



INNOVATION ATTRIBUTES: CHALLENGING OR FACILITATING THE DIFFUSION OF TECHNOLOGY

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ABSTRACT

The perceived innovation attributes are significant background factors for technology to put into use and also are essential aspects of technology to determine the rate and pattern of innovation adoption. The characteristics of innovation as perceived by the users impact the rate and speed of its adoption and determine the amount of resistance generated. Accordingly, this study tries to fill this gap to help comprehend the innovation attributes that upset or invigorate the selection of ICT by SMEs in a developing country like India. The research methodology embraced in attempting this investigation is the qualitative research. A semi-structured interview with ten SMEs' owners, managers or IT/ICT supervisors was utilized to achieve an exploratory snapshot of the subject matter under consideration. The thematic analysis was put into use for interpreting and analyzing the data obtained from interviews. Based on the research findings, it is evident that cost, security, compatibility, complexity, communicability and reversibility attributes of technology are sometimes impeding the diffusion of technology in SMEs. Besides, the innovation attributes like relative advantage, observability, modifiability trialability and divisibility encourage the technology adoption decision in SMEs.

Keywords: *IT, ICT, SMEs.*

1. INTRODUCTION

Different theorists and researchers with regard to the subject of technology adoption highlight the different innovation characteristics (technology attributes) which either hinder or assist the process of technology adoption among individuals and organizations depending on their perceived characteristics of using an innovation. Downs and Mohr [1] recognize the characteristics of innovation as primary and secondary attributes. The authors briefly clarify the use of these terms and infer that primary attributes of innovation are those essential attributes which are inherent to it independent of their perception by potential adopters [1]. To this end, Moore and Benbasat [2] suggest that the individual's behavior is however envisaged by how they perceive the primary attributes because different adopters might perceive primary characteristics with different outlooks and eventually their behaviors might be unlike [2]. On the other hand, secondary attributes of innovation are those which are perceived by the senses, thus might be diversely assessed by various percipient, for example, the perception of cost [1]. Taking into account the lack of insight towards this subject matter in developing



countries, particularly in India, the objective of this study is to investigate the various innovation attributes which determine the adoption and usage of ICT among SMEs in India.

II.LITERATURE REVIEW

Rogers [3] proposed the innovation diffusion theory to study the technology adoption behavior towards acceptance of new technology. Rogers [4] identifies five innovation attributes namely relative advantage, compatibility, complexity, trialability, and observability as significant determinants of technology adoption as perceived by the members of a social system. Moore and Benbasat [2] improved the innovation diffusion theory proposed by Rogers [4] and presented the following seven technology attributes determining the acceptance of technology by users: relative advantage, ease of use, image, visibility, compatibility, result demonstrability and voluntariness of use. Moore and Benbasat [2] concluded that based on the definition of observability, it is reasonable to split the construct and focus on each dimension independently. One dimension was named results demonstrability and the other was visibility [2]. Tornatzky and Klein [5] carried out a meta-analysis of 105 studies and identified ten characteristics of innovation which had been recognized most frequently in articles they reviewed. These included five characteristics from Rogers's Diffusion of Innovation as relative advantage, compatibility, complexity, trialability, observability and other innovation attributes include cost, communicability, divisibility, profitability and social approval. In addition, Glanz et al. [6]; Oldenburg and Parcel [7] have identified other attributes related to innovation apart from five attributes from Diffusion of Innovation theory that also determine the rate of technology adoption. These include relative advantage, compatibility, complexity, trialability, observability, impact on social relations, reversibility, communicability, time, risk and uncertainty, commitment and modifiability. Zaltman et al. [8] have identified some other characteristics of innovations which are relevant in the contest of innovation resistance. These are reversibility, realization, amenability to modification and effect on adoption of other innovations. Davis [9] proposed two important characteristics of innovation namely perceived usefulness and perceived ease of use which determines the individual's acceptable behavior towards innovation. Zhu et al. [10] in their research specify and developed an instrument of four constructs of innovation characteristics: relative advantage, compatibility, costs, and security concern. Tanakinjal [11] also recognize perceived risk in technological adoption perspective. Pantano and Pietro [12] identified perceived cost and perceived security as perceived attributes of technology determining user acceptance of a new technology. Kumar [13] highlights seven technology attributes for the assessment of his research objectives. These attributes were simplicity, compatibility, observability, divisibility, cost of technology, profitability, and predictability. Woosley and Ashia [14] identified technical complexity as ease of use and relative advantage as perceived usefulness. Moreover, Grandon and Pearson [15] investigated the impact of perceived usefulness (relative advantage) and perceived ease of use (complexity) and include the compatibility as significant factors influencing the adoption of technology. Kelly and Kranzberg [16] have classified all characteristics of innovations into two categories: those that are dependent on the consumer and those that are not. According to them, trialability, divisibility, reversibility and the form of the innovation (idea,



