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December 2007

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Abstract:

Rapid advances in hand-held computing and communication capabilities, decreasing cost of mobile devices, and emergence of standards are fuelling the growth of mobile distributed work arrangement (DWA) in business operations. However, mobile DWA is more than a technological arrangement; it is an organizational innovation that could involve structural and administrative changes in the organization for successful deployment and usage. Thus apart from the attributes of the technology, fit between the organization's management style, values, policies and procedures and the demands imposed by the mobile DWA as well as the external environmental context of the organization could be crucial determinants of successful adoption. We investigate this issue in this research. Implications of our findings are discussed.

Keywords: Mobile Distributed Work, Technology Adoption, Organisational Culture

Introduction

Distributed work arrangements (DWA), defined as "working away from the traditional office using computers and telecommunication facilities to maintain a link to the office" (Belanger (1999) p.139) are new work structures that entail remote working by employees for certain periods (Belanger et al., 2001). Organisational work is being increasingly decentralized to increase competitiveness, operational efficiency and effectiveness of the complex and information rich nature of modern organizations (Qureshi and Vogel, 2001). Very often, distributed work involves the performance of organizational tasks in geographical locations outside the traditional boundaries of organizations (Gupta et al., 1995). For instance, many organisations have call center agents who work remotely from home offices or other locations and offer 24 hour support to customers over the Internet. However, apart from such stationary DWA, there is an increasing trend towards mobile DWA. For instance, consultants or sales representatives have intrinsic demands for mobility as they travel to client's premises to conduct their work. Similarly, top-level managers also need access to corporate and client information and engage in meetings outside their offices while travelling to other locations.

Rapid advances in hand-held computing and communication capabilities, decreasing cost of mobile devices, and emergence of standards are fuelling the growth of mobile DWA in business operations. For example, one emerging standard is SIP, or Session Initiation Protocol that is likely to have significant impact on mobile DWA. SIP is an open-standard signalling protocol for IP communications including telephony, conferencing, presence, and instant messaging. Contrary to proprietary standards in enterprise communications, an SIP-enabled device can interoperate with any other SIP-enabled device. While the importance of mobile distributed work is unquestionable, there is still paucity of research on adoption and success of such arrangements. A variant of DWA extensively studied over the last decade is working from home offices, at the individual level (e.g., Duxbury et al., 1992; Venkatesh et al., 1992). Other variants of DWA studied in the past include satellite work centers, generic offices (hotels), and supplemental work at home. Research on adoption of mobile DWA however remains scarce. Additionally, prior research on variants of DWA has been confined to understanding aspects of technological requirements (e.g., Gupta et al., 1995) and task and employee characteristics (e.g., Olson, 1983; Duxbury et al., 1992; Venkatesh et al., 1992). However, mobile DWA is more than a technological arrangement; it is an organizational innovation (Harrington and Ruppel, 1999) that could involve structural and administrative changes in the organization for successful deployment and usage (Ettlie and Bridges, 1982). Failure of most technological devices and applications has been attributed in a large number of cases to the lack of concern for the psychosocial impact of the technology on users and their organizational culture (Lanzi and Marti, 2002). Thus, organizational characteristics and culture could be an important determinant of mobile DWA adoption. We therefore use the integrated perspective of three contexts - technology, organization and environment in the framework of Tornatzky and Fleischer, 1990 to understand mobile DWA adoption. The framework has been successfully used to explain adoption of stationary technological innovations and we therefore use the tenets of this framework to understand organisational adoption of mobile DWA.

The organization of this paper is as follows. The following section discusses literature on distributed work, and the technology-organization-environment framework, and presents our research framework and hypotheses. Next, we describe the research design and measures, followed by description of the data analysis and results. The paper concludes with discussions of the research findings, contributions of the study, and the limitations.

