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## The Adoption and Usage of Mobile and Wireless Technologies in Small to Medium-Sized Enterprises in New Zealand A Meta Model

*Nabeel A. Al-Qirim*, United Arab Emirates University, UAE

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### INTRODUCTION

A key objective of much IT research including Mobile and Wireless Commerce/Business (MWT) is to assess the value of IT to an organisation and to understand the determinants of that value in order to help organisations to better deploy and manage their IT resources and enhance overall effectiveness. MWT is defined as “content delivery (notification and reporting) and transactions (purchasing and data entry) on mobile devices” (Leung & Antypas, 2001) or mobile networks. That is to enable mobile users to compute, to commerce and to access information from anywhere and any time (Samaras, 2002). “Transactions conducted through mobile devices using wireless networks”, is another definition provided by Keng et al. (2001). Let us not forget that MWT is the result of the wired marketplace and pervasive computing, where mobile computing and communication capabilities are envisioned to be embedded in everyday activities of different users (ubiquitous) (Lee, 2002; Samaras, 2002; Turban et al., 2002).

Being a novel technological innovation, exploring the potential impact of MWT on the business environment of enterprises in general and in small to medium-sized enterprises (SMEs) specifically is very important and is not explored in large. The importance of this focus stems from the economical importance of SMEs in different countries in the world. For example, SMEs constitute around 95 percent of enterprises and account for 60 to 70 percent of employment within the countries of the Organisation for Economic Cooperation and Development (OECD, 1997). New Zealand (NZ) SMEs form a significant component of the economy output (35%) in terms of the number of firms (96%) and number of employees (41%). NZ SMEs are defined as enterprises employing 19 or fewer full time equivalent and working proprietors plus half the number of part-time employees and working employees (FTEs) MOED, 2000a).

The open standards of the Internet and global interconnectedness bring the wired and the wireless worlds within the reach of the smallest firms and help reduce the gap between large and small firms and hence, introduce many opportunities for SMEs to gain access to global markets and to expand in terms of scope and diversity. However, according to recent research in SMEs (Blili & Raymond, 1993; Levy & Powell, 2002; McDonagh & Prothero, 2000; Oliver & Damaskopoulos, 2002; Wlaczuch et al., 2000), the implications here are twofold. Initially, recent research indicated that SMEs were slow in adopting electronic business technologies (EBT) in general and in using EBT strategically in their businesses. Secondly, there are several inherent deficiencies in the structure (central and simple structure, busy nature, multi-tasks) and the business environment (technological, competition, suppliers/buyers) of SMEs which could impede them from adopting and using EBT/MWT more strategically, i.e., the central organisational structure and decision-making in SMEs is represented usually by the personality of manager (who is usually the owner as well) of the business.

Accordingly, this research was interested in finding answers to the following main exploratory research question: *How can factors influence the adoption and usage of MWT in SMEs.* That is, what are the adopted MWT and what are the factors that could influence MWT adoption and usage of MWT in business and which of those factors have the most significant impact on the adoption and

usage decision of MWT in SMEs. The following sections further expand on these views by introducing relevant literature about MWT. The research then provides a framework to analyse MWT adoption and diffusion. The research then introduces the research methodology section and concludes with a discussion and a conclusion section.

## LITERATURE REVIEW

### Mobile and Wireless Technologies

There are different stakeholders involved in the MWT industry, such as mobile hardware manufacturers, mobile applications and portals developers, middleware developers and integrators, and wireless networks providers and carriers, intermediaries, and finally services and content providers. In view of the different technologies that provide MWT functionality, the following taxonomy depicts six main categories:

- Interactive or two-way pagers, which exchange short SMS (Short Message Systems) messages.
- Mobile phones either voice-based or the ones that provide access to the Web (browsing, email) through the Wireless Application Protocol (WAP's WML *Vs.* DoCoMo's i-mode) or to short-message-services (SMS) services.
- Personal Digital Assistance (PDA) with wireless modem (e.g., Palm).
- Wireless Internet access on laptop computers using IEEE 802.11a, b<sup>1</sup> radio frequencies (CSMA/CA not CD) standards.
- Wireless network devices such as those offered by Cisco, Symbol (e.g., wireless barcode reader/transmitters), and Proxim using, e.g., infrared and radio frequencies and other wireless technologies including satellite, cellular and microwave communications.
- Wireless identification technologies such as Radio Frequency Identification (RFID), Bluetooth, and GPS.