product or process) would be consumer independent. These factors can be expected to create the same type of resistance across all consumers. All other characteristics such as relative advantage, compatibility etc. would be consumer dependent and would generate resistance depending on how each consumer perceived the innovation on each of these attributes.

Table 1: Definition of Innovation Characteristics/ Technology Attributes

Variable	Definition
Relative Advantage	<p>“The degree to which an innovation is perceived as better than the idea what it supersedes” [4].</p> <p>“Is the innovation perceived to be better than what it will replace?” ([6], [7]).</p>
Compatibility	<p>“The degree to which an innovation is perceived as being consistent with existing values, past experiences and needs of potential adopters” [4].</p> <p>“Is the innovation consistent with the values and needs of potential adopters?” ([6], [7]).</p> <p>“The degree to which ICT is compatible with a company’s business processes, distribution channel, corporate culture and value system” [10].</p>
Complexity	<p>“The degree to which an innovation is perceived as difficult to understand and use” [4].</p> <p>“Is the innovation easy to use?” ([6], [7]).</p> <p>“The perceived difficulty in adopting IT innovation” [17].</p>
Trialability	<p>“The degree to which an innovation may be experimented with on a limited basis” [4].</p> <p>“Can the innovation be adopted on trial?” ([6], [7]).</p>
Observability	<p>“The degree to which the results of an innovation are visible to others” [4].</p> <p>“Are the results of the innovation observable and measurable?” ([6], [7]).</p> <p>“The degree to which the results of a technology are visible to others” [13].</p> <p>“Observability is how much the use and benefits of innovation are visible to others” [18].</p>
Communicability	<p>“Can the innovation be understood clearly and easily?” ([6], [7]).</p> <p>“The degree to which aspects of an innovation may be conveyed to others” [43].</p>
Reversibility	<p>“Can the innovation be reversed or discontinued easily?” ([6], [7]).</p>
Perceived risk (Security and privacy)	<p>“Can the innovation be adopted with minimal risks?” ([6], [7]).</p> <p>“Security concern is the degree to which the internet platform is deemed insecure for exchanging data and conducting online transactions” [10].</p> <p>“Perceived risk (security and privacy) is individual’s subjective belief of suffering a loss in pursuit of the desired outcome” [19].</p>
Modifiability	<p>“Can the innovation be updated, modified or reinvented over time?” ([6], [7]).</p>
Visibility	See Observability
Usability	See Compatibility, Perceived Usefulness



Profitability	See Relative Advantage
Divisibility	<p>“The degree to which a technology may be partitioned into isolated components for adoption” [13].</p> <p>“The extent to which an innovation can be tried on a small scale prior to adoption” [20].</p> <p>See Trialability also</p>
Cost	<p>“Refers to expenses of implementing necessary technologies” [10].</p> <p>“Refers to the expenses involved in adopting a technology” [13].</p>
Simplicity	<p>“The degree to which a technology is perceived as easy to understand and use [13].</p> <p>See also Complexity</p>
Profitability	<p>“The degree to which the technology provides an economic return over the cost involved” [13].</p> <p>See also Relative Advantage</p>
Predictability	<p>“The degree of certainty of receiving expected benefits from the adoption of a technology” [13].</p> <p>See also Observability</p>
Perceived Ease of Use	<p>“The degree to which an individual believes that using a particular system would be free from effort” [9]</p> <p>See also Complexity</p>
Perceived Usefulness	<p>“The degree to which an individual believes that using a particular system would enhance his/her job performance” [9].</p> <p>See Relative Advantage</p>

