

Facilitating Innovation Adoption and Diffusion: The Case of Telework

CYNTHIA P. RUPPEL
University of Toledo, USA

GEOFFRY S. HOWARD
Kent State University, USA

Despite many potential benefits for both the employer and the employee resulting from telework arrangements, this innovation has not been adopted and diffused as expected. This study uses innovation theory as a foundation to study the growth of telework by empirically testing the strength of the relationship between facilitator variables and the adoption and diffusion of telework. Strong relationships were found for both general innovation facilitator variables, such as top management support and a champion, and innovation-specific facilitator variables as suggested by the telework literature. These results suggest that to obtain a more complete model of the relevant factors in the adoption and diffusion of innovations, characteristics of the specific innovation must be considered. Also, these findings have implications for the future growth of telework and can guide those wishing to champion telework in their organization.

Due to the often cited benefits of telework to both the employer and the employee (U.S. Department of Transportation, 1993), telework has been predicted to experience rapid growth (Furger, 1989; Raths, 1990; Schepp, 1991). Yet, this predicted rapid growth has not materialized (Christensen, 1990). However, the increasing capabilities of enabling technologies, together with decreasing costs for these technologies, have spurred continued predictions for telework's rapid growth. For example, one source suggests that the number of teleworkers is expected to exceed 13 million by 1998 (Baig, 1996), while another predicts that by the year 2000 there will be about 25 million telecommuters (Dickisson, 1997).

While some of the technological barriers to telework have been reduced by advancements of enabling technologies such as the wider availability of ISDN, the major barriers to the growth of telework do not appear to be just technological, but

also cultural. A recent study by Ruppel and Harrington (1995) found that managerial attitude towards telework is a major barrier to telework's growth while another study suggests that another related barrier to telework's growth is reduced control and supervision by managers (Jones, 1996). While the problem of reduced control and supervision may be aided by technologies such as desktop video conferencing, there is still the cultural/attitudinal barrier that must be overcome for telework as well as other forms of virtual work to experience widespread growth.

A theoretical basis for the study of the growth/nongrowth of telework can be found in the organizational innovation literature. Innovation theory applies to the study of the adoption (the decision to use) and diffusion (the extent of implementation) of innovations within organizations. This theory is appropriate for the study of an innovation which is new to an organization, not just to the development of a novel

Manuscript originally submitted March 15, 1997; Revised November 18, 1997; Accepted December 10, 1997 for publication.

idea (Rogers, 1983; Wolfe, 1994). Existing studies have been meta-analyzed by Damanpour (1991) and include such traditional organizational innovation variables as formalization, centralization, specialization, professionalism, administrative intensity, functional differentiation, size and managerial attitude towards change.

However, innovation studies have often not been consistent in their findings (Prescott and Conger, 1995; Wolfe, 1994; Fiol, 1996), making it difficult to develop an all-encompassing theory that explains the adoption and diffusion processes of a myriad of innovations within an organizational context. Many classifications of innovations (i.e. radical v. incremental, administrative v. technological), the level at which the innovation is adopted and diffused (i.e. organization, work group, individual), the scope of the innovation, the type of innovation and the methodologies used by the study have all been proposed as important distinctions in an attempt to clarify inconsistent results from organizational innovation studies. Damanpour (1991) and Wolfe (1994) both review the organizational innovation literature and attempt to classify studies to find similarities and differences across these categories that may explain these inconsistent results, as well as identify needed areas for additional research. Prescott and Conger (1995) reviewed the Information Technology (IT) innovation literature and come to similar conclusions.

Also to aid in theory development, the traditional organizational innovation literature has been expanded to include additional concepts believed to affect innovation efforts. One such concept is that of absorptive capacity (Cohen and Levinthal, 1990; Boyton, Zmud and Jacobs, 1994). Absorptive capacity suggests that innovation adoption and diffusion are limited by a firm's ability to "recognize the value of new information, assimilate it, and apply it to commercial ends." (Cohen and Levinthal, 1990, p. 128)

Related to the concept of the importance of knowledge within an organization is the application of the concept of organizational learning to the adoption and diffusion of innovations. Sharma (1995) applied this concept to the study of the adoption and diffusion of Computer Aided Software Engineering (CASE). Huber (1996) also discusses the importance of organizational learning, particularly in technology-critical organizations, since a technology-critical organization requires the frequent adoption and diffusion of new technologies.

Along with the traditional adoption and diffusion variables of the innovation literature, as well as the concepts of absorptive capacity and organizational learning, others suggest that culture or climate of an organization is related to the adoption and diffusion of innovations in that organization (Prescott and Conger, 1995; Boyton, Zmud, and Jacobs, 1994). Prescott and Conger (1995) call for the need for additional research into this promising construct after reviewing the existing literature concerning the relationship between culture and the adoption and implementation of IT innova-

tions.

The search for additional explanatory variables, as well as the categorization of innovations, suggests that the search to find an explanation of inconsistent results has resulted in the addition of several concepts to the existing organizational innovation literature. Therefore, Wolfe (1994) suggests that the adoption and diffusion of innovations is a very complex process which is not easily explained. For example, why does an organization not adopt a potentially beneficial innovation such as telework?

While all of these concepts related to the adoption and diffusion of innovations contribute to our understanding concerning the adoption and diffusion behavior of organizations, the conflicting results may also be, in part, the result of the aggregation of innovation variables across several unique innovations. Recently there has been an attempt to study single innovations using an organizational innovation framework as suggested by Damanpour (1991). For example, the adoption and diffusion of CASE (Rai and Howard, 1994; Premkumar and Potter, 1995; Tyre and Orlikowski, 1994), Electronic Data Interchange (EDI) (Drury and Farhoomand, 1996) and telemarketing (Marshall & Vredenburg, 1993) all have been studied.

