}$ study

$T_i$ = Effect size of $i^{th}$ study

Q = Heterogeneity statistic

$\overline{T} = \sum (W_i * T_i) / \sum W_i$

c) Computation of overall effect size:

$$T\ (consolidated) = \sum_{i=1}^{n} W'_i * T_i$$

where,

$1/W'_i = 1/W_i + \tau^2$

$\tau^2$ = Max [0, (Q-df)/C]

df = Degrees of Freedom

$$C = \sum W_i - \frac{\sum W_i^2}{\sum W_i}$$

Overall effect size ($\bar{r}$) = $\frac{e^{2T(consolidated)} - 1}{e^{2T(consolidated)} + 1}$

d) Evaluating the significance level of the overall effect size.

## Results and Discussion

Meta-analysis either uses fixed effect model or random effect model. The assumption behind fixed effect model is that there exists one true effect size across all the studies considered. The difference in effect size takes place because of sampling error. However, effect size varies across the studies in case of random effect model (Borenstein et al., 2007). For estimating the heterogeneity in the effect sizes, Q statistic was used. The significant value of Q statistic supported the assumption of random effects model in the present meta-analysis study.

We used correlation co-efficient as the effect size metric in this study. Cohen et al. (2003) classified the effect size values of 0.5, 0.3, and 0.1 as strong, medium, and weak respectively. Although majority of the relationships had medium effect size in this study (Table 1), relative advantage was found to have the strongest relationship with adoption, followed by compatibility.

Our findings reveal that relative advantage of an innovation positively influences the organization's intention to use and adoption, thus supporting H1a and H1b. Results imply that when organizations perceive an IT innovation to be more useful than their existing systems in terms of benefits, such as reduced communication costs and faster problem-solving capability (Song, 2002), they demonstrate higher level of intention to use and adoption of that innovation. Thus, decision makers' perception of overall organizational benefits through the innovation will encourage the organization to share the information regarding benefits of innovative technology leading to its adoption by employees (Kaser and Miles, 2002).

Our results also suggest a positive relationship of compatibility with intention to use and adoption of IT innovation (H2a and H2b). Scholars argue that people prefer innovations which are consistent with their lifestyle, needs, and practices, and it is likely that they will adopt such innovations without hesitation (Du et al., 2012, Hanafizadeh et al., 2014, Koksal, 2016). Organizations also prefer greater compatibility between its policy and innovation as it facilitates interpretation of innovation in a more familiar way (Rogers, 1995).

For example, organizations considering adoption of innovative knowledge management technologies, find those technologies desirable that have a better fit with the knowledge-sharing activities among employees (Hislop, 2003). As a result, organizations show higher intention to internally promote IT innovations that have higher perceptual consistency with the policies, needs, and existing practices of an organization.

Our results also suggest a negative relationship between complexity and intention to use IT innovation, thereby supporting H3a. Higher complexity results in higher mental workload and stress (Sokol, 1994) and therefore, if an innovation is viewed as easy to understand and use, then there is greater chance that organization will develop a favourable intention to use it (Thong, 1999). Although complexity negatively affects the intention to use an innovation, yet it is not a decisive factor in its adoption. Thus, contrary to prior notion, our results did not suggest a significant relationship between complexity and actual adoption of an IT innovation, thereby rejecting H3b. If innovation is perceived to be complex, yet relatively advantageous, organizations may still would like to adopt it for its benefits over the existing systems (Plsek, 2003).

Our analysis also confirmed that trialability has significant and positive relationship with adoption of innovation. Though, given the small effect size, the degree of relationship is weak. In the light of the results, we accept H4b implying that trialability of IT innovation will encourage the organizations to adopt it. This feature of innovation allows firms to test an innovation before adopting it and thus reducing the risk of its failure (Gangi and Wasko, 2009). Results imply that allowing the employees to try innovative technologies may ultimately improve the chances of its adoption (Cheng and Cho, 2010).