III. RESEARCH METHODOLOGY

Given the exploratory nature of this study, the epistemological position or research philosophy taken for this study is that of interpretivism. The research approach used in this study is rather inductive, begins with a collection of empirical data which is then used in developing a theory. Besides, this research will particularly choose the case study research strategy with a cross-sectional time horizon due to the limited time available to undertake the research. The sample population for the proposed research will be ten SMEs from Kashmir India. The method of thematic analysis will be utilized to analyze the empirical data collected from cases.

IV. DATA ANALYSIS AND INTERPRETATION

To collect the empirical data, ten semi-structured interviews were conducted with SMEs’ owners, managers, and I.T professionals. Respondents from each case were requested to highlight their viewpoint about innovation attributes that facilitate or hinder them from effectively utilizing ICT in their respective enterprises, despite being recognized as ICT users. The case studies enabled the researcher to elicit respondents’ views and



experiences to obtain an in-depth understanding of fundamental issues pertaining to the proposed research, thereby assist in providing better information.

1.1 CASE PROFILE

Based on the researcher's convenience and willingness on the part of the participant SMEs to share their views concerning the research area, ten SMEs were selected as cases which comprised of diverse business sectors as shown in table 2. For the condition of being anonymous, the selected cases were disguised as Cs1#, Cs2#, Cs3#, Cs4#, Cs5#, Cs6#, Cs7#, Cs8#, Cs9#, and Cs10#. Similarly, the respondents were veiled as CsR1#, CsR2#, CsR3#, CsR4#, CsR5#, CsR6#, CsR7#, CsR8#, CsR9# and CsR10#.

Table 2: Case Profile

SME code	Business Sector	Company Size	Respondent's Code	Respondent's Position
Cs1#	Engineering	Medium	CsR1#	Owner
Cs2#	I.T	Large	CsR2#	I.T Officer
Cs3#	Food processing	Medium	CsR3#	Manager
Cs4#	Manufacturing	Medium	CsR4#	Manager
Cs5#	Wholesale and Retail	Small	CsR5#	Owner
Cs6#	Hotel and Restaurant	Medium	CsR6#	Manager
Cs7#	Tour and Travel	Small	CsR7#	Manager
Cs8#	Health and Medical	Medium	CsR8#	Owner
Cs9#	Education and Training	Large	CsR9#	Owner
Cs10#	Pharmacy/ Medical/ Health	Small	CsR10#	Owner

1.2 PERCEIVED INNOVATION CHARACTERISTICS INHIBITING ICT ADOPTION IN SMEs

The innovation characteristics/ technology attributes were discussed with respondents in a manner as to see whether the existing technology is perceived to be the best fit in their organizations. The respondents were asked to comment on the perceived innovation characteristics that prevent or delay the acceptance and adoption of ICT in their respective enterprises. All of the participants shared a similar view with regard to their perception of technology available or utilized in their business operations. The various emergent themes in the light of above objective provide the following findings.