These studies suggest some factors related to innovation adoption and diffusion seem to cross individual and categorical boundaries. For example, Prescott and Conger (1995) suggest that the importance of the existence of a champion for an innovation is almost universally agreed upon. Other factors may be uniquely important in the adoption and diffusion of an innovation categorized as an administrative innovation (Damanpour, 1991; Drury and Farhoomand, 1996). Administrative innovations are characterized as those that affect the organization's administrative process, organizational structure or management style (Damanpour, 1987; Drury and Farhoomand, 1996). In the case of technological innovations, other factors may be related to their adoption and diffusion (Damanpour, 1987).

However, when studying specific innovations, a fuller understanding of adoption and diffusion behaviors may be gained by consideration of organizational factors which facilitate the adoption and/or diffusion of these specific innovations. Prescott and Conger (1995) discuss the need for further study of "fit" between the organization and the specific innovation. The importance of these variables is also suggested by Rogers (1983) who, in the adoption process in organizations, identified a matching stage, which involves knowing and understanding the specific characteristics of the innovation under consideration. In the diffusion process he identifies a redefining/restructuring stage. This stage also requires understanding and/or modifying the specific characteristics of the innovation that has been adopted, or modifying the organizational structure of the adopting organization to facilitate the implementation of the innovation. These specific characteristics of an innovation will be referred to in this study as

facilitator variables.

While some facilitator variables may be found to be common across several innovations, such as the importance of top management support for the innovation's adoption and diffusion and the existence of a champion for the innovation, other facilitator variables may be suggested by the specific characteristics of the innovation being studied. Therefore, this paper discusses those factors which both the innovation literature, as well as the telework popular literature, suggests are uniquely related to the adoption and diffusion of telework. For purposes of this study adoption is the decision to use some form of telework in an organization for at least one employee. The degree of implementation or diffusion is a measure of how widely spread the use of telework is in an organization.

The study of these variables, both general innovation facilitator factors and telework specific innovation factors, should add to the innovation literature to suggest the impact of these innovation specific variables on innovation adoption and diffusion, as well as to suggest to practitioners wishing to champion telework ways to facilitate its adoption and diffusion. Each of these telework facilitator variables, as they are related to adoption and/or diffusion of telework, is discussed below.

Since little empirical work about telework exists, much of the literature consists of practitioner "how-to" implement articles and anecdotal information. This literature was examined to determine some of the more consistently mentioned factors which impact telework's implementation. The specific factors suggested by this literature as important to telework's use are the existence of a career ladder for teleworkers (Niles, 1992; Knight, 1994; Verespej, 1994), the availability of rich communications media for teleworkers and the manager (Hotch, 1993) and the planning of telework arrangements (Jones, 1992). Also included are the training of managers about the benefits of telework (Huws, Korte and Robinson, 1990; Blake, 1994), the training of managers to remotely manage teleworkers (Jones, 1992; Misutka 1992; Niles, 1992), the training of teleworkers (Lavellle, 1993; Szappanos, 1993) and the existence of perceived adequate security measures (Misutka, 1992; Niles, 1992).

General Innovation Facilitator Variables

Top Management Support

The innovation literature has consistently regarded top management support as an important factor in bringing about the changes required during the adoption and diffusion of an innovation (Prescott and Conger, 1995; Premkumar and Potter, 1995). This variable is also believed to be related to the adoption and diffusion of telework given its strong support across innovation studies. With respect to telework, Blake (1994) attributes this need for top management commitment to be important for supporting the cultural changes required in management style, managing for results, changes in work

practices and the need for information technologies and communications support. Therefore it is proposed that:

- H1 Top management support of telework is positively related to both the adoption and diffusion of telework in an organization.

Existence of a Champion

Another traditional innovation variable related to support from top management is the support for the innovation provided by the existence of a champion for that innovation. Prescott and Conger (1995) reviewed the innovation literature and concluded that continuous support of a champion is important in the diffusion of an innovation within an organization. Likewise, the growth of telework, and therefore its adoption and diffusion, is also believed to be related to the existence of champions for this innovation, particularly those who can publicize telework's benefits and provide validity to their attainability (Dvorak, 1994; Wheeler and Zackin, 1994). Therefore it is proposed that:

- H2 The existence of a champion for telework is positively related to both the adoption and diffusion of telework.

Telework-Specific Facilitator Variables

Perceived Adequate Security Measures

The idea that the slow acceptance of telework by organizations is related to security concerns has been suggested by several authors (D'Attilio, 1985; Davis, 1991, DeSanctis, 1983; DiMartino & Wirth, 1990). These concerns may be physical security concerns that, as suggested by D'Attilio (1985), the person logged on may not be the actual employee. Even if the employee is the person logged on, DeSanctis (1983) recommends a dial-up capability with a call-back procedure.

Study results also provide evidence that security is a concern of management with respect to telework arrangements. DiMartino and Wirth (1991) cite a United States Army pilot program, which despite positive results, was not adopted due to concerns about the risks of fraud and abuse. Likewise, Henderson (1995) reports that managers participating in a survey listed security risks as the highest rated (64%) disadvantage to telecommuting. Therefore it is proposed that:

- H3 The existence of perceived adequate security measures is positively related to both the adoption and diffusion of telework.

Availability of Quality Communications Media

"A good communication system is essential to the smooth running of a telecommuting programme" (Coulson-Thomas, 1991, p. 30). Hamilton (1987) also suggests the importance of exceptional communication links for

teleworkers. Huws, et al. (1990) report that among the barriers managers listed to telework, over half of the respondents mentioned communication problems. A widely used quality communications link can reduce a teleworker's feeling of social isolation as well as be used to provide relevant feedback to teleworkers. Therefore, it is proposed that:

- H4 The availability of quality communications media will be related positively to both the adoption and diffusion of telework.