We could not study the trialability→intention to use, observability→intention to use, and observability→adoption relationship due to insufficient number of studies. Thus, the hypotheses H4a, H5a, and H5b were left untested.

| Relationship (Hypothesis) | Study Count (N) | Sample Size | Combined Effect Size | Q-Value (Homogeneity Test) | Relationship Strength | Fail-safe No. |
|---|---|---|---|---|---|---|
| RA→INT (H1a) | 5 | 1275 | 0.312** | 50.110*** | Medium | 127.56 |
| RA→ADP (H1b) | 16 | 3014 | 0.463*** | 78.830*** | Medium | 2361.45 |
| CMPT→INT (H2a) | 9 | 2195 | 0.368** | 264.735*** | Medium | 430.41 |
| CMPT→ADP (H2b) | 29 | 5831 | 0.378*** | 233.421*** | Medium | 5064.37 |
| CPLX→INT (H3a) | 7 | 1261 | -0.315*** | 53.284*** | Medium | 140.33 |
| CPLX→ADP (H3b) | 18 | 3013 | 0.018 | 331.958*** | | 14.05 |
| TR→ADP (H4b) | 6 | 1085 | 0.258** | 29.684*** | Weak | 59.75 |

*Note: Meta-analysis should be conducted on factors examined in at least 3 studies (Kirca et al., 2005).*

*RA: Relative Advantage; CMPT: Compatibility; CPLX: Complexity; TR: Trialability; INT: Intention to Use; ADP: Adoption.*

*$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$*

**Table 1: Meta-Analysis Results - Effect Sizes and Relationship Strength**

## *Evaluation of Publication Bias*

Meta-analysis studies have the possibility of being influenced by the publication bias. The most common publication bias is the journals' tendency of publishing studies that have only statistically significant results (Rosenberg, 2005). Literature suggests different ways to test the existence of publication bias in the findings of meta-analysis. Present study utilized the classic fail-safe number suggested by Rosenthal (1991). This number helps in estimating the total number of insignificant effect sizes of unpublished research studies that would be required to reduce the overall effect size to the level of insignificance. A fail-safe number is typically observed as robust if it is greater than 5N+10, where N is the total quantity of studies involved in the meta-analysis originally. If the value of fail-safe number is greater than 5N+10, it indicates that the overall effect size is unlikely to be affected by publication bias. Table 1 depicts that classic fail-safe number is greater than 5N+10 for all the relationships which were found significant.

## *Moderating Effects*

The moderating influence of innovation type and socio-economic context were examined for explicating the heterogeneity in our sample. Tables 2 and 3 summarise the results of moderation analysis of innovation type and socio-economic context respectively.

The moderating effect of innovation type could only be conducted for Relative Advantage→Adoption, Compatibility→Intention to use, Compatibility→Adoption, and Complexity→Adoption relationships due to insufficient number of studies for the rest of the relationships. The Q-Value of two groups show that the innovation type significantly moderates the tested relationships (except for Compatibility→Adoption and Complexity→Adoption relationships). Among the tested relationships, the Relative Advantage→Adoption relationship was significant for both IT product and IT service innovations, and so was the Compatibility→Adoption relationship. The Compatibility→Intention to use relationship was significant only for product innovations, not for service innovations. Interestingly, the Complexity→Adoption relationship emerged as insignificant for both product as well as service innovations.

| Innovation Type | Relationship | Study Count | Combined Effect Size | Q-Value of two groups | Relationship Strength |
|---|---|---|---|---|---|
| Service | RA→ADP | 10 | 0.427*** | 4.409* | Medium |
| Product | | 6 | 0.503*** | | Strong |
| Service | CMPT→INT | 4 | 0.248 | 28.651*** | |
| Product | | 5 | 0.481** | | Medium |
| Service | CMPT→ADP | 11 | 0.367*** | 0.492 | Medium |
| Product | | 18 | 0.386*** | | Medium |
| Service | CPLX→ADP | 6 | 0.049 | 2.544 | |
| Product | | 12 | -0.014 | | |

*Note: Meta-analysis should be conducted on factors examined in at least 3 studies (Kirca et al., 2005).*

*RA: Relative Advantage; CMPT: Compatibility; CPLX: Complexity; INT: Intention to Use; ADP: Adoption.*