Table 3: Emerging themes

Categories	Themes	Respondent's support
Innovation Characteristics	Cost	RCs2#, RCs3#, RCs4#, RCs6#, RCs8#, RCs9#
	Security	RCs2#, RCs4#, RCs5#, RCs7#, RCs9#
	Compatibility	RCs1#, RCs3#, RCs5#, RCs8#



	Complexity	RCs1#, RCs4#, RCs6#, RCs7#, RCs9#
	Communicability	RCs2#, RCs9#
	Reversibility	RCs2#

1.3 PERCEIVED INNOVATION CHARACTERISTICS ENCOURAGING ICT ADOPTION IN SMEs

Besides the identification of various innovation characteristics inhibiting ICT adoption, the case studies were also intended to find out the various innovation characteristics which indeed encourage ICT adoption in SMEs. The interviewees comment on various perceived innovation characteristics which encourage or stimulate the acceptance and adoption of ICT in their enterprises. The various emergent themes in the light of above objective are as follows.

Table 4: Emerging themes

Categories	Themes	Respondent's support
Innovation characteristics	Relative advantage	RCs1#, RCs2#, RCs3#, RCs4#, RCs5#, RCs6#, RCs7#, RCs8#, RCs9#, RCs10#
	Observability	RCs2#, RCs7#, RCs9#
	Modifiability	RCs2#, RCs4#
	Trialability	RCs3#, RCs10#
	Divisibility	RCs5#, RCs7#, RCs9#

V.RESULTS AND DISCUSSION

The first research objective towards the diffusion of ICT was to ascertain that whether the attributes of the technology itself played an important role in SMEs technology adoption. The results indicate that the respondents perceive the existing technology as characterized by the number of attributes that limits ICT adoption in SMEs. The cost of ICT implementation and maintenance, security issues associated with ICT solutions, the complexity of modern ICT solutions, compatibility of existing software solutions interpreted as the relevance of ICT solutions to business, communicability and irreversibility attributes of technology were perceived to be inhibiting factors by SMEs. Insights gained from the study suggest that the cost is considered to be a key issue in deciding whether to adopt technology or not. According to Bazini et al. [21], the high cost of ICT is usually considered as a key issue among SMEs. Similarly, Harindranath et al. [22] infer that SMEs are often concerned about the cost of technology. Ireffin et al. [23] pointed out that ICT infrastructural cost has significant possibilities for influencing ICT adoption within SMEs. Consequently, Lee & Kim [24] suggest that the lowered cost of ICT might influence more on the wider adoption of ICT in the SME sectors [24]. It is not surprising that security is another issue which could affect ICT adoption in SMEs. As revealed from many past researchers, for example, Locke [25]; Lee and Kim [24]; Saleh and Burgess [26] etc. security issue is a consequential barrier to technology adoption in many SMEs. Tanakinjal [11] express that perceived risk is a



significant innovation attribute affecting technology adoption in SMEs. The users might resist trusting the technology since they perceive risk with respect to security and privacy of their valuable data; SMEs are greatly concerned about the security and privacy issues existing in association with ICT adoption, therefore, SMEs are unwilling or hesitant to adopt technology in their business [27]. The concerns about accidental disclosure of confidential information of organization can be a critical barrier that directly or indirectly affects the implementation or extension of ICT solutions. Because of this fact, SMEs are reluctant to adopt new ICT solution [24]. Tan and Eze [28] acknowledge that ICT security has emerged as the most significant characteristic that makes a difference to the readiness of SMEs to adopt ICT. Compatibility has also shown its roots in deciding technology adoption in SMEs. The lack of compatible/ relevant ICT solutions is another crucial barrier that directly influences ICT adoption in SMEs. Technology that is relevant or compatible is more promptly adopted without hesitation or reluctance [29]. Scupola [30] similarly highlighted that accessibility of relevant ICT solutions is a component that significantly impacts the appropriation and usage of web-based business. Manuere et al. [31] also establish that lack of suitable software solutions is a possible barrier to ICT adoption in SMEs. Akbari and Pijani, [32] infer that compatibility of technology is among crucial ICT determinants that limit ICT adoption by SMEs. Tan and Eze [28] suggest that the accessibility of appropriate ICT solutions contributes considerably to the adoption of ICT in SMEs. The compatibility might be thinking about on the individual or organizational levels [6]. The complexity associated with ICT implementation and maintenance also emerged as a critical factor in technology adoption in SMEs. Akbari and Pijani [32] also confirmed that the quality of technology being complicated affect the future adoption of ICT in SMEs. MacGregor et al [33] ascertain that SMEs are obliged to not to embrace technology in their business in case it is perceived to be complex. Innovation that is perceived to be simple to use probably have more inclination to adopt, while more perplexing or complex technologies are less effectively embraced. The communicability factor of technology also seems to be an important innovation characteristic determining ICT adoption in SMEs. Innovation outspread with the highest pace and success when its results can be conveyed to others with ease and effectiveness [34]. The current study proved that reversibility is also predicted as a key factor in technology adoption. This determinant is less evident in scholarly articles.

