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Telecommuting's past and future: a literature review and research agenda

Samia M. Siha Richard W. Monroe

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Telecommuting's past and future: a literature review and research agenda

Telecommuting's
past and future

455

Samia M. Siha

*Michael J. Coles College of Business, Kennesaw State University,
Kennesaw, Georgia, USA, and*

Richard W. Monroe

East Carolina University, Greenville, North Carolina, USA

Abstract

Purpose – Telecommuting continues to be a topic of interest for practitioners and researchers alike. There are significant numbers of employees currently involved in telecommuting around the globe. Organizational implications, global workforce implications and the scarcity of scholarly publications make this research topic one that warrants our further investigation. The purpose of this paper is to explore the literature to identify the substantive work, examine the state of this phenomenon as of to date, particularly the failure and success factors, provide valuable insight to the practitioners and research directions to researchers

Design/methodology/approach – An extensive literature review was conducted in an effort to identify the significant, substantive work to date. We reviewed two major business data bases and limit our review to refereed journals because of the rigorous review process that these articles go through before publication.

Findings – A schema was identified to help categorize topics found in the literature. A framework model is proposed to further explore the relationships between the motivating factors for telecommuting and the resulting outcomes from telecommuting programs.

Practical implications – The literature review and the model should be useful information for both practitioners and researchers in a variety of disciplines including management, communication, and information technology.

Originality/value – Few published papers have attempted to thoroughly review the telecommuting literature. Many of the articles concentrate solely on the individuals who telework. This review, looks at many facets of the telecommuting phenomenon like the workers, their managers, the organization as well as the technological and environmental issues.

Keywords Teleworking, Homeworking, Virtual work

Paper type Literature review

Introduction

A study by the Texas Transportation Institute found that the average time spent stuck in traffic in major US cities amounted to 56 hours per year in Los Angeles while Atlanta and Seattle followed closely with a total of 53 hours (Longman, 2001; <http://mobility.tamu.edu> (May 7, 2001). If we combine the traffic jams with the average total length of commute of more than 30 miles each way in those cities the total adds up to well over 400 hours per year. Clearly this is time that could be spent in a more productive fashion. Would not we all like to have ten additional weeks to accomplish more work each year?



Telecommuting is precisely the solution that can take many of those commuters out of their vehicles and out of those traffic jams. Workers will be more productive, the roads will be less congested and the air will be less polluted. Those are the promises of telecommuting – some have been realized while others have not.

Narrowly defined, telecommuting or “telework” (Watat and DiSanzo, 2000; Nilles, 1992; Olson, 1983) encompasses those opportunities that workers are given to work from home rather than reporting to a centralized office location. Another form of telecommuting is working at a distributed work arrangement such as satellite work centers, neighborhood work center, flexible work arrangement and generic offices (e.g. hotels and telework centers.) The number of workers involved in this form of telecommuting has been estimated at 7 million in the US in the mid 1990s (Feldman and Gainey, 1997) and has grown to about 19 million today (Davis, 2001). Elsewhere, about one million Canadians (Harris, 1998) and somewhat smaller numbers in Britain, New Zealand, Singapore and Finland have availed themselves of these opportunities.

An even greater number of workers are utilizing telecommunications technology to extend the workday after they arrive home (Feldman and Gainey, 1997). The people involved with this form of telecommuting are referred to as “occasional home workers” by Gray *et al.* (1993). Still another group is considered to be “mobile” workers (Gray, 1998) and this definition is typically associated with a mobile sales force and other workers that spend a majority of their time out of the office due to the nature of their job. Some of the issues related to the mobile workers are explored further by Watad and DiSanzo (2000). These additional forms of “telecommuting” increase the total number to somewhere between 30 and 40 million workers in the US (Apgar, 1998) that are working from home or from the road.

These distinctions are consistent with definitions offered by Gray *et al.* (1993) and as Mitchell (1996) suggested we need to put any discussion involving “telework” into context. The three forms described above apply to different situations and have different benefits and different issues. For our purposes, we will focus primarily on what we see as the true telecommuters or the individuals that represent the form of telecommuting that offers the greatest potential benefits. The telecommuting form in question applies to those workers that work from home for a full day on a weekly or monthly basis or perhaps on a more frequent basis and those who work at a satellite work location. So, “occasional home workers” or workaholics that extend the workday into the weekend hours and the “mobile” workforce will receive minimal coverage in the balance of our discussion.

Background

Telecommuting, virtual office and telework are a few of the terms used to describe the same phenomenon. The terms telecommuting and virtual office first appeared in articles in Martino (1979) and Giuliano (1981). The interest has grown significantly in more recent years as can be seen in Table I.

In the USA, companies have been motivated by the mandate from Congress in the 1990 Amendment to the Clean Air Act. The eleven states in the US with the worst air quality were targeted specifically. Organizations in those eleven states with more than 100 employees are required to reduce the number of employees commuting each day by 20 percent. Telecommuting is one means to achieve this reduction along with vanpools, mass transit incentives, four-day workweeks, and other variations.

Year	Business source elite ^a			Abi inform ^a		
	Telework	Virtual office	Telecommuting	Telework	Virtual office	Telecommuting
1979	0	0	0	0	0	1
1980	0	0	0	0	0	1
1981	0	0	0	0	1	4
1982	0	0	1	0	0	3
1983	0	0	1	0	0	6
1984	0	0	1	0	0	11
1985	0	0	0	2	0	21
1986	0	0	0	2	0	11
1987	0	0	0	0	0	12
1988	1	0	7	1	0	7
1989	0	0	8	1	0	20
1990	0	0	5	4	0	26
1991	0	0	10	3	2	34
1992	0	1	14	3	1	53
1993	0	2	41	0	11	95
1994	6	10	173	3	38	188
1995	14	26	165	14	35	285
1996	4	30	110	6	43	216
1997	6	33	116	13	36	293
1998	10	20	107	13	39	307
1999	12	15	83	16	34	209
2000	12	5	101	29	13	142
2001	10	6	76	39	14	151
2002	2	1	28	11	5	36
Totals	77	149	1047	160	272	2132

Note: ^aAs of July 11, 2002

Table I.
Distribution of articles by
year of publication,
database and keyword

Outside the US, studies of telecommuting in Britain (Stanworth, 1997; Mitchell, 1996), Finland (Suomi and Pekkola, 1998), Canada (Duxbury and Neufeld, 1999) and Singapore (Teo and Lim, 1998, 1999) are indicative of the worldwide interest in this topic. Although companies in those regions are not affected by US regulations, a variety of factors provide the motivation for implementing telecommuting programs in these countries.