Theoretical Background:

Distributed work arrangement (DWA), can have several advantages over centralized work. For example, it has the potential to improve workers' autonomy, flexibility, and productivity (Belanger et al., 2001; Gupta et al., 1995), to reduce operating costs, increase output and productivity, and confer competitive advantage and agility (Belanger, 2001; Ruppel and Harrington, 1995). However, DWA requires investments in advanced information and communication technologies, and entails fundamental restructuring of the organization. As an organizational innovation, DWAs may be used to outperform rivals, and it could lead to changes in structure or rules of a particular industry (Zhu et al., 2003). For instance, firms have been shown to be influenced significantly by the innovative practices of other firms through appeals to notions of 'good practice', through normative pressure or isomorphism (Deephouse, 1996; Johnston and Gregor, 2000). Thus the organisational and environmental contexts, apart from the technology, are likely to be impacted by and in turn, may impact, mobile DWA adoption. The TOE framework (Tornatzky and Fleischer, 1990) with its three dimensions of technology, organisational and environmental contexts has been used to study technology adoption in a number of prior studies. For example, Chau and Tam (1997) studied the adoption of open systems based on the technology-organization-environment (TOE) framework and achieved a classification accuracy of 73 percent in correctly classifying all respondents into adopters and non-adopters groups as compared to a random choice of 58 percent. In another study, Kuan and Chau (2001) evaluated the factors affecting EDI adoption in small businesses by using the TOE framework. More recently, Zhu et al. (2003) used the TOE framework to examine the electronic business adoption by European firms. We therefore investigate the organisational adoption of mobile distributed work based on the tenets of this framework.

The Technology-Organization-Environment (TOE) framework

The TOE framework (Tornatzky and Fleischer, 1990) identifies three main elements – (1) the organizational context, (2) the technological context, and (3) the environmental context – that influence the process by which innovations are adopted. The organizational context refers to the characteristics of an organization. Several descriptive measures include firm size, complexity of its managerial structure, the quality of its human resources, and the amount of slack resources available internally. These are factors internal to an organization with regards to its structure and processes that inhibit or facilitate the adoption of innovations. Depending on the fit between the innovation with current work practices, management style and values, policies and procedures, some organizations may be more receptive to change and require less effort to introduce an IT innovation than others (Tornatzky and Fleischer, 1990).

The environmental context is the external space in terms of the industry, competitors, and the government (Tornatzky and Fleischer, 1990) in which the firms conducts business. These external factors present both opportunities and constraints in adoption of technical innovations. Among these, industry circumstances are often found to have a significant influence on innovation process, in terms of competition, power relations, and norms (DiMaggio and Powell, 1983; Crook and Kumar, 1998; Johnston and Gregor, 2000). Competition has long been recognized as an adoption driver that stimulates the process of innovation adoption (e.g., Grover, 1993; Johnston and Gregor, 2000). Due to increased pressures from competition, many firms tend to follow the best practices within an industry to gain higher degree of legitimacy and increase standardization. The 'decision to adopt' may be tacitly formalized by certain regulatory units or leading firms of the industry.

The technological context describes how characteristics of the innovation per se influence the process of adoption. In particular, the degree to which an innovation is viewed to be pertinent to an organization depends on the potential benefits received, the barriers and costs involved, and its ability to adopt (Chau and Tam, 1997).

Thus the TOE framework with its integrated perspective of technology, the organisation and the environment is argued to be a good foundation for evaluating firm-level adoption of mobile DWA.

Research Model

Based on Tornatzky and Fleischer's theoretical framework, this study proposes a perception-based adoption model for mobile DWA, as illustrated in Figure 1. It ties together four predictors for DWA adoption, representing the three contexts of the TOE framework.

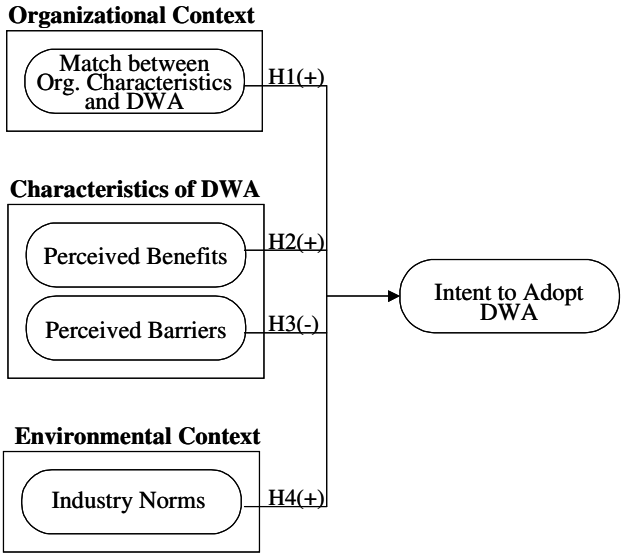


Figure 1 Conceptual model for DWA adoption

The organizational context in our framework refers to the resources, values, management style and processes of an organization. Depending on these organizational characteristics, some organizations may be more receptive to change and require less effort to introduce mobile DWA than other organizations. For instance, organizations with poor wireless communications infrastructure, highly bureaucratic structures (need to "see" their employees' working), and managers who are less able to organize and manage remote work would be less likely to adopt DWA (Olson, 1988). Thus the degree of match between extant organization characteristics and the demands imposed due to introduction of the new innovative distributed mobile work arrangement is argued to be a crucial determinant of adoption. Thus our first hypothesis is:

H1: Higher degrees of match between extant organisational characteristics and demands imposed by the new mobile DWA will positively impact organizational intent to adopt mobile DWA.

The technological context in the framework are the perceived benefits and barriers accruing from chracteristics of the technology, in our case the mobile infrastructure for conducting distributed work from remote locations. Research has shown that distributed work offers more flexibility in that work structures are no longer constrained by traditional organization boundaries. The advantages accruing to firms from use of mobile distributed work are instant access to important organizational and customer information in any geographical location as well as the facility to draw upon the expertise of a wide pool of professional talents with desired skills (Gordon, 1988; Korte, 1988; Qureshi and Vogel, 1999; Tomaskovic-Devey et al., 1993). One dimension of benefit is control over information in that mobile workers may direct urgent emails to handheld devices or cell phones, and less urgent information to secondary devices such as desktop personal computers (PCs) (Barnes, 2004). The advantages translate to increased output and productivity, flexibility and agility, faster decision making and strategic competitiveness (Belanger et al., 2001; Ruppel and Harrington, 1995) compared to traditional firms that use standard non-mobile work practices. Therefore, organisational perceptions of benefit from strategic deployment of mobile distributed work are likely to have impact on adoption of mobile distributed work. Our second hypothesis is therefore:

H2: Higher levels of perceived benefits will positively impact organizational intent to adopt mobile DWA.

While firms may perceive benefit, there may perceptions of barriers to adoption as well. Perceived barriers could be difficulties in evaluating the performance of employees, negative consequences of virtual work (e.g. information security, social isolation due to lack of human contact, disruption to family life, etc.), irrecoverable losses of investment, and changes in management control processes. In so far as a lower than expected return on investment could result from the use of new technologies, potential barriers could have a significant impact on the organisational decision to introduce mobile distributed work. Thus our third hypothesis is:

H3: Higher levels of perceived barriers will negatively impact organizational intent to adopt mobile DWA.

Environmental context in the framework is the industry context of the firm. There is evidence that competitive pressure could drive the adoption of an innovation within an industry (e.g., Grover, 1993; Porter and Millar, 1985). Organizations within an industry tend to seek conformity so as to gain legitimacy and increase standardization (DiMaggio and Powell, 1983; Martinez and Dacin, 1999). It can also apply to the adoption of mobile DWA. Some organizations would like to observe the others or follow the practices of the leading companies in their field, especially if such 'good practice' has brought about obvious benefits and success (Deephouse, 1996). Hence, we propose that when an organization perceives that the industry in which it is situated has started adopting mobile DWA (industry norm), it is more likely to follow suit. Thus our fourth hypothesis is:

H4: Higher levels of diffusion in the industry will positively impact organizational intent to adopt mobile DWA.

Research Design and Methodology

Our focus is organizational adoption of mobile DWA. Thus, opinions were elicited from senior executives of organizations. A survey was administered to 203 part time executive masters' students in a large university holding senior management positions. 127 completed questionnaires were usable in the final data analysis (See Appendix A).

The measurement model

We adopted the paradigm for validating measures suggested by Moore and Benbasat (1991), which include successive stages of theoretical modeling, statistical testing, and refinement of measures. A causal modeling statistical technique - partial least squares (PLS) (Wold, 1982), was used to evaluate reliability, convergent validity and discriminant validity of the measures.

The analysis of the data was performed using PLS-Graph version 3.0. The reliability was assessed by Cronbach's alpha, the most widely used measure for assessing reliability (Chau, 1999). The alpha values in Table 1 ranged from 0.792 to 0.970, indicating adequate reliability. Also, the composite reliability ranged from 0.855 to 0.978, all higher than the threshold value of 0.7 (Fornell, 1982; Hair et al., 1992).

