Mobile Data Technology (MDT) Adoption Process in Canadian Micro and Small Enterprises: An Exploratory Study

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ABSTRACT

Mobile Data Technologies (MDT) are a natural extension to the traditional office computing environment. It is predicted that more than two thirds of the active workforce will rely heavily on mobile data technologies for business related activities by 2007 (IDC, 2005). However, very little research is available on how MDT adoption decisions are taken by Micro and Small Enterprises (MSEs). In this paper, we present the results of an exploratory study on MDT adoption process in MSEs. The results presented are based on structured interview data collected from MDT adoption decision makers in 33 micro and small business enterprises. The study highlights some major ways in which the MDT adoption process in MSEs can differ significantly from Medium and Large sized organizations.

1. INTRODUCTION

Business use of computing has evolved consistently at a fast pace in the last few decades with the advancements in Information and Communication Technologies. The traditional method of accessing and managing information through a stationary desktop personal computer (PC) is close to obsolescence with an ever-increasing miniaturization of electronic devices and widespread diffusion of advanced wireless standards and technologies. The mobility extended to computing and communication devices by these technologies allows employees the prospect of information exchange anytime/anywhere. From the globe-trotting CEO to the traveling sales representative, *Mobile Data Technologies (*MDT) have radically changed the way employees work. Consequently, MDTs have experienced tremendous growth in the last few years. The market research firm Canalys reported recently that worldwide shipments of smart mobile devices rose 55% year-on-year in Q2 2006 (Canalys, 2006). This growth in MDT adoption has motivated several researchers to study the phenomenon, however, very little research is available on MDT adoption in the context of Micro and Small Enterprises (MSEs) (Riemenschneider *et al*., 2003; Paul *et al*., 1995; Yap *et al*., 1992).

In this paper we explore MDT adoption process in Canadian MSEs. MSEs are a major contributor to any nation's economy. According to a 2006 Statistics Canada's report, 94.5 % of all businesses operating in Canada employed fewer than 50 employees while 73.7 % of all businesses employed fewer than ten employees (Industry Canada, 2006). The problems, opportunities, and management issues encountered by small business are unique (Premkumar, 2003; Kuan & Chau, 2001). MSEs face different challenges in adopting Information Technology (IT) compared to large organizations (Harker & Van-Akkeren, 2002). For example, recruiting and retaining personal could represent a significant resource allocation for MSEs in comparison with medium and large organizations that could have an entire department dedicated to IT (Kuan & Chau, 2001; Dankbaar, 1998). Significant differences in operating conditions and concerns of MSEs prescribe differences in how the decision to adopt an MDT is initiated, evaluated, and approved within MSEs..

We explore the typical activities in the MDT adoption process of MSEs such as *adoption initiation*, *business case development*, *criteria for selection of product,* and *decision to proceed*. The theoretical foundation is based upon the innovation process theory approach wherein we adapt the Markus and Tanis (2000) framework to delineate the MDT adoption process. The next section provides the theoretical background of the study by defining the key concepts used in the study and developing the theoretical framework. Section 3 describes the methodology used in collecting data for the study. Section 4 presents findings and managerial implications and Section 5 presents our conclusions and recommendations for further research.

2. THEORETICAL BACKGROUND

Micro and Small Enterprises

Defining MSEs is not an easy task. Throughout the world, there is no standard or universal definition of MSEs; rather, it is clear that many countries use a variety of different types of criteria to define MSEs (Amboise, 1991). While some criteria are applicable to all industry areas, others are relevant only to certain types of business (Longenecker *et al*., 1998). In Canada, there is no clear guideline or definition for classifying MSEs (Balderson, 2003; Longenecker *et al.*, 1998; Amboise, 1991). For example, legislators may exclude small firms from certain regulations if they fall below a certain number of employees. Statistics Canada usually classifies an organization as a small business when there are fewer than 500 employees, and Revenue Canada uses a minimum profit amount to define small enterprises. Furthermore, a business may arbitrarily be described as "small" when compared to larger firms, but "large" when compared to smaller ones.