Since the inception of telecommuting, a huge number of articles have been written exploring many of the promises of telecommuting as well as many additional issues that have become directly associated with telecommuting. Few published papers have attempted to thoroughly review the telecommuting literature. Many of the articles concentrate solely on the individuals who telework. Haddon and Lewis (1994) offers an annotated review of European work. McCloskey and Igbaria (1998) reviewed 32 empirical research articles, and Pinsonneault and Boisvert (2001) consider the negative and positive impact on Teleworkers. Bailey and Kurland (2002) review the research to find answers for questions like who Telework and why individuals telework and what happen when they do. In our review, we decided to look at many facets of the telecommuting phenomenon like the workers, their managers, the organization as well as the technological and environmental issues. This paper will explore the literature to identify the substantive work, examine the state of this phenomenon as of to date,

particularly the failure and success factors, provide valuable insight to the practitioners and research directions to researchers. A framework model is proposed to further explore the relationships between the motivating factors for telecommuting and the resulting outcomes from telecommuting programs.

Scope of study and research methodology

To identify the journal articles that describe, analyze or test the concept of telecommuting, we used the three keywords, virtual office, telecommuting, and telework. We restricted our research to the ABI Inform and EBSCO Host – Business Source Elite databases. We are aware that the selection of these databases may be a source of bias since they do not include the European based journal. However, we included European journals from Emerald database in our search. The result was overwhelming, in the ABI INFORM database alone, we found 2,132 articles using the keyword telecommuting, 272 articles using the keyword virtual office and 160 using the keyword telework. However, there was a great overlap between the databases. Table I shows the distribution by the year of publication and database. The number of articles jumped to a high level in year 1994 and the growth continue in the subsequent years. The reader may notice that the word “telecommuting” is more widely used than the word “virtual office” or “telework”.

To select higher quality articles and reduce the total quantity of articles we decided to limit our review to refereed journals because of the rigorous review process that these articles go through before publication. This decision cut the number of articles tremendously; for example, in the database “Business Source Elite” and under the keyword telecommuting the number went from 2,132 to 210. Then we decided to handpick some articles from the non-peer reviewed list that added valuable information or important insight to the research (Coutu, 1998; Apgar, 1998). These articles were chosen based on the journal reputation (e.g. *Harvard Business Review*), the relevance and the importance of the article’s content.

Next, we reviewed the retrieved articles and excluded the articles that are not related to the management discipline. Then, we looked at the references of the articles that passed the review process to see if we missed any related articles and we applied the above screening process to them.

The articles reviewed are classified by their orientation into description, conceptual, empirical, and case study. In an attempt to relate the issues covered to various management disciplines (Figure 1), we classified articles also by the main issues emphasized.

Classification by orientation

The articles were classified by their orientation (Table II) into the following four categories:

Descriptive. Articles that overview the practice of telecommuting, and its benefits and drawbacks. Examples of these articles are: Byrd and Gulbro (1998) who emphasize the importance of communication for the success of telecommuting. They suggest the use of electronic infrastructure to facilitate the communication. Tung and Turban (1996) support this suggestion and surveyed the various tasks performed by telecommuters utilizing the new technological development. Davis (1995) sites the

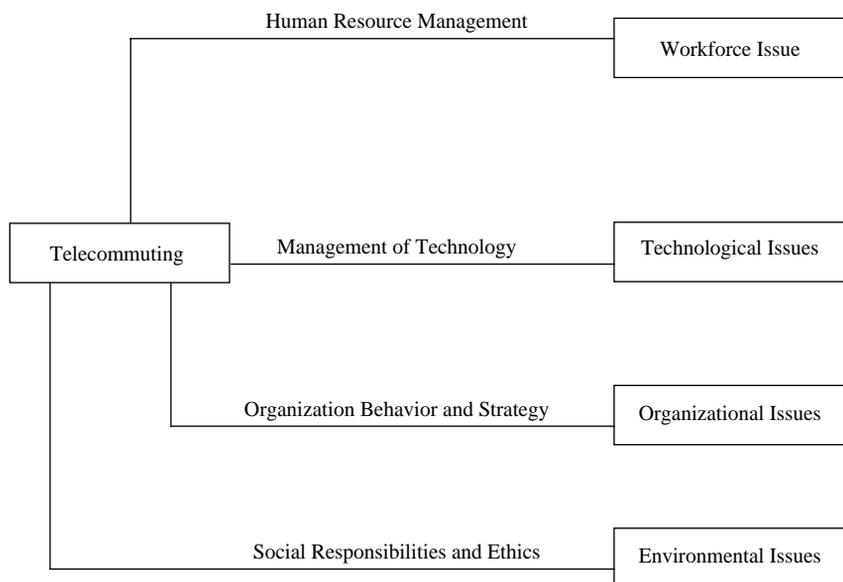


Figure 1.
Management disciplines
and telecommuting issues

Articles Orientation	Issues Number	Workforce	Organization	Technology	Environment
Descriptive	74	43	42	16	16
Conceptual	16	13	11	5	1
Empirical	52	47	21	5	3
Case Study	11	8	4	3	1
Total	153	111	78	26	21

Table II.
Distribution of articles by
orientation and issue

increase in productivity and the avoidance of traffic delay as major benefits of telecommuting.

Conceptual. Articles that present a theoretical framework, propositions, and models for implementing telecommuting. Examples of these articles are: Feldman and Gainey (1997) propose a theoretical framework that relates different telecommuting arrangement to employees' attitude and behavior. They also offer many propositions to be tested empirically along with a proposed research agenda. Shamir and Salomon (1985) who identifies some variables to be considered in the study of developing a telecommuting program investigates quality of working life of employees and its relation to telecommuting programs.

Empirical. Articles that present results from surveying and analyzing a large number of companies. Davenport and Pearlson (1998) performed one of the most extensive empirical studies. They surveyed 100 firms to understand how companies were adopting virtual office programs. They found different environments for virtual office that expands from working occasionally at home to being 100 percent mobile

with no office. This version again describes the mobile sales force working from their car and their hotel room. They suggest that managers need to adopt a different approach for leading in five key areas: managing people, managing information, managing teams, managing processes, and managing facilities. The importance of initiating a sound relationship between telecommuters and their managers was the subject of Reinsch's (1997) study. He concludes, among other issues, that the long-term telecommuting program may experience deterioration of the relationship. The federal government, states and local government have also experienced telecommuting programs and it proves to be successful (Kemp, 1995).

Case study. Articles that analyze the implementation of telecommuting to a particular company. Watad and DiSanzo (2000) presented a detailed case study that describes the success story of telecommuting program implementation. The program deployed new technologies, automated sales procedure, and their workers acquired new skills. The initial cost was high but the savings in direct cost offset it within 3 to 5 years. They contributed the success to top management support, comprehensive training and deployment of reliable IT architecture.