Training

To facilitate telework's successful use several types of training are recommended in the telework literature. To overcome the cultural barriers that may result from a shift in management style and techniques (Huws, et. al, 1990) and to increase manager's knowledge, and therefore the absorptive capacity of the organization, managers should be trained about telework and its potential benefits. Training will make managers aware of the potential benefits of telework, such as increased productivity, as well as suggest implementation strategies to overcome any potential drawbacks such as the social isolation of the teleworker.

Blake (1994) suggests that the attitudes of managers about telework are markedly different if they are informed about telework and made aware of its potential benefits. Therefore, trained managers are more likely to adopt this innovation, and also to allow more teleworking among employees. Therefore, it is proposed that:

- H5 Training managers about telework's potential benefits will be positively related to both the adoption and the diffusion of telework.

Telework-Specific Facilitator Variables Related to Diffusion

Several facilitator variables studied here are appropriate only after the decision has been made to adopt telework. These variables, however, have an impact on the diffusion of telework.

Training Those Involved in Telework Arrangements

Another type of training suggested by the telework literature is that the manager of a teleworker be instructed in the type of supervision that is most appropriate for managing remote workers. For successful telework management many sources suggest that management by objectives or results is necessary, as opposed to the traditional management by sight style. Also, managers should be provided information concerning appropriate techniques for providing feedback to remote employees (Dickisson, 1997; Jacobs and Sell, 1996; Steve, 1996). Once managers are comfortable they possess the management skills best suited to telework, they are more likely to allow telework more frequently and among a larger number of employees. Therefore it is proposed that:

- H6 Training managers of teleworkers in management techniques appropriate to managing teleworkers will be positively related to the diffusion of telework.

Similarly, training of teleworkers is also recommended (Blodgett, 1996; DeSanctis, 1983; Raths, 1990). Most experts agree that teleworkers should receive training on any new equipment, as well as in time management techniques. It is also recommended that they be trained to deal with learning to separate their worklife from their homelife. Employees who are trained to deal with these issues are more likely to be able to telework more frequently. Therefore, it is proposed that:

- H7 Training of teleworkers will be positively related to the diffusion of telework.

Planning of Telework Arrangements

The telework literature suggests that planning is important to the success of telework arrangements. Often this planning includes the use of a pilot program (Blake, 1994; Blodgett, 1996b). Blodgett (1996a) even recommends contacting other companies to learn from their experiences with telecommuting. Gordon (1987) advocates a "measure twice, cut once" approach to planning telework. Similarly, Atkinson (1985) states that those who do not plan or outline objectives for the use of telework arrangements are never as satisfied with the arrangements as those who do plan. Hamilton (1987) even suggests that there are very few disadvantages to telework that cannot be overcome by planning. Good planning of the arrangement will allow a larger number of people to telework by minimizing the barriers and disadvantages. Therefore, it is proposed:

- H8 Planning telework arrangements is positively related to the diffusion of telework.

Existence of a Career Ladder for Teleworkers

Many authors in the popular telework literature suggest that the growth of telework is limited by a fear on the part of teleworkers that they will be passed over for promotions (Coulson-Thomas, 1991; D'Attilio, 1985; DeSanctis, 1983; Jones, 1996; Verespej, 1994). They believe that when teleworkers are out-of-sight, they are also out-of-mind. Since it is commonly suggested by experts that telework be voluntary, individuals with such concerns would be less likely to agree to telework. Therefore it is proposed that:

- H9 The existence of a career ladder for teleworkers is positively related to the diffusion of telework.

Methodology

Data concerning the relationship between the facilitator

variables and the adoption and diffusion of telework among programmer/analysts was gathered through the use of a U. S. survey of top information systems (IS) executives who either head an IS firm or are the top executive of an IS department. Programmer/analysts were chosen both because the job is often cited as containing appropriate tasks for telework (Coulson-Thomas, 1991; Davis, 1991; DeSanctis, 1983; DiMartino and Worth, 1990), and these individuals also possess an existing familiarity with computers which would avoid compounding any effects that may result from the introduction of the use of computers to telework.

The executives were asked to respond based on telework performed by the programmer/analysts who reported to them. Telework was clearly defined to them as that work which is performed during normal work hours at a site other than the normal worksite. Only firms with more than four employees were used to eliminate the inclusion of firms with home offices as opposed to teleworkers who are substituting home-based work for office work.

Since the targeted population to study telework was programmer/analysts, firms were sought which would have a significant number of programmer/analysts. Initially, a mailing list containing the names of IS firms (those with SIC codes related to programming services) was obtained. To increase the sample size and to also gather data about programmer/analysts in IS departments, a list of top IS executives was obtained from Applied Computer Research.

Approximately 1590 total questionnaires were assumed to have reached the top IS executive, with 293 individuals responding (an eighteen percent response rate). These responses resulted in 252 usable surveys. Respondents were specifically asked to return the surveys regardless of whether or not any employees telework, so that adopters of telework could be compared to non-adopters. One hundred and twenty (120) respondents indicated that their firms permitted some degree of teleworking, while 132 respondents reported no teleworking was currently being done.

Non-response bias was checked for the IS firms by size and geography and no significant departures from expectations were noted. The non-response bias for IS departments was checked by industry and again no significant differences were noted.

Measurement of the Facilitator Variables

Since the facilitator variables are not currently widely used in the innovation literature, there were few measures that could be adapted for this study. The measures for the general facilitator innovation variables, top management support and the existence of a champion, were adapted from Rai (1990). The balance of the independent variables were suggested by the telework literature but no previously validated measures were available. Therefore, questions were developed specifically for this study. The questions used to measure each construct can be found in Appendix A.