Table 1 Reliability of Factors

Factor	Cronbach's alpha	Composite reliability
Match between org. characteristics and DWA (4 items)	0.920	0.944
Perceived Benefits (3 items)	0.962	0.975
Perceived Barriers (3 items)	0.792	0.855
Industry Norm (3 items)	0.793	0.878
Intention to Adopt DWA (4 items)	0.970	0.978

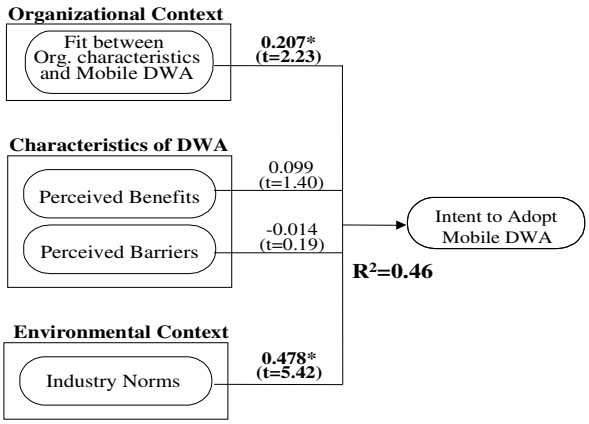
Convergent validity assesses the consistency of multi-items of a construct. In Appendix B, all estimated standard loadings are significant at $P \leq 0.001$ level, suggesting good convergent validity (Fornell and Larcker, 1981; Zhu et al., 2003). Discriminant validity refers to the extent to which measures of each construct are distinct from one another (Campbell and Fiske, 1959). It is achieved if the average variance extracted (AVE) for each construct is greater than the squared correlations between constructs (Fornell and Larcker, 1981). The correlation matrix (Table 2) reveals that our measurement model meets the criteria.

Table 2 Correlation and Square Root of AVE of Constructs

	MATCH	BENEFIT	BARRIER	NORM	INTENT
Match between org. characteristics and DWA (MATCH)	**0.899**				
Perceived Benefits (BENEFIT)	0.645	**0.963**			
Perceived Barriers (BARRIER)	0.268	0.304	**0.815**		
Industry Norm (NORM)	0.633	0.604	0.501	**0.840**	
Intention to Adopt DWA (INTENT)	0.657	0.551	0.322	0.695	**0.958**

The structural model

In the study, the explanatory power and path significance of the structural model was examined using the Bootstrap technique. Figure 2 presents the results of PLS analysis with overall explanatory powers (R^2), and each hypothesis was examined for the sign, size, and significance of the path coefficients.



Note: Hypotheses in BOLD were supported at p<0.01 level*

Overall, the model accounted for 46% of the variance in the organization intention to adopt mobile DWA, which is higher than the recommended threshold of 10% variance (Falk and Miller, 1992). As shown in Figure 2, two contexts of the framework – organizational context and environmental context have significant impact on organizational intention to adopt mobile DWA, and accounted for 45.5% of the variance. The two determinants ('match between organizational characteristics and DWA' and 'Industry Norm') are found to be statistically significant at 99 percent significance level, with path coefficients of 0.207 (t=2.23) and 0.478 (t=5.42) respectively. Thus H1 and H4 were supported. The study, however, did not find significant relationship between the characteristics of DWA and intent to adopt DWA (perceived benefits: 0.099, t=1.40; perceived barriers: -0.014, t=0.19), and thus H2 and H3 were not supported.

Discussion

The regression coefficients indicate that organizations with higher levels of match between the management structure, existing practice and expertise, and adjustments to these structures imposed by mobile DWA are more likely to adopt distributed works. This is consistent with prior research which shows that the organizational context is important for predicting innovation adoption (e.g., Srinivasan et al., 2002). The significantly positive coefficient of organizational context implies that the match between organizational characteristics and mobile DWA is a crucial antecedent. The study also found a positive relationship between industry norm and mobile DWA adoption. To some extent, organizations may conform to institutional pressure and aim at standard best practices (Martinez and Dacin, 1999). This appears to be the case for organizational adoption of distributed work within the IT consultancy industry in Asia, where intense competition has promoted the practice of mobile distributed work, so as to permit IT consultants to be close to their clients and be highly responsive to their needs.