Description of schema

The first element of the schema is the breakdown of four issues: workforce issues, organizational issues, technological issues, and environmental issues. These issues were chosen based on their relevance to the various management disciplines (Figure 1) and their strong association with telecommuting. The majority of published articles and studies address issues in the first two categories (Table III). The four issues are further described in the following section. In each category we discuss a representative selection of articles that illustrate each main issue.

Workforce issues. The "Workforce Issues" category is primarily viewed from the employee's perspective. In this category the topics of balance family responsibility and work, productivity, impact on job satisfaction, communication, quality of working life, and employees' attitude towards telecommunication are discussed.

One major issue that has garnered a significant amount of attention is the balance issue that may be stated in terms of "Work/Life Balance" or "Work/Family Balance." Some of the articles that address this issue in various forms include Greengard (1994), Henkoff (1995), Shellenbarger (1997), Mokhtarian *et al.* (1998), Dixon and Webster (1998) and Hill *et al.* (1998). This issue is often cited as the major benefit that the worker who elects to telecommute will receive. The most frequently discussed topic within this group is work responsibility and family responsibility tradeoffs for telecommuters (Giuliano, 1981; Shamir and Salomon, 1985). The flexibility issue, of caring for young children or elderly family members while working from home, is typically discussed in conjunction with the balance issue. Dixon and Webster (1998) examine the relation between family structure and the perception of quality of work and non-work lives of telecommuters. Hill *et al.* (1998) present the results of an empirical study where the influence of the virtual office was examined. They found that it has a positive influence on productivity and flexibility; however, their results did not support the positive influence on work/life balance. Bailey and Kurland (2002) further conclude that work/life balance is indeed a benefit of telework but that the effect is primarily a benefit for "dual-career" families. Tietze (2002) in a series of case studies of UK telecommuters provides additional support for the benefits to dual-career spouses. In three focused

Name of author(s) (year)	Orientation	WF	Issues		Env't	Telecommuting's past and future
			Org.	Tech.		
Ahmadi <i>et al.</i> (2000)	D	X	X			
Allenby and Richards (1999)	D	X			X	
Allenby (2001)	D	X			X	
Apgar (1998)	D/CA	X	X			
Bailey and Foley (1990)	CA	X	X			
Bailey and Kurland (2002)	D	X	X			
Bélanger (1999a)	E	X				
Bailyn (1989)	E	X				
Bélanger (1999b)	E	X				
Bélanger and Collins (1998)	C	X	X			
Bentley and Young (2000)	CA	X		X		
Betts (1994)	D				X	
Bronson (1993)	D	X			X	
Boudreau <i>et al.</i> (1998)	C	X	X	X		
Byrd and Gulbro (1998)	D		X	X		
Chevron and Primeau (1996)	E	X				
Cascio (2000)	D		X			
Christensen (1992)	D		X			
Coulson-Thomas (1996)	E		X			
Coutu (1998)	CA	X				
Davenport <i>et al.</i> (1996)	C	X	X			
Crossman and Burton (1993)						
Davenport and Pearlson (1998)	D	X	X	X		
Davies (1996)	D	X	X			
Davis (1995)	D	X				
Demarie and Hitt (2000)	C		X	X		
Dennis (1998)	CA			X		
Martino and Wirth (1990)	D	X				
DeSanctis (1984)						
Dixon and Webster (1998)	E	X				
Dobrian (1999)	D		X		X	
DuBrin (1991)	E	X				
Duxbury and Neufeld (1999)	E	X	X			
DuBrin and Barnard (1993)	E	X				
Duxbury and Haines (1991)	E	X	X			
Ellis and Webster (1999)	E		X			
Duxbury <i>et al.</i> (1992)	E	X				
Evans (1993)	E	X				
Fairweather (1999)	D				X	
Feldman and Gainey (1997)	C	X				
Fitzer (1997)	CA	X				
Fritz <i>et al.</i> (1998)	E	X	X			
Gainey and Kelley (1999)	D	X	X			
Gallagher and Watchman (2000)	D		X			
Gerber (1995)	D	X	X			
Giuliano (1981)	D	X	X		X	
Gordon (1999)	D	X				
Grantham and Paul (1995)	CA		X		X	
Goodrich (1990)	D	X	X			

(continued)

Table III.
Telecommuting articles
listed by category and
issues

Name of author(s) (year)	Orientation	WF	Issues		Env't
			Org.	Tech.	
Gray <i>et al.</i> (1993)	D	X	X	X	
Gray (1997)	D		X	X	
Greengard (1994)	D		X		
Guimaraes and Dallow (1999)	E	X	X		
Gupta, <i>et al.</i> (2000)	E	X		X	
Guthrie (1997)	E		X		
Guthrie and Pick (1998)	E	X			
Haddon and Lewis (1994)					
Hamer <i>et al.</i> , 1991	E				X
Handy (1995)	D		X		
Handy and Mokhtarian (1995)	D		X		
Harler (1997)	D		X		X
Harrington and Ruppel (1999)	E	X	X		
Hartman <i>et al.</i> (1992)	E	X	X		
Henkoff (1995)	D	X			
Hequet (1996)	D	X			
Hill, <i>et al.</i> (1998)	CA	X			
Hobbs and Armstrong (1998)	E	X			
Hoejer (1996)	D			X	
Hooks (1990)	E	X	X		
Horner and Day (1995)	D	X	X		
Howard (1998)	D		X		
Hughson and Goodman (1986)					
Igbaria and Guimaraes (1999)	E	X			
Johnson (1998)	D	X	X	X	
Kavan, and Saunders (1998)	E	X	X		
Kemp (1995)	E	X			
Khaifa and Davidson (2000)	E	X			
Kilberg (2000)	D	X			
Knight and Westbrook (1999)	E	X			
Korzeniowski (1997)	D		X		
Kraut (1989)	D	X			
Kurland and Bailey (1999)	E	X			
Laws (2000)	D	X			
Leonard (1997)	D		X		X
Lim and Teo (2000)	E	X			
Lind (1999)	E	X			
Lupton and Haynes (2000)	E	X	X		
Lindstorm and Moberg (1997)	D		X		
Manire (1997)	D	X	X	X	
Martino (1979)	D			X	
Martino and Wirth (1990)	D	X			
Maruca and Egan (1998)	CA	X	X		
McCloskey <i>et al.</i> (1998)	E	X			
McCloskey and Igbaria (1998)					
McLarty 1993	D		X		X
Miller and Cardy (2000)	C	X	X		
Mitchell (1998)	D			X	
Mitchell (1996)	C	X	X		

Table III.