There are four commonly used criteria to distinguish the size of an organization (Balderson, 2003; Longenecker *et al.*, 1998; Amboise, 1991). They are: number of employees, total revenue, profit, and type of management-ownership structure. This study will employ the most widely used criterion to size a business: number of employees (Balderson, 2003; Longenecker *et al.*, 1998; Amboise, 1991). This criterion is justified by the abundant adoption studies that have classified enterprises through 'number of employees' (Harker & Van Akkeren, 2003; Fink, 1998; Harrison *et al*., 1997; Igbaris *et al*., 1997; Paul *et al*., 1995; Iacovou *et al*., 1995; Paul *et al*., 1993; Raymond, 1985;). Table 1 illustrates how this paper has defined MSEs.

Mobile Data Technology

Mobile computing and communication devices have radically changed the way organizations conduct their day-to-day business. Increased mobility offers a significant opportunity for businesses, by improving customer service, increasing employee productivity, or allowing for shorter decision approval cycles. In any

Table 1. MSE classifications

Category	Size Definition	Source
Micro Enterprises	1 - 4 employees	(Industry Canada, 2006)
Small Enterprises	5-50 employees	(Industry Canada, 2006; Statistics Canada, 2004; B.-C.-Stats, 2003; Harfield, Driver, & Beukman, 2001; Longenecker et al., 1998; Philp, 1998)

Table 2. Mobile device spectrum

	Price (per month)	Portability (weight in grams and size in centimeters)		Functionality
MDT Basic Basic Cell Phones - a sophisticated radio transceiver used to make phone calls. Basic PDA - a scaled down PC. Basic features include: address book, notepad, appointments diary, calculator and phone list.	$20 - $75	60 – 100 grams	5(w)*10(h)*2(d)	limited
MDT Handhelds Integrated Handhelds - digital wireless devices that can send and receive voice, data and video as well as operate software programs. Able to connect to the internet for e-mail and web access.	$50 - $200	120 – 140 grams	12(w)*7.5(h)*2(d)	Medium
MDT Robust Laptops - a small mobile computer capable of doing the same tasks a desktop computer can do. Tablet PCs - allows the user to write directly on the screen, making it easier for the user to capture, access, and utilize information.	$100 - $500	1.8 – 3.5 kg	30(w)*26(h)*3(d)	High

Table 3. Project chartering phase: Typical activities

Key Activities	
▪ Idea of adopting MDTs surfaced ▪ Business case for investment developed (may be highly informal) ▪ Current state analysis (may be deferred or not done) ▪ Selection of mobile device ▪ Initial plans for how the device will be used, supported, and maintained, upgraded, etc. (may be deferred) ▪ Communication to organization ▪ Organizational changes and/or incentives related to mobile devise and/or organizational performance improvement, if any (may be deferred) ▪ Decision to proceed; approval of MDT adoption plan	**Can you explain how the idea of adopting the MDT was initiated?** ▪ Who initiated it? ▪ Why was it initiated? ▪ When was the idea initiated? **Can you explain how the MDT was evaluated?** ▪ What was the main reason for adopting the MDT? ▪ Was a business case used in the evaluation? ▪ Were any criteria set to help evaluate the device? ▪ What is your level of information technology awareness? ▪ Was the ever changing technological environment evaluated? ▪ Were other additional costs associated with the adoption of the MDT? ▪ Did you test pilot the MDT before the decision was made? ▪ Were plans created to support, train, maintain and upgrade the MDT? ▪ Was there a plan created for how the MDT was going to be rolled out within the organization? ▪ Were the end users consulted about the MDT? ▪ Was there a plan created for how the MDT was going to be communicated to the organization? ▪ When deciding to adopt the MDT's, to what extent would re-engineering have to take place in your work process after the adoption? **Can you explain how the decision to adopt the MDT was approved?** ▪ What was the time period from initiation to evaluation to approval? ▪ How many were involved in making the approval? ▪ Was the MDT approval method the same as other technology acquisitions?

modern business employees routinely require technology to work away from the office and on the move. Leung & Antypas (2001) noted that MDTs can enhance business efficiency by distributing information to the workforce remotely and by offering new channels through which employees can interact with customers and work processes even when they are on the move. Examples could include sales representatives at a client's location or maintenance crews on service calls.