*$*p < 0.05$; $**p < 0.01$; $***p < 0.001$*

**Table 2: Moderating Effects of Innovation Type**

The results point towards some interesting variations between products and service innovations. We found that relative advantage and compatibility were both associated with the adoption of IT product as well as IT service innovations. These results validate the applicability of these two innovation features in examining the intention to use and adoption of both product and service innovations in the organizations (Rogers, 2003) and support prior research on the importance of relative advantage and compatibility for IT innovation adoption (Kasperavičiūtė-Černiauskienė and Serafinas, 2018; Ilin et al., 2017; Yuen et al., 2018). However, in our sample, complexity was unrelated to adoption for both types of innovation. These results add to a research trend that finds complexity to be one of the asymmetrical antecedents of innovation adoption with results ranging from no relationship (Hassan et al., 2017; Shaltoni, 2017; Safari et al., 2015) to a negative relationship (Azmi et al., 2016; Henderson et al., 2012). Our results attest to the paradigm shift that has happened over the last few years in how complexity is perceived. It is more or less accepted as a default attribute of the business and IT context now and is no longer perceived negatively. Our results for the relationship between compatibility and intention to use were significant only for product innovations. One of the reasons could lie in the distinct nature of the innovation types. Given that product innovations are typically more tangible, visible, and transportable, than service innovations, organizations may show higher intention to use such innovations due to a clearer understanding of their compatibility.

Further, the moderating effect of economic situation could only be conducted for Relative Advantage→Adoption, Compatibility→Adoption, and Complexity→Adoption relationships due to insufficient number of studies for the rest of the relationships. Interestingly, among the tested relationships, the Relative Advantage→Adoption relationship emerged as strongest for developing countries, but this relationship was not significant for developed countries. Surprisingly, the Complexity→Adoption relationship was not found significant for either of the socio-economic conditions.

| Socio-Economic Context | Relationship | Study Count | Combined Effect Size | Q-Value of two groups | Relationship Strength |
|---|---|---|---|---|---|
| Developing | RA→ADP | 13 | 0.479*** | 4.668* | Medium |
| Developed | | 3 | 0.370 | | |
| Developing | CMPT→ADP | 21 | 0.404*** | 12.268* | Medium |
| Developed | | 8 | 0.289*** | | Medium |
| Developing | CPLX→ADP | 11 | -0.007 | 3.002 | |
| Developed | | 7 | 0.061 | | |

*Note: Meta-analysis should be conducted on factors examined in at least 3 studies (Kirca et al., 2005).*

*RA: Relative Advantage; CMPT: Compatibility; CPLX: Complexity; ADP: Adoption.*

**p < 0.05; **p < 0.01; ***p < 0.001*

**Table 3: Moderating Effects of Socio-Economic Context**

Overall, we found some evidence of the differential impact of socio-economic context on the examined relationships. Our results suggest that the association between relative advantage and adoption of IT innovations was significant for developing nations, but not for developed countries. One of the reasons for these results may lie in the comparative rate of IT innovations in the developed and developing nations. Due to the rapid introduction of successive IT innovations in the developed nations, their capacity for adopting multiple innovations is typically higher. Thus, innovations that have "unique advantage" may have higher chances of adoption than innovations with perceived relative advantage. On the other hand, in case of developing economies, IT innovations precedents are sporadic, so that even small innovations are perceived as having a significant relative advantage, which improves their adoption.

We also found compatibility to be moderately significant across economic situations. This confirms that compatibility is a relatively stable predictor of IT innovation adoption across context. The results suggest that IT innovation being adopted in developing and developed nations are in accordance with the demands of their respective experiences, values, and needs. Another interesting result was that complexity was not associated with adoption. The results can be attributed to the changing perceptions of organizational stakeholders regarding the notion of complexity across the globe. Organizations are open and ready to adopt simple as well as complex IT innovations provided, they enable it to gain competitive advantage. With global networks of individuals, teams, and organizations, working together to accomplish goals, complexity is seen as essential and customary, rather than a negative characteristic of innovations.

## Conclusions

Prior meta-analyses of IT innovation diffusion literature were conducted five years ago and did not examine intention to use the IT innovations. Nor did they examine any contingency effects. Results of our meta-analysis suggest that the IT innovation landscape has changed significantly in the last few years. For example, contrary to the previous meta-analysis, which found significant negative correlation of complexity with innovation adoption (Weigel et al. 2014), our effect sizes were insignificant for this relationship. This suggests that although complexity still hurts intention to use IT innovation in organizations, we could not find significant evidence of a negative mindset among organizations towards adoption of complex IT innovations. Although, it may be a far-fetched conclusion to draw, still this might be indicative of a long-term notable shift in organizational readiness to adopt even complex innovations. Our examination of innovation type and socio-economic context as moderating variables also show interesting variations in various relationships.