(continued)

Name of author(s) (year)	Orientation	WF	Issues		Env't	Telecommuting's past and future
			Org.	Tech.		
Mitomo and Jitsuzumi (1999)	Q				X	
Mokhtarian <i>et al.</i> (1998)	E	X	X			
Mooney (1999)	D	X		X		
Montgomery and Clancy (1994)	D		X			
Morris (2000)	E	X				
Mowshowitz (1994)	D		X	X		
Nilles (1992)	D	X				
Nilles (1996)	E	X				
Nilles (1997)	D	X				
Ogilvie (1994)	D		X			
Olson (1982)	D		X	X		
Olson (1983)	D	X				
Pendyala, Goulias, and Kitamura (1991)	E	X			X	
Philpott (1999)	D	X	X			
Pinsonneault and Boisvert (2001)	E	X	X			
Piskurich (1996)	D	X	X		X	
Pliskin (1997)	D			X		
Poltrock and Engelbeck (1999)	E	X				
Raghuram (1996)	D	X		X		
Ramsey (1997)	D	X	X			
Reinsch (1999)	E	X	X			
Reinsch (1997)	E	X				
Risman and Tomaskov-Devey (1989)	E		X	X		
Rose and Parker (1994)	D		X		X	
Ruppel and Howard (1998a)	E	X		X		
Ruppel and Howard (1998b)	E	X			X	
Salomon and Salomon (1984)	D	X				
Solomon and Templer (1993)	E	X	X			
Schilling (1999)	D		X			
Scott and Timmerman (1999)	E	X		X		
Seaman (1997)	D	X			X	
Shade (1998)	C	X		X		
Shamir and Salomon (1985)	C	X	X			
Shellenbarger (1994)	D	X				
Shifan (2000)	C				X	
Shuste (1999)	D	X	X			
Solomon and Templer (1993)	E	X	X			
Stanworth (1997)	D	X	X	X		
Staples <i>et al.</i> (1999)	C/E	X	X			
Sturgeon (1996)	C	X		X		
Sturgeon (1998)	C	X		X		
Suomi and Pekkola (1998)	C	X	X			
Tanzillo (1995)	D	X	X		X	
Teo and Lim (1998)	E	X	X			
Teo and Lim (1999)	E	X				
Tomaskovic-Devey and Risman (1993)	C	X	X			
Tung and Turban (1996)	D			X		
Tunyaplin <i>et al.</i> (1998)	E	X	X			

(continued)

Table III.

Name of author(s) (year)	Orientation	WF	Issues		
			Org.	Tech.	Env't
Vega and Brenan (2000)	C		X		
Venkatesh and Vitalari (1992)	E	X		X	
Walker (1995)	D		X		X
Wattad and Will (2003)	E		X		
Watad and DiSanzo (2000)	CA	X		X	
Wright (1993)	D	X	X		
Wright and Oldford (1993)	D	X			
Wustemann (1999)	CA	X			
Zeleny (1998)	D	X			
Zeleny (2000)	D	X			

Table III.

Note: The format of this table is adapted from Ahire and Golhar (1995)

cases, one male spouse was able to take on more family duties including "child rearing tasks" as a result of telework opportunities. A female in another case felt more pressure to maintain a very structured work atmosphere at home so that she could be productive and keep pace in her career. By contrast, one male subject turned down a promotion because it did not offer the opportunity to telework. From the range of research outcomes and propositions, the work/life balance issue is not as many had envisioned. In particular, women do not seem to benefit as much as do men. Additionally, the time that can be devoted to family duties is very limited. We believe that two major reasons for this limitation are the part-time nature of most telework arrangements and the need to show work results when teleworking.

Another frequently discussed topic is the increased productivity that results from eliminating the wasted time that a real commute requires (Davis, 1995; Hill *et al.*, 1998). An empirical study performed by DuBrin (1991) showed an increase in productivity of work-at-home employees, this was primarily associated with work that is structured, repetitive and measurable. The productivity benefits described in these articles are to some extent counter to the expected result. The potential productivity increases are key to company decisions to utilize telecommuting. As long as jobs and people are selected carefully for telecommuting, any concerns over productivity are mitigated.

Job satisfaction and worker motivation were the topic of empirical research by Bélanger (1999a), Igbaria and Guimaraes (1999), Venkatesh and Vitalari (1992), Hartman *et al.* (1992) and Dubrin (1991). They reported telecommuters' satisfaction with their job arrangement particularly if it is not mandatory by their employers. Working conditions, scheduling of one's own working hours, and taking care of family/personal responsibilities were the source of job satisfaction (DuBrin, 1991). Employees who reported the greatest satisfaction were those with children living at home (DuBrin, 1991).

A smaller number of articles have addressed worker attitudes (Knight and Westbrook, 1999; Teo and Lim, 1998; Feldman and Gainey, 1997; Chevron and Primeau, 1996). An empirical study by Chevron and Primeau (1996) examined telecommuters' attitude and behavior. They found that telecommuters appreciate the freedom and feel more efficient; however, the one aspect of the office that they missed was socialization (Chevron and Primeau, 1996).

Workforce Issues are also often interwoven with organizational issues and technology issues (Manire, 1997, Raghuram, 1996). One example of the crossover effect from one category to another is a group of articles that have suggested, "work rules" for the telecommuter (Feldman and Gainey, 1997; Manire, 1997; Wright and Oldford, 1993). This approach places limits on the worker thereby reducing their freedom but from the organization's perspective work rules offer at least a small degree of control that they may fear will be lost.

Organizational issues. Topics under organizational issues range from telecommuting adoption, employee retention and recruitment, increased work capacity, and other benefits to be gained by the organization (Ogilvie, 1994; Giuliano, 1981; Anderton, 1998; Apgar, 1998). Corporate culture, management attitude, relationship between telecommuters and managers, intra-organizational communication, and the role of trust are also investigated (Harrington and Ruppel, 1999). The relationship between telecommuting and business process reengineering was presented by Coulson-Thomas (1996).

A limited number of organizations have openly shared their experiences and given free access for researchers to delve deeper into the details of their organization's telecommuting initiatives (Hill *et al.*, 1998; Apgar, 1998). We identified 62 articles that focus on organizational issues.

Ruppel and Howard (1998b) explored environmental factors that impact telecommuting adoption and pinpointed "competitor's adoption" as a key factor that motivated firms to initiate their own telecommuting program. This factor also relates to several other organizational issues such as employee recruitment and employee retention.