Interestingly, the study did not find significant relationship between perceived benefits and/or barriers of DWA and intent to adopt mobile DWA, even though mobile DWA provides benefits such as providing a more flexible work structure for organizations and improving workers' autonomy and productivity, requirement of less office space for business operations, and access to expertise of a wider pool of professionals instantly (Qureshi and Vogel, 2001; Sia et al., 1998). A plausible explanation could be that in assessing the match between organizational characteristics and mobile DWA, executives may already account for the perceived benefits from mobile distributed work. For instance, in an uncertain market, more innovative

firms may be keen to alter their work processes and structures (a match) to increase flexibility and information processing capacity, while firms that prefer traditional practices may tend to resist such change because of overly formalized and bureaucratic structure (a mismatch). In such cases, the restructuring of employee's work and alternate business practices may be called for in order for organizations to enjoy the benefits brought about by such innovations. Another plausible explanation is that organizations may have a set of pre-defined rules and procedures for innovation adoption. For example, firms may generally conduct some prior studies or pilot tests to assess its feasibility, and to identify any possibilities for benefits and losses of the innovation. Given a favorable assessment, perceived risk of adoption, if it is unmanageable, may tend to offset benefits and lead to non-adoption.

Implications

The study has several important implications for managers. First, our empirical results demonstrate the importance of some antecedents in organizational adoption of mobile DWA. For example, industry norm appears to be a significant determinant, suggesting that major organizations in an industry could proactively consider mobile DWA adoption and play a leading role in paving the way for the entire industry and derive benefits from mobile DWA. Individual organizations may be inspired with lessons learnt from the leading firms with successful experience. In addition, executives should pay great attention when assessing the match between their extant organizational structures and that required by mobile DWA. There must be a clear analysis of the benefits to be derived from mobile DWA and must take into consideration such perceived benefits rather than basing their decision to adopt solely on the match between organisational work structures and management styles and that imposed by mobile DWA.

From a theoretical perspective, this study reveals the usefulness of employing the TOE framework to understand mobile DWA adoption. Future research could move beyond the above context, and pay attention to the cultural and economic factors that may affect the adoption process of mobile DWA. To achieve this, it would be interesting to replicate the study across a wide spectrum of economic communities (e.g., China, and North America).

Limitations:

The context of this study was a mix of organizations in different industry verticals situated in Hong Kong, a city that is unique, both in terms of its geography, and mobile penetration. Being a small city with excellent transport facilities, commuting is very easy and cheap. The city also has one of the highest usage of mobile networks and mobile devices. Both of these demographic factors have a bearing on adoption of mobile DWA. Thus, the findings of this study may not be generalized to organizations in other countries, where these demographic factors may be significantly different. For example, in under-developed countries with lack of mobile communication infrastructure or low mobile device penetration, perceived barriers to mobile DWA may be significant and may well be the crucial determinant of non-adoption of DWA. Managerial disposition towards DWA is also likely to vary across organizations with different cultures. Thus replication of this study in such varying settings may yield different results. Notwithstanding this limitation, we believe that a foundation has been laid through this research for investigating mobile DWA adoption that may be extended with findings from replication studies across different cultural and demographic settings.

Appendix A. Demographics

Profiles	Percent (%)
Top Management (includes: President, Director)	36.2
Senior Management (includes: General/Regional Manager, Senior Manager, Manager)	50.0
Others (includes: Solicitor, Consultant, Business Analyst, Accountant)	13.8

Appendix B. Psychometric Properties of Measures

Indicator	Loading	Standard error	T-stat
MATCH1	0.919	0.025	37.098
MATCH2	0.958	0.008	126.944
MATCH3	0.946	0.011	84.887
MATCH4	0.762	0.063	12.064
BENEFIT1	0.952	0.014	68.780
BENEFIT2	0.969	0.010	102.085
BENEFIT3	0.970	0.006	167.995
BARRIER1	-0.797	0.125	6.392
BARRIER2	-0.718	0.144	4.993
BARRIER3	-0.919	0.082	11.230
NORM1	0.880	0.019	47.223
NORM2	0.791	0.054	14.754
NORM3	0.848	0.036	23.398
INTENT1	0.933	0.029	32.561
INTENT2	0.979	0.005	181.169
INTENT3	0.939	0.023	41.610
INTENT4	0.980	0.005	184.672

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