## *Implication for Theory and Practice*

Present study provides both theoretical as well as practical implications. From a theoretical perspective, present study not only reconciles conflicting findings in the IT innovation literature, but also makes the DOI theory more precise for future examinations. Several studies have been conducted to understand the role of IT innovation features on the intention to use and adoption. However, there exists inconsistent findings regarding the influence of innovation features on the intention to use and adoption. Present study consolidates the existing research and highlights the reasoning behind the inconsistent results of the previous studies. In addition, the study improves the precision of DOI theory by examining the influence of innovation features on both adoption as well as intention to use. In doing so, this study also synthesizes prior findings in these two major areas of IT innovation diffusion literature. Finally, the results of this study further improve the precision of DOI theory by separately examining the diffusion of novel products and services in the technological domain. Theoretical precision is further enhanced by examining the contingency effect of socio-economic factors on intention to use as well as adoption of IT innovations.

From a practical perspective, present study provides following insights to better identify the most useful features among five innovation features to enhance the intention to use and adoption of an IT innovation. First, intention to use and adoption are majorly influenced by compatibility and relative advantage. Thus, practitioners should excessively focus on promoting these two innovation features for enhancing the intention to use and adoption of their IT innovation. Second, for ensuring smooth adoption of IT innovation in developed nations, it is essential for practitioners to strongly emphasize on key and unique advantages of IT innovation. While users in developing nations may not pose such a challenge as they get easily motivated by relative advantage. Third, it is no more a requirement to put extra efforts in simplifying the IT solution because, with the availability of varied expertise in global teams, user organisations do not perceive complexity to be a hurdle in the adoption. Fourth, practitioners providing IT product should emphasize on improving the compatibility of their innovation to enhance user organizations intention to use it.

## *Limitations and Future Research Directions*

Present study also offers future research directions. Based on our results, we suggest that future studies explore interaction effects between various innovation features themselves. For example, studies could examine if relative advantage of an IT innovation affects the influence of perceived complexity on innovation adoption.

The study has some limitations that are typical to meta-analytic research. First, although we cast a wide search-net to identify all relevant studies in our meta-analysis, we still may have missed some relevant papers. Second, some relationships could not be examined due to lack of sufficient number of studies. Third, this study only considered direct effect of innovation features with the intention to use and adoption. Future researchers can study the indirect effects. Finally, we could only examine the moderating effects of innovation type and socio-economic context, whereas other contextual factors could also possibly moderate the relationships we tested for.

**Appendix: Summary of Research Papers used in the Meta-Analysis**

| Authors | Socio-Economic Context | Innovation Type | Sample Size | Relationship Studied (Correlation Value) |
|---|---|---|---|---|
| Ainin et al. (2015) | Developing | Product | 259 | CMPT→ADP (0.3797) |
| Ainin et al. (2015) | Developing | Product | 259 | CMPT→ADP (0.5531) |
| Ainin et al. (2015) | Developing | Product | 259 | CMPT→ADP (0.3255) |
| Ali et al. (2012) | Developing | Product | 146 | RA→ADP (0.68), CMPT→ADP (0.69) |
| Awa et al. (2017) | Developing | Product | 262 | CMPT→ADP (0.525), CPLX→ADP (0.564) |
| Azmi et al. (2016) | Developing | Product | 401 | RA→ADP (0.577), CMPT→ADP (0.45), CPLX→ADP (0.283) |
| Cao et al. (2013) | Developed | Product | 207 | CMPT→ADP (0.15), CPLX→ADP (-0.33) |
| Chandra and Kumar (2018) | Both | Service | 107 | RA→INT (0.67) |