Guimaraes and Dallow (1999) empirically tested the success factors for telecommuting programs. They found that the characteristics of supervisors, employees, tasks, and work environment are positively related to the success of the program. They also emphasized the importance of planning, management support and employees' selection.

The corporate culture is another concern, and it may be highly impacted when a telecommuting program is implemented (Watad and Will, 2003). Gainey and Kelley (1999) presented two arguments. The corporate culture that draws its strength from the employees' continuous interaction and face-to-face communications will be most affected. However, a bureaucratic culture that has extensive rules and regulations will handle telecommuting well. Additionally, Harrington and Ruppel (1999) empirical study indicates that the lack of trust of the employees is a primary barrier to telecommuting adoption and diffusion. It appears that group culture and organizational culture will influence the level of trust. Handy (1995) supports this argument and proposed seven rules of trust as a way to foster an environment that is conducive to telecommuting adoption.

In a directly linked topic, Duxbury and Neufeld (1999) assess empirically the impact of telecommuting on intra-organizational communication. They found that telework arrangements have no significant impact on the method or frequency of communications. They also found that managers effectively adapted how they communicate with telecommuters.

The issue of procedure and direction for choosing and assessing telecommuters was further discussed by Schilling (1995). He presents guidelines for evaluating types of

telework positions and parameters of telecommuter selection policy. Another study performed by Reinsch (1997) emphasized the importance of telecommuters' selection as well as the quality of the relationship between them and their managers.

One of the few case studies found during our research presents a successful telecommunication program implementation. The success was due to: "top management support, comprehensive training, deployment of reliable IT architecture in less than 6 months, and addressing technical and personnel issues immediately" (Watad and DiSanzo, 2000). An interesting relationship between telecommuting and BPR was presented by Coulson-Thomas (1996) based on a European study. It was found that more radical improvement and fundamental changes could be achieved by adopting telecommuting. The introduction of telecommuting may "redefine both processes and organizational structure" and its outcome can be as substantial as those of BPR.

A very revealing perspective suggests that telecommuting remains a passive strategy rather than a strategy that is pursued aggressively by management. This stems from management's reluctance to implement telecommuting as a prominent corporate wide strategy (Watad and DiSanzo, 2000). If this assessment is accurate, this is a major factor in the slow growth of telecommuting implementation.

Technological issues. Technology is the backbone of any telecommuting program. Managing information technology is critical in the ongoing support of all telecommuting programs. Companies must invest in the appropriate equipment at the central office and at the virtual office before they can claim any success in the world of telecommuting.

The topics and articles that deal with technological issues range from visionary (Martino, 1979) to very technical and very practical (Manire, 1997) and ultimately to the conceptual end of the spectrum (Tung and Turban, 1996). The primary topics include the most appropriate technologies for the telecommuter and the matching of technology with the task to be performed (Manire, 1997). Competing technologies, technology choices, and availability of technologies (i.e. rural versus urban) have also been described extensively. Gender equity has been raised as an issue with regard to access to the Canadian information infrastructure along with other issues that affect women who are telecommuting (Shade, 1998). Of the articles we reviewed, there were 26 articles (12.8 percent) that focus on technological issues.

Byrd and Gulbro (1998) discussed the importance of E-mail as a distributor and disseminator of information. However, they do caution that E-mail should not be utilized to solve employee problems or to convey criticism. Guidelines should be provided so that employees know when they should use face-to-face or telephone interactions.

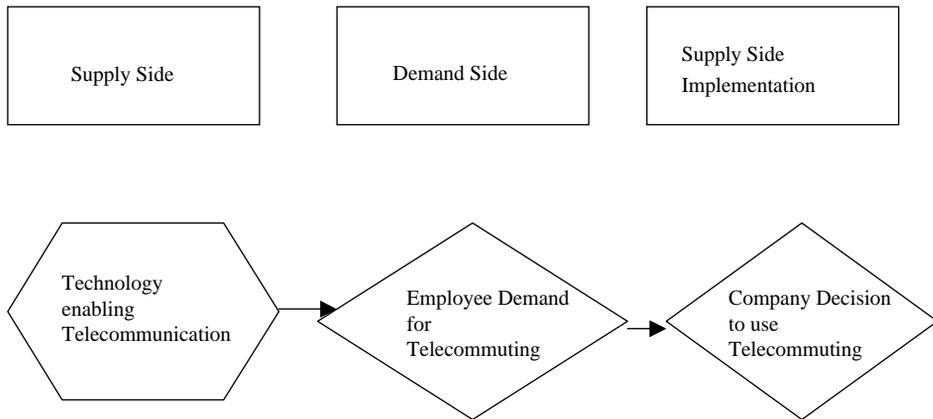
Several telecommuting issues were evaluated by Scott and Timmerman (1999) including communication technology options and their effect on virtual work and multiple workplace identification. The communication technologies they tested were voice mail, fax, electronic mail, videoconferencing and GroupWare. They concluded that the telephone is the most frequently used technology. They also found that there are several differences between the telecommunication technologies teleworkers used for interaction with a variety of other parties.

An empirical study to test the use of these communication technologies was conducted by Gupta *et al.* (2000). They found telecommuters with college degrees tend

to have higher usage of technology. They also found that the usage is higher among females than males and are significantly high among telecommuters living in suburban areas vs urban and rural areas (Gupta *et al.*, 2000). The importance of IT infrastructure is described by Pliskin (1997). He explains how the availability of high bandwidth communication facilitates information sharing and group collaboration. Nilles (1997) discussed the role of IT managers. He emphasized the importance of security issues as well as the importance of the proper choice of hardware/ software. Watad and DiSanzo (2000) in their case study describe the successful deployment of a highly reliable IT infrastructure. The realized benefits from the project include increased revenue as a result of an increase in sales force field time and improvements in customer relationships. New technology developments and competing delivery technology systems will continue to dominate this category. Other issues deal with standardizing the "at home" technology for all telecommuters and whether the technology is provided by the company or by the employee.

Since, technology is the enabler that makes telecommuting possible, our first model (Figure 2) is a simple one based on the fundamental concept of supply and demand as documented by Gray (1997). Gray also states that it is inadequate to assume that demand will follow just because enabling technology makes it possible to supply telecommuting opportunities (Gray, 1997). But this simplistic model provides a starting point to assist our development of more comprehensive model of telecommuting.