A search through the literature provides only limited results on the definition of Mobile Data Technologies. This is not surprising given the recent emergence of these technologies. Harker & Van Akkeren (2002) describes MDT as being a mobile device, whether it is a mobile phone, PDA, or an integrated handheld that is associated with services. These authors also suggest that MDT 'marries' the two components of mobile phones and e-commerce technologies, hence, helping to eliminate time and distance barriers for organizations. In Computer Associates (2002, p. 2) White Paper mobile devices are defined as "portable electronic components that are used by mobile people to do their work". Schmidt *et al.*(1998, p. 2) defines a handheld computer as "an unobtrusive computing device that is accompanying the user most of the time and provides assistance in different situations and for a wide range of tasks." In this paper we define Mobile Data Technology as an *End user technology which enables the mobility of employees in order to provide functionality for the organization anytime/anywhere.*

An issue that arises in referring to these mobile devices is how to classify the devices into categories. Devices differ in size, weight, performance, storage capacity, display (screen) and input (Keyboard) dimensions, and other so-called cost form-factors (Gebauer & Shaw, 2002). Gebauer & Shaw's propose to position devices along a portability continuum, where portability is determined by the weight and size of a device. We use three evaluation criteria that categorize mobile devices into three groups. The three criteria are as follows: price, portability and functionality. Price is simply defined as the estimated total monthly cost of operating each device. MSEs are price sensitive when adopting new technologies, hence price is our first consideration. Portability is determined by weight and size of the device. Functionality determines the sum of what a product can do for the user (Whatis.com, 2005). Three mobile device categories are thus developed and used in this research are MDT Basic, MDT Handhelds, and MDT Robust. Table 2 highlights how the three evaluation criteria[1] are used to derive the three devices categories.

THEORETICAL FRAMEWORK

The theoretical foundations of this study are based on the process theory approach (Mohr, 1982). Process theories are acclaimed for providing powerful explanations even when strong causal relationships cannot be demonstrated between possible change factors and outcomes. These attributes makes process theories useful to practitioners interested in implementing effective change and to researchers interested in developing comprehensive frameworks of determinants and consequences of innovation adoption.

A common practice in studies using process theory approach is to inductively develop models that identify a set of sequential stages through which organizations pass when implementing change. For example, Soh and Markus (1995) developed a model to explain how investments in information technology, a primary example of discontinuous change, create business value. Their model includes three stages: development, implementation, and ongoing operation. The outcomes of the first stage become the starting conditions for the second stage, and the outcomes of the second stage become the basis for the third stage. Performance in each successive stage is contingent, at least to a degree, on the actions taken in the preceding stage, as well as on the environmental conditions prevailing at the time. Markus and Tanis (2000) extended the Soh and Markus model by adding the fourth stage, dealing with predevelopment activities and by broadening the definition of performance to encompass multiple performance dimensions. We adapt Markus and Tanis's (2000) process theory framework for the purpose of this study and focus on the adoption phase. Markus and Tanis (2000) argue that a business decision to adopt an innovation is not an instantaneous act, rather, it is a process that occurs over time, which can be characterized by key players, typical activities, characteristic problems, appropriate performance metrics, and a range of possible outcomes.

The process model used in this study is a adaptation of the first of four stages (Project Chartering, The Project Configure & Rollout, Shakedown, and Onward and Upward) of Markus and Tanis's (2000) innovation process framework. The focus of this paper is on understanding how MDT adoption decision is initiated, evaluated, and approved in MSEs. Using the typical activities described by Markus and Tanis (2000) in the chartering phase which corresponds to adoption, we illustrate the MDT adoption process as consisting of three prime activities of initiation, evaluation and approval and develop the main investigative questions for this research (Table 3).

3. METHODOLOGY

This paper focuses on empirically exploring the typical activities and issues in the MDT adoption process including *adoption initiation*, *business case development*, *criteria for selection of product,* and *decision to proceed*. Results presented are based on interview data collected from key people responsible for making the MDT

Table 4. Characteristics of respondents (n=33)

	Micro Enterprise	Small Enterprise	*Total*
MDT Basic	6	5	11
MDT Handheld	8	6	14
MDT Robust	3	5	8
Total	17	16	

adoption decision in thirty-three MSEs. Most of the questions asked were open-ended, which helped in soliciting top of the mind concerns and avoiding choice bias. The sample frame used for this study was Canadian MSEs that have already made the decision to adopt an MDT device. The survey instrument was pre-tested with three organizations and did not result in any significant changes.

The respondents represent seven industries. A majority of our respondents (71%) were also the owners of the organization while the rest are at a management level, which is not unusual given the nature of micro organizations. Table 4 describes the characteristics of the survey respondents.