The second research question seeks to explain the innovation attributes which encourage SMEs to adopt or extend their level of ICT adoption. The empirical data proved that ICT implementation in organizations is enthused by many innovation attributes namely relative advantage, observability, modifiability, trialability, and divisibility. The perceived relative advantage (perceived benefits) emerges as a key factor that leads SMEs to adopt technology in their business. According to Rogers [35], the benefits received could be economic, social, utilitarian and so on. Similarly, Ram [36] infers that the relative advantages of technology might be as economic gain or as cost savings. According to Alam and Noor [37], perceived benefits are significantly important with respect to any technology adoption decision. Mpofo et al. [38] reveal that ICT is directed by the perceived benefits upheld by management and employees. Similarly, Lee and Kim [24] suggest that the perceived benefits are very much associated with new technology adoption. It is a significant issue which has a marked effect or



influence on ICT adoption [39]. Also, Ahuja et al. [40] reveal that perceived benefits of innovation positively influence the technology adoption within SMEs, which additionally prompts expanded utilization of ICT. Besides the relative advantage, the observability of innovation inspires the development of technology in the organizations. If the benefits of an innovation are easily identifiable and noticeable to others it will be embraced all the more effortlessly [6]. Wei [41] in his study found that the utilization of a specific innovation has continually been influenced by its observability character. Tan and Eze [28] express that individual's motive towards technology adoption is positively related to observability. Insights gained from the findings also suggest that SMEs indeed takes into consideration the modifiability of innovation before the enterprises make any decision to adopt a certain technology. The capacity to adapt, refine or modify the technology to meet the particular need of users will encourage it to be adopted with fewer efforts [18]. The modifiability or reinvention of innovation can likewise be thought of as an extension of compatibility [6] and is often recognized as a distinguished characteristic of innovation. In the event that possible users can adjust, change and alter an innovation to suit their particular requirements and the context that relates to it, it will be received with more ease [6]. The findings of the research indicated that the trialability of the existing technology is another motivating factor towards innovation adoption in SMEs. Trialability of innovation is the degree to which innovation is subjected to trial or tried out (tested). For instance, there are certain products and services that merely can't be made available on trial. The less difficult it is to try an innovation the more the possibility it will be tested, which thusly builds the likelihood of adoption. Innovations which the potential users can experiment on a limited basis are accepted and implemented more easily [6]. New innovations that can be put to trial or test prior to adoption will probably be picked up easily [42]. The effective utilization of ICT has also been attributed to the divisibility of the technology. Divisibility is the ability to separate the product into units small enough to try out. According to Glanz, et al. [6] innovations that are capable of being separated into parts and adopted in especially small increments will probably be adopted [6]. Keeping in consideration the available resources of the SMEs, the implementation of technology can be confined or restricted to certain functional limits before attaining the highest goals or achievements of technology.

VI.CONCLUSION

Innovation is the immense approach to achievement in this advanced age. The way of development in routine activities implies accomplishing something other than what's expected, more astute or better, that will have a beneficial outcome regarding value, quality or profitability by utilizing rising or demonstrated innovations of the world. The innovation which has effectively substantiated itself in most recent two decades is obviously the information and communication technology (ICT). Contrary to this fact, innovation adoption is being inhibited or encouraged by its attributes perceived by users depending on their competences and available resources.



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