Environmental issues. Decreased highway traffic, air quality, and atmospheric ozone levels are some of the interrelated environmental topics that have been presented (Giuliano, 1981; Seaman, 1997). Other topics include; the environmental impact of telecommuters technology, the initiatives taken by organizations, city governments and the federal government to enhance the environment and the measures of environmental benefits. The breadth of "telecommuting" has also led to stern disagreement about the environmental benefits (*Economist* 1998-1999). For example, is fuel actually saved and is there an air quality benefit if telecommuters are still taking trips in their vehicle at some point during the day (Nilles, 1996)? Does the increased



Source: Nilles 1976 and Gray 1997

Figure 2.
Simplified
Supply-Demand Model of
Telecommuting

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electricity consumption to power personal computers offset the energy benefit associated with reduced fuel consumption resulting from reduced travel miles (Crede, 1995)

Technology is the enabler of telecommuting. One possible reason that the environmental impact of telecommuting has not received substantial attention may be due to the uncertain environmental impact of technology in general. Crede (1995) points more specifically to the uncertain environmental impact of computers. Major areas of environmental concern include: "the direct effects of computers on the computer user . . . the effects of the use of computers on the environment (consumption of electrical energy and solid waste disposal) and the environmental hazards of producing computers" (Crede, 1995). All of these concerns can be added as concerns of telecommuting because computer technology is an unavoidable requirement. The first two concerns are directly connected with telecommuting but these certainly are not the favorable environmental impact that telecommuting advocates would highlight. The primary environmental issue is air quality.

Congress, in the 1990 Amendment, Title I of the Clean Air Act, mandated the environmental motivation for telecommuting programs. The eleven states in the US with the worst air quality were targeted specifically. Organizations in those eleven states with more than 100 employees are required to reduce the number of employees commuting each day by 25 percent (Bronson, 1993). The original target areas were expanded to include major cities, where firms with more than 100 employees had to "increase their average vehicle occupancies (or reduced vehicles) . . . by 1996" (Walker, 1995). Penalties for non-compliance by those firms with more than 100 employees vary from state to state and range "from \$5,000 a month to \$25,000 a day" (Betts, 1994). Telecommuting is not a mandated solution but telecommuting is one means to achieve this reduction along with car pools, van pools, mass transit incentives, and other similar measures. More recently, the 106th US Congress passed legislation aimed at promoting significantly more telecommuting in the "Telecommuting and Air Quality Act (HR2556, S1521)" (Allenby, 2001).

AT&T was one of the organizations that offered environmental programs at various locations as New Jersey (Apgar, 1998) and Los Angeles (McLarty 1993). Dobrian (1999) provides an excellent overview of the AT&T programs and discusses New Jersey, Los Angeles and Phoenix as areas that have been favorably impacted. Within the AT&T organizational structure there is a functional area that deals with all environmental regulation compliance. This extends from the manufacturing processes owned by AT&T to all of the long distance operations consisting primarily of offices.

Prudential Insurance Company has also a "clean air compliance office" and they explicitly state that a major reason for their telecommuting program is the Clean Air Act (Betts, 1994).

At Hewlett Packard (HP) clean air regulations were why HP got involved in telecommuting (Betts, 1994). HP supports their program with an extensive set of guidelines. The guidelines are an important tool for managing the telecommuting workforce and for providing a guide regarding health and safety issues (Howard, 1998). Throughout the US, somewhere between "4,000 and 6,000 HP workers commute at least once very two weeks" (Howard, 1998).

The city of Phoenix, Arizona began a telecommuting program in 1995 based on research that indicated about 50 percent of all their workers were interested in

telecommuting or had jobs that were well-suited to telecommuting (Harler, 1997). Other governmental agencies have also instituted telecommuting programs including the City of San Diego and the State of Georgia. Although Georgia was not among the original eleven states targeted in 1990 but the Atlanta area was faced with rapidly increasing smog in the early 1990s. Atlanta's inability to meet ozone limits specified by the Clean Air Act led to the threat of losing federal funding for city highways. The Atlanta Chamber of Commerce then approached local companies like Georgia Power (division of Southern Company) and urged them to take major strides to reduce the number of their employees commuting to offices in downtown Atlanta (Tanzillo, 1995).

The US Federal government has also implemented telecommuting in a wide range of agencies. In recent years, US Federal employees have utilized several "telework centers" located around the perimeter of Washington, DC and are actively supporting more telework opportunities for other Federal workers (Alcott, 2001). In the Washington, DC area there are fifteen (15) satellite telework centers where federal employees can conduct their work. Average capacity utilization is about 54 percent for the fifteen telework centers based on regular users with reserved space (Alcott, 2001). The range varies from 25 percent to 85 percent utilization with a few centers approaching 100 percent utilization for some time slots (Alcott, 2001). These numbers clearly indicate that the number of federal teleworkers taking advantage of the telework centers could be dramatically improved upon for those centers with low utilization. There is also the potential to spread telework beyond the DC area to include other Federal offices nationwide. The barrier seems to be a lack of willingness on the part of federal agencies to allow certain types of work to be performed in this fashion. This attitude may be out of concern for confidentiality, security or some other reason that dictates that certain tasks still have to be conducted at a centralized location rather than from a distance.

Environmental Protection Agency (EPA) research in the US has found that telecommuters reduce their vehicle use by 30 percent despite taking more personal trips compared to workers that do not telecommute (Leonard, 1997). Again, the logic is that fewer cars, fewer commuters, less time traveled, fewer miles traveled all translate into fewer pollutants that are being emitted. That is the logic and it does not appear to be flawed but quantifying improvement of air quality that is associated with telecommuting is a difficult task.

However, some organizations and agencies attempt to measure the environmental improvement due to telecommuters. Georgia Power estimates that the use of satellite centers saves each employee "about an hour and a half of their" commuting time each day and "each center saves about 300 commute miles a day" (or 3,000 total commute miles per day for ten satellite centers) (Tanzillo, 1995, p. 14). Other organizations and agencies have attempted to make more detailed and scientific measures. The City of Phoenix, AZ estimates that 1.4 tons of pollutants were kept out of the air in the first six months of their program based on a total reduction of 97,000 commuting miles (Harler, 1997). This type of measure may be more speculative but it does attempt to address the Clean Air Act and the air quality issue as it relates to telecommuting.

A few guesstimates have also been thrown out into the discussion. The New York City Department of Transportation has proposed a "what if" measure. "If 15 percent of the workers in New York City telecommuted 3.7 days per month, the potential impact ... would be 95,000 fewer commuting vehicles per day (and) 2.5 fewer tons of toxic

emissions per day” (Betts, 1994). The California Engineering Foundation (CEF) with members from leading organizations such as Pacific Bell, Xerox Corp., Bechtel Industries, and Rockwell International Corp. took a bolder approach and estimated that the state of California could “save close to \$5 billion a year in fuel costs and productivity loss” (Cummings, 1992).