4. FINDINGS AND MANAGEMENT IMPLICATIONS

MDT Adoption Initiation

Adoption initiation is strongly influenced by the expected benefits of technology adoption in medium and large organizations (Kumar *et al.,* 1995). Different organizations may adopt an innovation for entirely different reasons. Recognition of a need or an opportunity may initiate the idea of MDT adoption. In our study respondents were asked about the main reasons which prompted adoption initiation.

Access anywhere/anytime, enhancing productivity, and ability to communicate/online flexibly appeared as the three prime reasons. Access anywhere/anytime was a key driver for more than 63% organizations. Productivity enhancement was an important motivational factor for more than 51% organizations, and more than 30% of the organizations cited ability to communicate and get online as their main reasons (Table 5). Interestingly, about 48% of the MSEs did not consider MDTs they adopted as a productivity increasing technology. Few respondents indicated that they were also motivated by the innovative nature and newness of the devise as a reason for adoption initiation. As one of the respondents commented, "Frankly I went looking for a laptop for productivity enhancement and ended up with a state-of-the-art Tablet PC for innovation. It was also recommended by my niece's husband"

Not surprisingly, 76% owner-managers initiated the idea of MDT adoption. The prime role of owner-manager in making adoption decisions in MSEs has been acknowledged by several studies (Harker & Van Akkeren, 2003; Kumar *et al*., 1995) and we found that the same sentiments were echoed in our study. In most cases, the adoption of an MDT was likely to affect them directly as they were also going to use the MDT and possessed the autonomy to subsequently implement the decision. In other cases the ideas were initiated by end users. Interestingly, the percentage of end user initiated adoptions was less than 25% which may also be a reflection on the centralization of the decision making authority in MSEs with the owner-manager.

There was a large lag between initiation and adoption of devices in many organizations. More than 50% organizations waited 24 months or more before adopting the MDT (Table 6). Some of the respondents attributed this to the reason that some of these devices are expensive to acquire, maintain and support when initially introduced and it made sense for them to wait until the devices were more affordable. The fact that most MSEs have fewer funds for these types of capital purchases than larger organizations may also explain the large time lag. Alternatively, in a few cases, when the owner-managers were interested in reasons like esteem value and innovation they adopted the device in the very first months of its introduction. These owner-managers also indicated a high level of technology awareness.

Table 5. Main reasons for initiating/adopting MDT (n=33)

	Frequency	Percent
Access anywhere/anytime	21	63.6%
Productivity	17	51.5%
Communication/Online	10	30.3%
Innovation and newness	2	6.1%

Table 6. How long ago was the idea initiated before purchased of MDT (n=33)

	Frequency	Percent
In the last 6 months	4	12.1%
More than 6 months and less than 12 months	6	18.2%
More than 12 months and less than 18 months	2	6.1%
More than 18 months and less than 24 months	15	45.5%
More than 24 months and less than 30 months	6	18.2%

MDT Evaluation

Once the idea of MDT adoption is initiated, the next steps in the adoption process are justification, identification of risks, mitigation of risk, evaluation and selection of product, communicating the idea to the organization, and having an initial plan. Markus and Tanis (2000) groups these activities under developing the business case for adoption. Building a business case is the hallmark process in technology adoption decisions of large firms. Business cases are extremely important as they lead to definition of strategic objectives and diagnosis of implementation difficulties. Interestingly, only two (6%) MSEs in our study indicated developing a formal business case for MDT adoption. In most cases (70%), the business case made was informal at best and about 24% of the organizations acknowledged not making a business case at all.

Respondents who prepared an informal business case used a variety of components considered as part of the business case development, which were not documented. More than 53% of the respondents were concerned with the changing technological environment and more than 56% estimated the additional costs associated with the purchase, while the majority of the respondents (76%) consulted the end-users about the adoption.

Some of the components which are common for large organizations were not used by the MSEs. For example, more than 61% of the respondents did not perform a test pilot while about 64% had created no plans to support, maintain, or train their MDT adoption. Almost half of the respondents (48%) had no formal plan to communicate about the MDT adoption to the organization and more than half of the respondents estimated no business re-engineering was required to adopt the MDT. Interestingly, about 35% acknowledged doing some re-engineering post adoption. Major re-engineering was only required in about 14% of the cases.