Validity and Reliability

Several steps were taken to ensure the validity and reliability of the questions used. The completed questionnaire was reviewed for content validity by four academics who were familiar with the research.

Reliability was tested by computing Cronbach's alphas for each multi-item measure (results of this analysis can be found in Appendix A). Confirmatory factor analysis was performed on the facilitator variables to test for construct validity. The factors loaded as expected, as indicated in Appendix B.

Measurement of the Adoption and Diffusion Variables

The measures used to determine the extent of innovation adoption and diffusion have been the subject of much discussion (Fichman, 1994; Grover and Goslar, 1993; Rogers, 1983; Tornatzky and Klein, 1982). For purposes of this study, adoption and diffusion were measured using the multi-dimensional matrix shown in Appendix C. This matrix is similar to that used by Nilakanta and Scamell (1990) to measure the diffusion of database development environments, as well as by Rai and Howard (1994) to describe CASE diffusion. The use of this type of multi-dimensional measure was also encouraged by Grover and Goslar (1993) and Tornatzky and Klein (1982).

Using the response matrix, respondents reported the number of days teleworked per week (level of telework) and the percentages of employees who teleworked at each level. Adopters are defined as organizations which have any employees teleworking at all, while non-adopters are those for whom 100 percent of the employees never telework. Diffusion is calculated as a weighted average of a level indicating the amount of weekly work-time spent teleworking and the number of employees participating at each level. (See Appendix C for a sample computation).

This multi-dimensional measure has several advantages, particularly when studying a single innovation. It can be designed to account for the characteristics of the particular innovation. The information available from the use of this multi-dimensional measure is one of the advantages of studying a single innovation, but it does mean care must be taken to maintain consistency when comparisons are made across innovations. Also, the use of the multi-dimensional measure allows an interval measurement scale to be used for diffusion rather than the categorical, or at best interval, measures often used. The use of this measure results in different scales for the facilitator variables and the adoption and diffusion measures, thereby reducing the chance of common method variance.

Results

Demographics

Among those reporting telework arrangements, only

16.44% are formal telework programs recognized by management. When asked to report the model that best described the one used in the organization, 7.7% reported it is targeted to a business function or job, while 20% reported that the arrangements are corporate policy and 81.5% reported adhoc arrangements (note: some respondents reported the use of multiple models). These two statistics together suggest that most telework is taking place on an informal, ad-hoc basis. Therefore, telework adoption and diffusion appear to be implemented on a bottom-up basis (i.e., employees or individual managers initiating the arrangement) rather than a top-down (corporate policy) approach.

Even among those who have adopted telework, it is not widely diffused. Among adopters an average of 73.4% of the staff never teleworks, 15% telework occasionally, 3.9% telework one day a week, 1.8% telework two days a week, 1.4% telework three days a week, 0.6% telework four days a week and 3.8% telework full-time (five days a week).

Adoption and Diffusion

Because of the use of multiple mailing lists and the use of Likert-scales for the facilitator variables resulting in rank-order scales, non-parametric statistics were used. Both the Mann-Whitney U test (the equivalent parametric test is the t-test) and Kendall's Tau (the equivalent parametric test is the Pearson Correlation) were chosen because they are very powerful relative to their equivalent parametric tests. (Daniels, 1990, Conover, 1980; Gibbons, 1985).

Adoption Variables

The availability of quality communications media (H4), training managers about the benefits of telework (H5), the existence of adequate security measures (H3), the existence of a champion (H2) and top management support (H1) were all highly, significantly related to the adoption of telework (p values < 0.0002). Thus all the hypotheses related to the adoption of telework were supported.

Diffusion Variables

In the case of diffusion the existence of a career ladder (H9), planning of telework arrangements (H8), training managers about the benefits of telework (H5), the existence of perceived adequate security measures (H3), the existence of a champion (H2) and top management support (H1) were all significantly related to the diffusion of telework. However, availability of quality communications media (H4), training the managers of teleworkers (H6) and training of teleworkers (H7) were not significantly related to the diffusion of telework.

Although these facilitators are recommended in the popular literature by those familiar with telework, they were not found to be significantly related to diffusion in this study. This may be a result of the fact that the respondent was the IS manager. Also in this study few teleworkers were teleworking full-time. Those teleworking part-time may be able to arrange tasks in such a way as to minimize the need for these facilitators. Also the success of the program was not measured. Perhaps these variables are important to the level of success of

<u>Variable</u>	<u>Adopters</u>	<u>Nonadopters</u>	<u>p-value</u>
Availability of Quality Comm. Media	146.39	108.42	0.0000
Training Manager-Benefits	142.64	109.68	0.0002
Perceived Adequate Security Measures	144.60	108.97	0.0001
Champion for telework	155.67	99.98	0.0000
Top Management Support for telework	159.92	94.93	0.0000

Table 1: Mann-Whitney U Test for Adoption Variables

<u>Variable</u>	<u>Coefficient</u>	<u>p-value</u>
Career Ladder for teleworkers	0.3329	0.000
Planning	0.1677	0.024
Availability of Quality Comm. Media	0.0321	0.317
Training Manager—		
—About Benefits	0.1724	0.006
—Of Teleworker	0.0980	0.138
Training Teleworker	0.1260	0.073
Perceived Adequate Security Measures	0.2790	0.000
Champion for telework	0.3325	0.000
Top Management Support for telework	0.3889	0.000

Table 2: Kendall's Tau Correlation Test for Diffusion Variables

the telework program rather than the diffusion of the program.

The impact of the general facilitator variables, the existence of a champion and top management support, on both the adoption and diffusion of telework suggests that these variables are also generalizable to the specific innovation telework.