Conceptually, the “triple bottom line” is a very appealing description that acknowledges telecommuting’s benefits to the company, the employee and society (Allenby and Richards, 1999). The environmental impact is the primary benefit that society stands to gain. One very recent estimate takes a step towards answering the environmental questions that have been sparsely addressed. Allenby (2001) uses the following data to extrapolate an environmental impact: “one gallon of gasoline produces 19 pounds of carbon dioxide (CO₂), the 5.1 million gallons of gas teleworkers didn’t use in 2,000 equate to almost 50,000 tons of CO₂ . . .” and continues by stating that “these are estimates based on reasonable assumptions, but they provide an idea of the magnitude of reductions in emissions which teleworking might support if engaged in on a global scale” (Allenby, 2001).

What is the appropriate measure? Ozone levels? Number of smog alert days *per* season? Perhaps it is compliance with Federal regulations for emissions in the region? These are the types of measures where improvement is not likely to be found. But these are exactly the measures that need to be improved. These are the measures that prompted congressional action in the beginning. The telecommuting advocate might simply argue that: “Without telecommuting, the air quality would be much worse.” That is probably the best argument one can make when the measures that matter most are used.

Results and discussion

Table III shows the distribution of the articles between the four categories. The reader will notice that the majority of the articles published are in the descriptive and empirical categories with very few in the conceptual and case study categories. A careful review of Table III will show that most of the empirical studies are done in the past few years. The availability of the World Wide Web and the easy access to databases and lists make performing this type of study easier and less expensive. Moreover, many of the case studies were published in practitioner or trade journals that we excluded from our review.

Most of the articles that we reviewed deal with human resource or workforce issues (46.8 percent). Worker motivations, worker productivity, worker travel behaviors and other worker issues are abundant in the articles reviewed here. That is as expected since employees are the individuals whose life pattern will change dramatically due to telecommuting. In terms of research methods, the experiences of workers are relatively easy to investigate via surveys or interviews and afford the best opportunity to explore the realities of telecommuting.

The second largest group of articles deal with organizational and management issues (30.5 percent). The topics here cover a broad range including the business environment, the firm’s motivation for telecommuting programs, managing from afar, employee recruitment and employee retention. The topics can be summarized briefly as: Why does a company implement telecommuting? And how do they manage the program once implemented?

While technology is the backbone of the telecommuting program, the number of articles that dealt primarily with technology accounted for only 12.8 percent of the total. Since, we limited our literature review to business and management databases, articles with a strong interest in technology and information technology are not well represented. Another possible factor is that companies have the IT expertise within their organization and they may prefer to guard most of the technological specifics rather than sharing them openly. The competitive issues from the previous category may play a role in this guarded approach to IT information and partially explain the lack of published reports.

Environmental issues and corporate social responsibility issues contribute the least to our survey with only 9.8 percent. We included some of the practitioner journals to gain some insight into why there is not more published that address these issues. Based on those publications, measurement seems to be the number one problem that researchers face. The published articles contain estimated environmental impact because actual measurement is extremely difficult. The best available data is expressed as reduced commuter miles or reduced commuter hours. Environmental impact has to be extrapolated from those numbers and the conversion is not straightforward. The productivity benefits, real estate savings and family/work balance issues from the other categories are more lucrative topics and have attracted much more attention.

In most regions, the number of telecommuters has grown at a slow rate. The rapid growth that was predicted a decade ago has not materialized. That said, telecommuting should continue to increase in the coming years. There are many factors contributing to this growth. The incredible development of technology and the advances in portable technology platforms and telecommunications connectivity options, the increase in dual income families and the need to work from home to care for family members (both young and old), the increase of home business owners and the relatively low cost of technology are all reasons for this growth.

A proposed model for a successful telecommuting program

An additional outcome of our literature review is the initial development of a theoretical model for telecommuting success. The model includes major factors that the literature suggests are significant antecedents and outcomes of successful telecommuting initiatives (Figure 3).

This model is helping us also in proposing the future telecommuting research agenda.

We propose that the government regulations and competition are the two important inputs that motivate organizations to consider a telecommuting strategy. The outcomes of a successful telecommuting program are:

- regulatory compliance;
- favorable environmental impact;
- productivity increases and cost reductions; and
- worker satisfaction as a result of flexibility and work/life balance.

Directions for future research

In spite of the sheer volume of published research, there are some issues that have not been resolved.

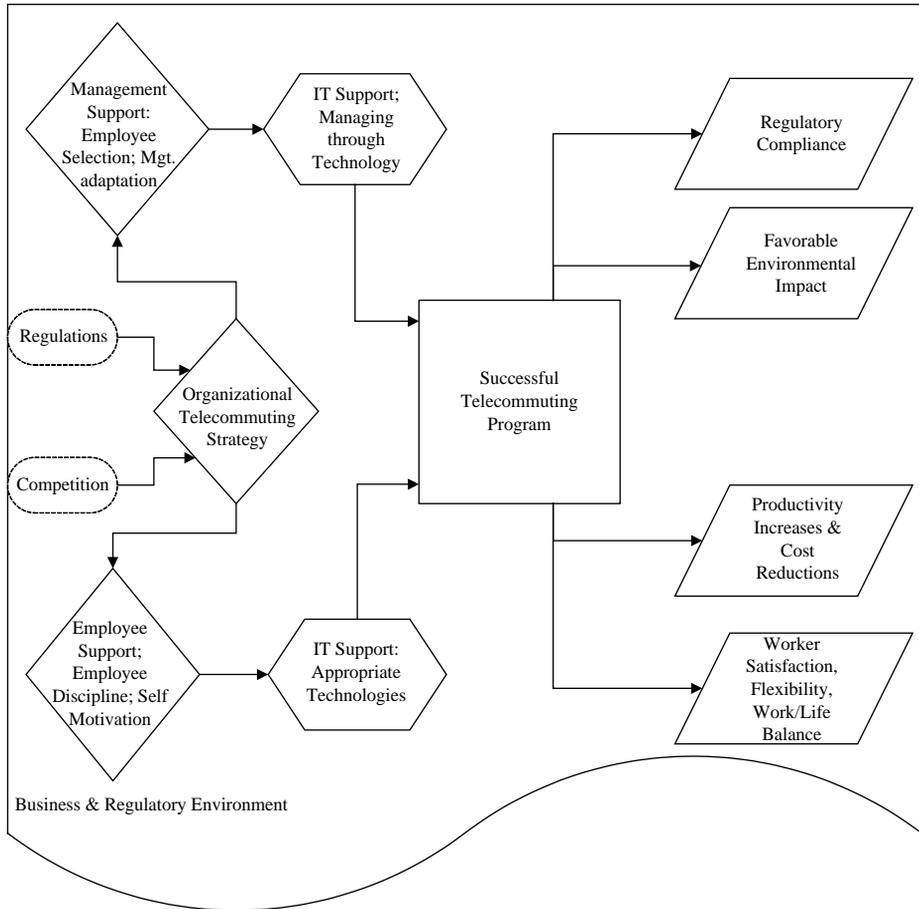


Figure 3.
Telecommuting success
model

Standard definition

There is no standard definition to define a telecommuter, which makes comparing results of various studies is impossible. What is the minimum number of days / month the employee has to be working away from the office to be considered a “telecommuter”? Is the telecommuter working from home or from another alternative place? The mobile sales force and other workers that spend a majority of their time out of the office due to the nature of their jobs are they considered “telecommuters”? There is a need for creating a set of standard definitions for telecommuters to specify both the time and place.