Most respondents also acknowledged informally evaluating the MDT device. Functionality (70%) and Price (55%) were the most frequently cited criterion for

Table 7. Criteria set to help evaluating the device

	Frequency	Percent
Functionality	20	69.7%
Price	18	54.5%
Portability	9	27.3%
Availability	7	21.2%
Ease of Use	4	12.1%
Quality and Service	4	12.1%
Compatibility with other Devices	2	6.1%

evaluating the mobile device (Table 7). Interestingly, few organizations considered compatibility (6%) with other devices and service quality (12%). This seems to support the view that MSEs are mostly concerned with what a device does and with how much it costs.

Most of the respondents had a high level of IT knowledge. Over 50% of the organizations evaluated the external technology environment and, given that most of the respondents had a high level of IT knowledge, they probably had the capabilities and did this well, even though informally. Although our respondents were not too concerned with test pilots, communications to the organization, maintenance, or roll-out plans, they did make sure that MDT end-users were involved and consulted.

MDT Approval

Project approval was a relatively easy and straightforward exercise, as in more than 44% of the cases one person was involved in the decision-making process. Two people were involved in the approval decision in 27% of the cases, and three or more people were involved in the decision approval in just 29% of the cases.

We asked the respondents about the time lapse between the approval and final purchase. Interestingly, in more than 50% of the cases the final purchase of the device happened within one month of the evaluation (Table 8). One of the owner-managers commented that he is an impulse buyer, and his buying impulse also applies to some of his business technology acquisitions. However, there were an equally large number of cases where the final purchase was delayed due to several reasons. For example, in one case the shipment of the laptops was delayed due to unavailability of the number of pieces required for the model approved. Ultimately, the supplier agreed to provide a higher version at same terms and conditions.

Interestingly, more than 75% of the respondents used the same methodology of approving MDT acquisition as any other types of technology purchases, while only 9% considered this MDT acquisition process more rigorously.

5. CONCLUSIONS

This research is at an exploratory level as not much empirically supported research is available on MDT adoption in MSEs. While it does not produce generalizable results, the reasonably representative sample selected provides valuable insight into the MDT adoption process and documents some critical MDT adoption issues in MSEs. This study bridges the gap in literature with regards to the understanding of MDT adoption in MSEs. The analysis indicated that the adoption process in MSEs is often informal and is significantly influenced in many cases by the owner-manager. The sample studied showed an average time lag of about 24 months or more between when the idea to adopt the device was originated and the adoption decision was made. Evaluation of the adoption decision also was conducted very informally and sometimes not at all. Interestingly, firms did not create a formal business case for adoption which is a regular practice in large organizations.

Business cases are tools that support planning and decision-making (Schmidt, 1999). A good business plan outlines tangible benefits, resources, cost, and risk (Wee, 2000). Respondents did a good job of discussing the MDTs with end-users; this is likely because the organizations were so small that it would be difficult not to discuss the purchase with end-users. Even though the users were contacted, it does not mean that a plan was in place or communicated to support, maintain, and upgrade the MDT post-adoption. The final step, approval, was marked by the lack of a significant time lag, most often taking a month or less. MSEs involved very few people, in most cases two or fewer, in the approval process, and they evaluated this technology acquisition as they would any other.

Table 8. What was the time period from approval to purchase (n=33)

	Frequency	Percent
Right Away	5	15.2 %
Within Two Weeks	8	24.2 %
Within One Month	5	15.2 %
Within Six Months	11	33.3 %
One Year and Greater	4	12.1 %

This study has uncovered a key finding that we feel is pertinent and relevant to the literature: the general absence of a formal business case to evaluate MDTs. This research showed that MSEs generally did not prepare formal business cases and most respondents prepared no businesses case at all.

This research provides a base for further research in focused areas of the adoption process in MSEs. More detailed research can be performed on the need analysis, systems scoping and selection of MDTs, and on the thoroughness of the decision process and its impact on the realization of business benefits. As a high percentage of MSEs are also managed by their owners, we think it would be interesting to explore the affect of ownership structure on MDT adoption in future studies.

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ENDNOTE

[1] Web sources were used to estimate facts on each device category. It should be noted that these facts change quickly over time. While the format remains useful, the searched facts can soon become outdated.