Limitations

Caution must be advised in generalizing this study beyond an IS framework. As stated above, programmer/analysts were chosen due to the suitability of job tasks and their familiarity with computers. If these factors are not present, they must be taken into account in future studies. However, it would be valuable to extend this research beyond IS professionals.

Also, this study is cross-sectional since the aim was to empirically explore the factors related to telework adoption and diffusion across a number of different organizations in the U.S. As a result, it suffers from the limitations of cross-sectional studies and further research should study the adoption and diffusion processes of telework on a longitudinal basis.

Similarly, in-depth studies of these relationships, particularly the use of the facilitator variables, using case study methodology are recommended. Additionally, since the variables related to training were subdivided, the resulting measures were single-item measures. Future studies should explore these training variables using multiple-item measures.

Discussion and Conclusions

The general innovation facilitator variables adapted to telework, the existence of a champion for telework and the importance of top management support for telework, were related to both the adoption and the diffusion of telework. This result is consistent with other innovation studies and is particularly relevant since telework, as discussed, is an administrative innovation which requires structural changes in the organization and/or its culture. These changes are best accomplished with both a champion and top management support.

The telework specific variable, perception of adequate security measures, was also significantly related to both the adoption and diffusion of telework. With the use of a company intranet (using web tools to build an internal network behind corporate firewalls), security concerns may be reduced without sacrificing access to important information. Intranets and other new technologies (i.e., encryption technologies) can provide increased security, while still maintaining the availability of corporate information necessary for teleworkers. If these technologies can be implemented cost-effectively, they should help spur the growth of telework and other forms of remote work.

Training managers about the benefits of telework was also found to be related to both the adoption and diffusion of telework. Although the literature suggests that managers

provide a significant barrier to both the adoption and diffusion of telework (Ruppel and Harrington, 1995), it appears that training managers about the benefits of telework can provide a method for reducing the impact of this barrier. This finding is consistent with the absorptive capacity and organizational learning literatures previously discussed which suggest the importance of knowledge to innovation adoption and diffusion.

Similarly, the availability of quality communications media was significantly related to the adoption of telework, but not its diffusion. Perhaps the availability of quality communications media is important when deciding to adopt telework. However, once it has been found that the media is sufficient to support one programmer/analyst, and the role quality communications media plays in teleworking is clarified, this factor is not important when considering allowing others to telework or allowing the teleworker to work from home more frequently. However, since the majority of the arrangements represented in this study are part-time, this factor may not be as limiting as it would be in the diffusion of full-time telework. If telework grows as predicted, this issue should be revisited using full-time telework arrangements.

Also, the current growth of the Internet and intranets has the ability to increase the availability of quality communications media. By the year 2000 it is estimated that 36 million U. S. households will be connected to the Internet (Spangler, 1996). This also suggests that computers and communications links will be available in many workers' homes. Internet phone applications, Internet fax applications and desktop videoconferencing are also becoming more widely available and more cost effective. Additionally, the availability of access for telecommuters to company information and applications is becoming easier through company intranets. As previously discussed with respect to perceived adequate security measures and intranets, as the use of these enabling technologies grows they may well positively impact the growth of telework.

Champions of telework may also wish to ensure the existence of a career ladder for teleworkers since this factor was significantly related to the diffusion of telework. Electronic newsletters on an intranet can be a way to provide teleworkers with career information (by including job postings), as well as keeping teleworkers informed about the social aspects of the company to reduce any sense of social isolation. Teleworkers can also post personal pages and join chat sessions on the intranet so that while they are "out-of-sight" they are not necessarily "out-of-mind."

Similarly, planning telework arrangements is also related to the diffusion of telework as the practitioner literature suggests. This planning may include several of the other variables previously discussed such as providing training and putting quality communications channels into place. It is interesting to note that planning and training of managers and teleworkers loaded on the same factor in the analysis. Perhaps

the type of training related to telework is specific to the type of telework arrangement planned. As discussed, many of the telework arrangements in this study are part-time and this type of training may not be as important as it would be in a full-time arrangement. Planning may also include pilot-testing of telework arrangements. Blodgett (1996a) reports that Aegon was able to control costs and learn from its mistakes by pilot-testing their telecommuting arrangements.

Therefore, the results of this study suggest that the general facilitator variables of top management support and the existence of a champion are important in the adoption and diffusion of telework, these general facilitator variables do not provide information concerning all the factors appropriate to facilitating the adoption and diffusion of the innovation telework. Several innovation-specific variables such as availability of quality communications media, perceived adequate security measures and managerial training about telework were also significantly related to both the adoption and diffusion of telework.

The strength of the significance of these facilitator variables suggests that studying only general innovation variables will not provide a complete explanation to the innovation process, and this oversight may help explain the inconsistencies found in the innovation literature. Meanwhile, the search

also continues for additional general innovation variables that may provide insight. For example, Prescott and Conger (1995) suggest the use of climate/culture as one such promising variable. However, this study suggests that part of the answer is that the general innovation variables may apply to many different innovations. For example, top management support and the existence of a champion for an innovation appear to be important across many different innovations, while other general innovation variables appear to be relevant to some innovations but not others (Damanpour, 1991; Prescott and Conger, 1995; Wolfe, 1994).

Therefore, these results suggest that explaining the adoption and diffusion of a specific innovation also requires consideration of the factors related to that specific innovation. Rather than applying only general innovation variables to all innovations, an explanation of the inconsistencies in the innovation literature may lie in the study of specific innovations, including specific factors, and the subsequent identification of similarities and difference in these factors across innovations. This method may also lead to groupings within innovations, which may include common facilitators similar to those found in this study. Future research should study specific innovations or small groups of highly related innovations. Care must still be exercised to compare the relevant

Appendix A

Facilitator Variables

Existence of a Champion for Telework (alpha = .72)

Telework has no strong advocates or champions here (reverse scored).