Measurements

There are major difficulties in measuring success factors and outcomes. Bélanger and Collins (1998) explained an example where the measures of outcomes for organizations and workers are contradictory. There is a need to find an agreed upon set of measure of

outcomes of a telecommuting program. Both internal and external measures are needed. Telecommuting's
past and future

Rigorous empirical research

Feldman and Gainey (1997) observed "there has been little rigorous empirical work on telecommuting to date ... and virtually no theoretical work on telecommuting." McCloskey and Igbaria (1998) after reviewing a number of empirical research articles concluded that there is methodological weakness and lack of control of potential significant extraneous variables. Although the number of the empirical research articles we found was growing, most of them have severe limitations. For example, Fritz *et al.* (1998), Dixon and Webster (1998) and Dubrin (1991) admit that there are differences between their "control" group and "treated" group and that is an issue that future research must address. Is it possible to select samples from a homogeneous population to study differences between telecommuters and non-telecommuters? Gupta *et al.* (2000) state that there is a need for "a large sample, which is beyond the means of standard small-scale academic research." Bailey and Kurland (2002) referred to the errors in the assumptions used for some of the empirical research. We believe that there is a need for designing a longitudinal study to explore both the positive and negative long-term effects of telecommuting for workers and organizations. The empirical research also needs to consider an integrated set of variables such as job characteristics, family structure, degree of commuting and commuters individualities and skills. We also agree with Bailey and Kurland (2002) that there is a need for grounded theory building studies.

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Contradicting results

Under "Workforce Issues" the balance issue has received a significant share of the attention in published works but remains unsettled. Based on the results reported by Hill *et al.* (1998), further investigation of the "balance" issue is needed. If telecommuting does not provide a positive effect for family and life issues, then greater resistance on the part of workers should be an outcome and should be more readily evident. There are no articles that indicate any major resistance from workers. The result reported by Hill *et al.* (1998) is counter-intuitive and inconsistent with anecdotal evidence. Further work should seek to clarify, confirm or refute the reported results.

Virtual teams

Other "Workforce Issues" that are likely to receive additional attention are related to virtual teams. The general topic of virtual teams can be further explored via team communication, team leadership, team supervision and team performance. DeMarie and Hitt (2000) offer several untested propositions on virtual team membership, investment in advanced information technology and contingency workers as a related phenomenon that may evolve from telecommuting. Exploring any of these topics in part or as a whole will be a welcome contribution to the virtual team version of telecommuting.

Adaptation of telecommuting

In the "Organizational Issues" category, the alleged reluctance of management to deploy telecommuting on a grand scale (Watad and DiSanzo, 2000) definitely deserves

a further look. In order to reap the full benefits of telecommuting, the magnitude of implementation has to be greater than it is today. Additional research may offer prescriptive ways to overcome this reluctance and achieve a broader implementation within organizations. Another question to be asked in this category is - Why has the growth of telecommuting progressed so slowly? Why have local governments adopted telecommuting on a grander scale than the federal government has? Have organizations kept the rate of deployment low or have workers failed to accept telecommuting opportunities when offered? Do barriers differ from country to country? In general, the barriers to adoption, acceptance and success need further exploration.

Impact on business process

Organizations have dealt with the issue of centralization versus decentralization in making business process decisions. Similarly, the issue of telecommuting is another factor that shares many of the same elements as the decentralization decision. Many of the issues raised in the literature reviewed here point to a need for organizations to design business processes in a manner that make them compatible with telecommuting. Issues of confidentiality and proprietary information need to be addressed in business process design where they are relevant. Paperless systems and electronic signatures are examples of other business process features that may be needed in some cases to facilitate telecommuting. Overall, telecommuting has numerous potential effects on business process design that warrant consideration.

Environmental impact

As far as the "Environmental Issues" further investigation of telecommuting is warranted in major metropolitan areas such as Los Angeles and Atlanta, where traffic problems and poor air quality compliance are forcing organizations to consider new work arrangements and altering their location choices. Further delineation between categories of telecommuters such as "always mobile" telecommuters and "home-based" telecommuters will provide a better indication of favorable environmental impact. These more specific categories may also be linked with industries to pinpoint the organizations to be congratulated and those to be reprimanded. Measuring the impact of telecommuting on the environment is another area of conflict where researchers need to consider.

The academia

The unique implementation and circumstances of telecommuting in higher education warrant further consideration. Johnson (1998) states, "Remote work is an implied part of any academic job but with few articulated expectations in work load or infrastructure." The various configurations include the regular workload of university professors who work from home, deliver their classes to/from remote locations and access computers at major research facilities via telecommuting.

Organization type

Identifying the type of industries that lend themselves to successful telecommuting. Service organizations tend to be well suited but does telecommuting suit every type of service. Which industry characteristics favor telecommuting and which do not?

Clearly, there is much more to be learned from the actual experiences of organizations. Well-documented successes and failures in the form of case studies, surveys and longitudinal empirical studies will augment the research in all categories tremendously.

Conclusion

From a scholar's viewpoint, the research on telecommuting is only beginning to scratch the surface. To better understand all of the nuances associated with this phenomenon, there is a need to understand organizational, managerial, and worker motivations. It is also necessary to understand the "do's and don'ts" associated with telecommuting program implementation. It is also important to better understand the technological aspects and the environmental effects associated with telecommuting. Therefore, there is ample opportunity to conduct research and contribute a better understanding for both scholars and business people.

Researchers working closely with practitioners may develop more rigorous research grounded in theory on how a telecommuting program should be implemented in order to be successful. The schema and the success model presented in this paper may be helpful as a foundation for future research. Research of this sort may ultimately provide important prescriptive information for future telecommuting program developers.

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Corresponding author

Samia M. Siha can be contacted at: samia_siha@coles2.kennesaw.edu

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