| | | | | |
|---|---|---|---|---|
| Chen et al. (2019) | Developing | Product | 175 | RA→ADP (0.30), CMPT→ADP (-0.05), CPLX→ADP (-0.20) |
| Cheng and Cho (2011) | Developing | Product | 190 | CMPT→INT (0.14), CPLX→INT (-0.27), TR→INT (0.30), OBS→INT (0.38), CMPT→ADP (0.03), CPLX→ADP (-0.15), TR→ADP (0.16), OBS→ADP (0.29) |
| Deng et al. (2009) | Developing | Service | 80 | RA→INT (0.42), CMPT→INT (0.377), CPLX→INT (-0.022), TR→INT (0.388), RA→ADP (0.319), CMPT→ADP (0.167), CPLX→ADP (-0.131), TR→ADP (0.125) |
| Ghobakhloo and Hong Tang (2013) | Developing | Service | 268 | CMPT→ADP (0.226) |
| Hasani et al. (2017) | Developing | Product | 389 | RA→ADP (0.457), CMPT→ADP (0.601), TR→ADP (0.426), OBS→ADP (0.384) |
| Hassan et al. (2017) | Developed | Service | 151 | RA→ADP (0.544), CMPT→ADP (0.506), CPLX→ADP (0.536) |
| Hassan et al. (2017) | Developed | Service | 151 | RA→ADP (0.473), CMPT→ADP (0.545), CPLX→ADP (0.41) |
| Henderson et al. (2012) | Developed | Product | 65 | CMPT→ADP (0.44), CPLX→ADP (-0.04), TR→ADP (0.43) |
| Henderson et al. (2012) | Developed | Product | 65 | CMPT→ADP (0.34), CPLX→ADP (-0.08), TR→ADP (0.18) |
| Ilin et al. (2017) | Developing | Service | 159 | RA→ADP (0.408) |
| Klein (2012) | Developed | Service | 216 | CMPT→ADP (0.26) |
| Kuo et al. (2011) | Developing | Product | 500 | CMPT→ADP (0.31) |
| Lin (2006) | Developing | Service | 720 | RA→INT (0.22), CMPT→INT (0.35) |
| Lin and Lee (2006) | Developing | Product | 154 | RA→INT (0.10), CMPT→INT (0.12), CPLX→INT (-0.09) |
| Mohammed et al. (2017) | Developing | Service | 296 | RA→ADP (0.3947), CMPT→ADP (0.3652), CPLX→ADP (-0.3175), TR→ADP (0.0891) |
| Rajan and Baral (2015) | Developing | Product | 154 | CMPT→INT (0.507), CPLX→INT (-0.281), CMPT→ADP (0.386), CPLX→ADP (-0.205) |
| Ruivo et al. (2014) | Developed | Product | 134 | CMPT→ADP (0.097), CPLX→ADP (-0.238) |
| Safari et al. (2015) | Developing | Product | 92 | RA→ADP (0.565), CMPT→ADP (0.435), CPLX→ADP (0.411) |
| Shaltoni (2017) | Developing | Service | 105 | RA→ADP (0.63), CMPT→ADP (0.61), CPLX→ADP (-0.14) |
| Shih and Lin (2017) | Developing | Service | 214 | RA→INT (0.481), CMPT→INT (0.523) |
| Sun et al. (2009) | Developing | Product | 138 | CMPT→INT (0.60), CPLX→INT (-0.47), CMPT→ADP (0.53), CPLX→ADP (-0.24) |
| Tajudeen et al. (2018) | Developing | Service | 174 | RA→ADP (0.45), CMPT→ADP (0.48) |
| Tajudeen et al. (2018) | Developing | Service | 174 | RA→ADP (0.50), CMPT→ADP (0.41) |
| Tajudeen et al. (2018) | Developing | Service | 174 | RA→ADP (0.45), CMPT→ADP (0.41) |
| Thong (1999) | Developed | Service | 166 | RA→ADP (0.073), CMPT→ADP (0.073), CPLX→ADP (0.076) |
| Wang et al. (2016) | Developing | Product | 256 | CMPT→INT (0.736), CPLX→INT (-0.576) |
| Wu et al. (2013) | Developed | Service | 289 | CMPT→INT (-0.297), CPLX→INT (-0.205) |
| Xu et al. (2017) | Developing | Product | 181 | RA→ADP (0.399), CMPT→ADP (0.256), CPLX→ADP (-0.124) |

*Notes: The total number of rows in this table (36) is greater than the number of research papers (30) as some research papers included multiple sub-studies.*

*RA: Relative Advantage; CMPT: Compatibility; CPLX: Complexity; TR: Trialability; OBS: Observability; INT: Intention to Use; ADP: Adoption.*

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