There are one or more persons in this IS department/firm who are pushing for telework very enthusiastically.

Top Management Support for Telework (alpha = .66)

Top management does not consider telework appropriate for programmer/analysts in this firm.

This firm's top management is in favor of implementing telework arrangements.

Availability of Quality Communications Media (alpha = .61)

This firm has an e-mail or voice-mail system which is widely used.

This firm has sophisticated communications tools in place such as networks and dial-in capability.

Existence of a Career Ladder (alpha = .60)

This department has a career ladder available to all teleworkers.

Teleworkers have the same opportunities for career advancement as those who work in the office.

Planning (alpha = .71)

This department/firm pilot-tested our telework arrangement(s).

This department/firm carefully planned our telework arrangement(s) before adopting it.

Perceived Adequate Security Measures (alpha = .71)

Security measures in this firm are not sufficient to allow programmer/analysts to telework. (reverse scored)

This firm has a set of security measures that would be adequate to support telework.

Training

Manager about the benefits

The managers in this IS department/firm have been provided information concerning the benefits to the company of teleworking.

Manager of teleworker

Managers of teleworkers were provided training in special techniques for managing teleworkers.

Teleworker

All teleworkers were provided training sessions on the techniques which can be used to make them productive teleworkers.

Appendix B: Facilitator Variable Factor Analysis

	ROTATED FACTOR MATRIX				
	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
Career Ladder	.05270	-.04563	.83672	.03297	.13195
Career Ladder	.05113	.25878	.69475	.16100	-.12888
Planning	.73360	.23295	-.23138	-.03770	.10767
Planning	.83206	-.00150	.02946	.09550	-.07112
Avail. of Quality Comm. Media	.11366	-.06442	-.05755	-.08118	.85805
Avail. of Quality Comm. Media	.05409	-.01318	.12187	.46466	.59372
Training Manager- Benefits	.49722	.40531	.19048	-.07775	.21418
Perceived Adequate Security	-.06716	.31209	-.09287	.77183	.16556
Perceived Adequate Security	.12116	.01321	.24165	.76952	-.10721
Champion for telework	.02538	.84428	-.01537	.14401	.05505
Champion for telework	.38367	.57435	-.13404	.02665	-.00788
Top Management Support	-.09621	.74284	.22215	.07783	-.12992
Top Management Support	.16117	.61253	.50299	.12915	-.12796
Training-Teleworker	.78658	-.05736	.20062	.16713	.05533
Training-Mgr. Tele.	.59541	.00323	.40159	-.24716	.18287

Appendix C: Diffusion Measure

	Example	Your Responses
Percentage of our staff who never telework	30 %	__%
Percentage of our staff who occasionally, but not regularly, telework	15 %	__%
Percentage who regularly telework an equivalent of 1 day a week	30 %	__%
Percentage who regularly telework an equivalent of 2 days a week	20 %	__%
Percentage who regularly telework an equivalent of 3 days a week	5 %	__%
Percentage who regularly telework an equivalent of 4 days a week	0 %	__%
Percentage who regularly telework an equivalent of 5 days a week	0 %	__%
Total:	100 %	100 %

The frequency levels of telework have been coded to range from zero for the first level (never telework) to 6 for the last level (equivalent of 5 days a week). These codes are then weighted by the percentage of workers at each level. For the example case, the calculation would be: $0.30*0 + 0.15*1 + 0.30*2 + 0.20*3 + 0.05*4 + 0*5 + 0*6 = 1.55$

factors, as previously discussed, at similar points in the innovation process (Prescott and Conger, 1995, Wolfe, 1994).

The importance of comparing factors at similar points in the innovation process is also indicated by the results of this study. The factors, including innovation specific factors, which affect innovation adoption are not necessarily the same factors as those impacting innovation diffusion. For example, the availability of quality communications media was related to the adoption of telework, but not the diffusion of telework. These variables may have a direct effect, as in this study, or may interact with other variables, including the general innovation variables.

The inclusion of these innovation-specific facilitator variables can be particularly useful in identifying possible barriers to an innovation's adoption and diffusion within an organization. This knowledge can be useful for two purposes.

One purpose is to make information concerning possible barriers to an innovation's adoption and diffusion available to those wishing to champion and/or implement the innovation, while another purpose is to help explain why potentially beneficial innovations may not be adopted and/or diffused as expected.

This study provides insights to those wishing to champion telework concerning factors which may act as barriers to the adoption and diffusion of telework. As these results suggest, those who wish to champion telework should obtain top management support. Additionally, this study also suggests that gaining this support may be aided by providing information/training about the potential benefits of telework. Similarly, it may also be easier to obtain support for telework soon after the adoption and implementation of communications and security related innovations such as intranets and

Internet access. Therefore, while the growth of telework has been slower than expected, this study suggests that recent advancements in communications and security technologies may impact telework's growth by removing or mitigating these barriers. Whether it will ever reach the proportions often predicted and become a widespread phenomenon remains to be seen.

References

- Atkinson, W., (1985). Home/Work, *Personnel Journal*, 64(11), pp. 105-109.
- Baig, E. C. (1995). Welcome to the Officeless Office, *Business Week*, 430, 104-106.
- Blake, M. (1994, April). Teleworking in the Nineties: A Look at Current Views, *Managing Information*, 1(4), 24-26.
- Blodgett, M. (a), (1996). Lower costs spur move to more telecommuting, *ComputerWorld*, 30(45), 8.
- Blodgett, M. (b), (1996). Telecommuting pilot test proves space-saving plan, *ComputerWorld*, 30(46), p 81-82.
- Boyton, A. C., Zmud R. W. and Jacobs, G. C.(1994). The Influence of IT Management Practice on IT Use in Large Organizations, *MIS Quarterly*, 18(3), 299-318.
- Christensen, K. (1990, February). Remote Control, *PC Computing*, 3(2) 90-94.
- Cohen, W. M. and Levinthal, D. A. (1990) Absorptive Capacity: A New Perspective on Learning and Innovation, *Administrative Science Quarterly*, 35, 128-152.
- Conover, W. J. (1980). *Practical Nonparametric Statistics*, 2nd edition, New York: John Wiley & Sons.
- Coulson-Thomas, C. (1991). IT and New Forms of Organisation for Knowledge Workers: Opportunity and Implementation, *Employee Relations*, 13(4), 22-32.
- D'Atillo, L. (1985, February 15). On the Job, *Datamation*, 31(4), 156-158.
- Damanpour, F. (1987). The Adoption of Technological, Administrative, and Ancillary Innovations: Impact of Organizational Factors, *Journal of Management*, 13(4), 675-688.
- Damanpour, F. (1991). Organizational Innovation: A Meta-Analysis of Effect of Determinants and Moderators, *Academy of Management Journal*, 34(3), 555-590.
- Daniel, W. W. (1990) *Applied Nonparametric Statistics*, 2nd edition, Boston: PW-Kent Publishing Co.
- Davis, F. (1991, April 1). Telecommuting Aids Economy, Ecology, Firm and Employee, *PC Week*, 138.
- DeSanctis, G. (1983, October). A Telecommuting Primer, *Datamation*, 29(10), 214-220.
- Dickisson, K. H. (1997). Telecommuting Got your homework done?, *CMA Magazine*, 3-14.
- DiMartino, V. and Wirth, L. (1990). Telework: A New Way of Working and Living, *International Labour Review*, 129(5), 529-554.
- Drury, D. H. and Farhoomand, A. (1996). Administrative innovation applied to systems adoption, *International Journal of Technology Management*, 12(1), 45-58.
- Dvorak, J. C. (1994). Domestic Bliss, *PC Computing*, 7(12), 75.
- Fichman, R. G. (1994, December) Alternative Measures of Organizational Innovativeness: A Conceptual and Empirical Analysis, Diffusion Interest Group in Information Technology (DIGIT) Conference, Vancouver, Canada.
- Fiol, C. M. (1996) Squeezing harder doesn't always work: Continuing the search for consistency in innovation research, *Academy of Management Review*, v21(4), 1012-1021.
- Furger, R. (1989, October 9). The Growth of the Home Office. *InfoWorld*, 11(41), 45-49
- Gibbons, J. D. (1985). *Nonparametric Statistical Inference*, 2nd edition, New York: Marcel Dekker, Inc.
- Gordon, G. E. (1986, Summer). Telecommuting: Planning for a New Work Environment, *Journal of Information Systems Management*, 3(3), 37-44/
- Grover V. and Goslar, M. E. (1993). The Initiation, Adoption, and Implementation of Telecommunications Technologies in U.S. Organization, *Journal of Management Information Systems*, 10(1) 141-163.
- Hamilton, C.A. (1987, April). Telecommuting, *Personnel Journal*, 66(4) 91-101.
- Henderson, Lisa (1995) Telecommuting: It's All in Your Head, *Midrange Systems*, 14.
- Hotch, R. (1993, February). Managing From A Distance, *Nations Business*, 24-26.
- Huber, George (1996). Organizational learning: A guide for executives in technology-critical organizations, *International Journal of Technology Management*, 1996, 11(7&8) 821-832.
- Huws, U., Korte, W. B. and Robinson, S. (1990). *Telework: Towards the Elusive Office*. Chichester: John Wiley & Sons.
- Jacobs, S. M. and Sell, M. V. (1996, Winter) Telecommuting: Issues for the IS Manager, *Information Systems Management*, 18-22.
- Jones, D. (1992, June 15). Telecommuting A Good Fit for Insurance, *National Underwriter*, 96(24), 35.
- Jones, D. (1996, November 25). Telecommuting Honks Own Horn: Few Hop Aboard, *USA Today*.
- Knight, F. S. (1994, March). Telecommuting's Time—Has It Come?, *Business Communications Review*, 24(3), 6.
- Kwon, T. E. and Zmud, R. W. (1987). Unifying the Fragmented Models of Information Systems Implementation, in Boland R. J. and Hirschheim, R. W. (Eds.) *Critical Issues in Information Systems Research*, Chichester: John Wiley & Sons.
- Lavalle, W. (1993, December). Telecommuting still limited, but growing, *Communications News*, 30(12), 30,35.
- Marshall, J. J. and Vredenburg, H. (1992). An Empirical Study of the Factors Influencing Innovation Implementation in Industrial Sales Organizations, *Journal of the Academy of Marketing Science*, 20(3), 205-215.
- Misutka, F. (1992, May). The Workplace Takes Wing, *Canadian Business*, 65(5), 73-77.
- Nilakanta, S., and Scamell, R. W. (1990) The Effect of Information Sources and Communication Channels on the Diffusion of Innovation in a Database Development Environment, *Management Science*, 36(1), 24-40.
- Niles, J. S. (1992, November). Bringing it All Back Home: A Look at the Bottom Line, *Corporate Computing*, 1(5), 181-183.
- Premkumar, G. and Potter, M., (1995). Adoption of computer Aided Software Engineering (CASE) Technology: An Innovation Adoption Perspective, *The DATABASE for Advances in Information Systems*, 26(2&3) 105-123.
- Prescott, M. B. and Conger, S. A., (1995). Information Technology Innovations: A Classification by IT Locus of Impact and Research Approach, *The DATABASE for Advances in Information Systems*, 26(2&3), 20-41.

- Rai, A. (1990). Stimulating the Use of Computer-Aided Software Engineering in Information Systems Departments: An Empirical Investigation of Elements of Innovation Theory, (Doctoral dissertation, Kent State University, 1990).
- Rai, A. & Howard, G. S. (1994), Propagating CASE Usage for Software Development: An Empirical Investigation of Key Organizational Correlates, *OMEGA International Journal of Management Science*, 22 (2), 133-147.
- Raths, D. (1990, December 10), Taking An Alternate Route, *InfoWorld*, 12(50), 51-56.
- Rogers, E. M. (1983). *Diffusion of Innovations*, New York: Free Press.
- Ruppel, C. P and Harrington, S.J. (1995). Telework: An Innovation Where Nobody is Getting on the Bandwagon?, *The DATABASE for Advances in Information Systems*, 26(2&3), 87-104.
- Sharma, S. (1995). Studying Computer-Aided Software Engineering Diffusion in Organizations: Complementing Classical Diffusion Theory with Organizational Learning Perspective, *Proceedings of the First Americas Conference on Information Systems*, August 25-27, 1995, 340-342.
- Schepp, B. (1990, October). The Best Opportunities for Telecommuter, *Home-Office Computing* 8(10), 49-51.
- Steve, B. (1996, January) Telecommuting: Concepts and Resources, *Business Credit*, 36-40.
- Spangler, T. (1996, November 19). The Net Grows Wider, *PC Magazine*. 147-162.
- Szappanos, A. (1993, January 18). Technology eases telecommuting: At-home employees on the rise, *Crain's Cleveland Business*, 14(3), 13-14.
- Tornatzky, L. G. and Klein, K. J. (1982). Innovation Characteristics and Innovation Adoption-Implementation: A Meta-Analysis of Findings, *IEEE Transactions of Engineering Management*, 29(1), 28-45..
- Tyre, M.J. and Orlikowski, W. J. (1993). Exploiting Opportunities for Technological Improvement in Organizations, *Sloan Management Review*, 35(1) 13-26.
- Verespej, M. (1994, July 4). The Anytime, Anyplace Workplace, *Industry Week*, 243(13), 37-40.
- Wheeler, M. and Zackin, D. (1994, June). *How Telecommuting Computes, Across the Board*, 31(6), 56-57.
- Wolfe, Richard A. (1994) Organizational innovation: Review, critique and suggested research directions, *Journal of Management Studies* 31(3) pp. 405-431.
- U. S. Department of Transportation. (1993, April). *Transportation Implications of Telecommuting*, Washington, DC: U. S. Government Printing Office.

Cynthia P. Ruppel, Assistant Professor, College of Business, The University of Toledo, Toledo, OH, received her Ph.D. in Management Information Systems from Kent State University. Her interests include telecommuting and other forms of virtual work arrangements, IT innovation adoption and diffusion, as well as organizational culture/climate and change management. She has published in DATABASE for Advances in Information Systems.

Geoffrey S. Howard, Associate Professor, College of Business, Kent State University, received a D.B.A. in Management Information Systems from Kent State University in 1984. Dr. Howard is active in many areas of research interest, including offshore programming in small island nations (SINs), the functional displacement and retraining of late-career analysts and programmers, the diffusion of innovation in corporate data centers, telecommuting and virtual corporations, computer anxiety and technophilia, and the impact of CASE tools and systems methodologies on system development. He has led the design and implementation of a leading-edge university advisement application that runs in a LAN-based SQL-compliant client/server environment. Prior to coming to Kent, he accumulated 15 years of industry experience in various management capacities in electrical engineering and system development. He has published his work in Decision Sciences, Communications of the ACM, The Journal of Systems Management, The Computer Journal, and other academic outlets. He was selected twice as one of the top ten teaching professors at Kent State University, is frequently chosen as top Freshman Orientation instructor, has been inducted repeatedly into Mortar Board for excellence in classroom teaching, and was the first winner of the Paul Pfeiffer Award for Creative Excellence in Teaching. Dr. Howard is a Registered Professional Engineer in the State of Ohio, and is active in a number of professional societies in the systems and engineering professions.

0 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/article/facilitating-innovation-adoption-diffusion/51052

Related Content

A Comparison of American and Indian Consumers' Perceptions of Electronic Commerce

Craig Van Slyke, France Belanger and Varadharajan Sridhar (2005). *Information Resources Management Journal* (pp. 24-40).

www.irma-international.org/article/comparison-american-indian-consumers-perceptions/1269

eInsurance Project: How to Develop Novel Electronic Services with Co-operation between Academics and Practitioners

Raija Järvinen, Jarno Salonen, Aki Ahonen and Jouni Kivistö-Rahnasto (2010). *Journal of Cases on Information Technology* (pp. 35-49).

www.irma-international.org/article/einsurance-project-develop-novel-electronic/49195

The Relevance of Learning Processes for IT Implementation

Tanya Bondarouk and Klaas Sikkell (2007). *Emerging Information Resources Management and Technologies* (pp. 1-23).

www.irma-international.org/chapter/relevance-learning-processes-implementation/10092

Distance Learning Techniques in University Courses

Paolo Frignani (2009). *Encyclopedia of Information Communication Technology* (pp. 166-172).

www.irma-international.org/chapter/distance-learning-techniques-university-courses/13354

Free Wireless Internet Park Services: An Investigation of Technology Adoption in Qatar from a Citizens' Perspective

Shafi Al-Shafi (2008). *Journal of Cases on Information Technology* (pp. 21-34).

www.irma-international.org/article/free-wireless-internet-park-services/3226