MWT has a number of advantages over EC due to its unique features such as portability, ubiquitously, flexibility where mobile users are capable of receiving information or conducting transactions regardless of location or time (Keng et al., 2001). It is important here to make a clear distinction between two sets of opportunities provided by MWT:

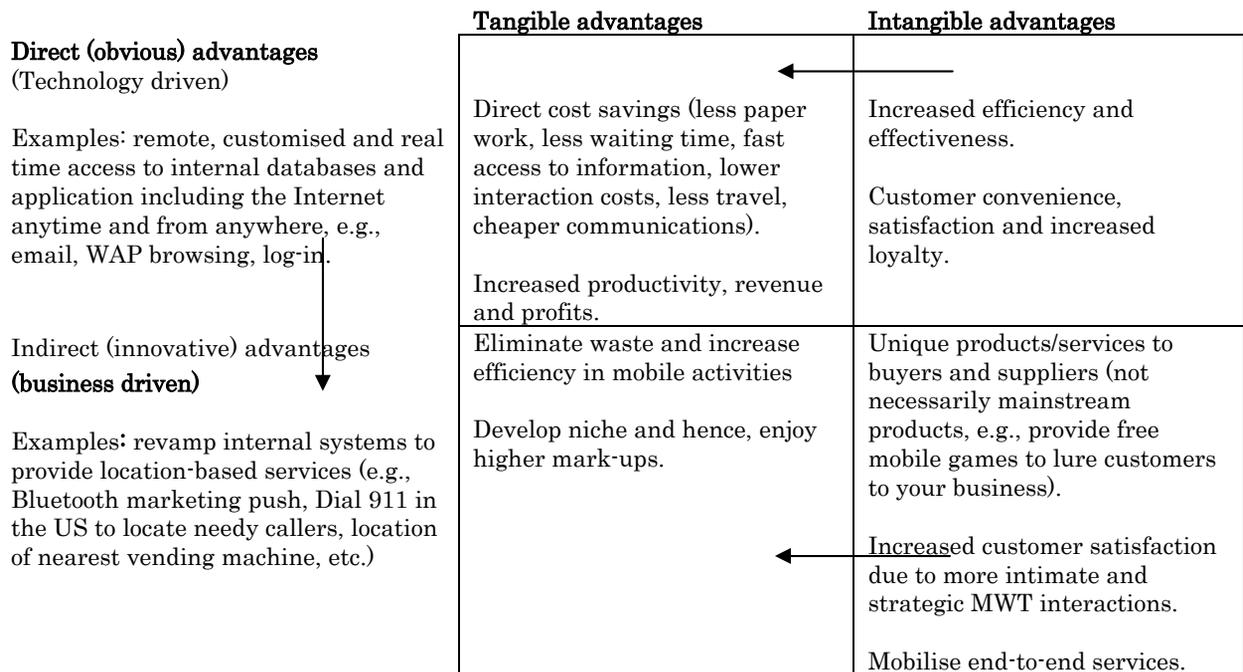
- Direct advantages: represented here by the strength of MWT in providing remote, personalised (mass customisation) and real time access to internal databases and applications including the Internet anytime and from anywhere.
- Indirect advantages: such advantages will require organisations to reconsider their internal processes and interaction mechanisms with buyers and suppliers in order to develop new and competitive MWT business models. A good example here is to revamp internal systems to provide location-based services (e.g., Bluetooth marketing push, Dial 911 in the US to locate needy callers, location of nearest vending machine, etc.)

However, the above classifications should be explained alongside a third dimension, namely, tangible and intangible benefits (Figure 1). It is understandable that organisation in the long term will be able to manage the transformation process (moving from the direct to the indirect advantages) to mobilise their internal processes and systems in place in order to realise tangible benefits. In the same vein, the above advantages could be further explained alongside a fourth dimension, namely, the business models. Depending on the type of the targeted stakeholder (B2B, B2C, C2B, B2E (employees), Machine2B (e.g., telemetry), B2G, G2B), businesses could pursue either transaction or process based MWT applications.

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<sup>1</sup> 802.11a (High-speed 54Mbps, 5GHz band), 802.11b (or called Wi-Fi: Low-speed 11 Mbps, 2.4GHz band)

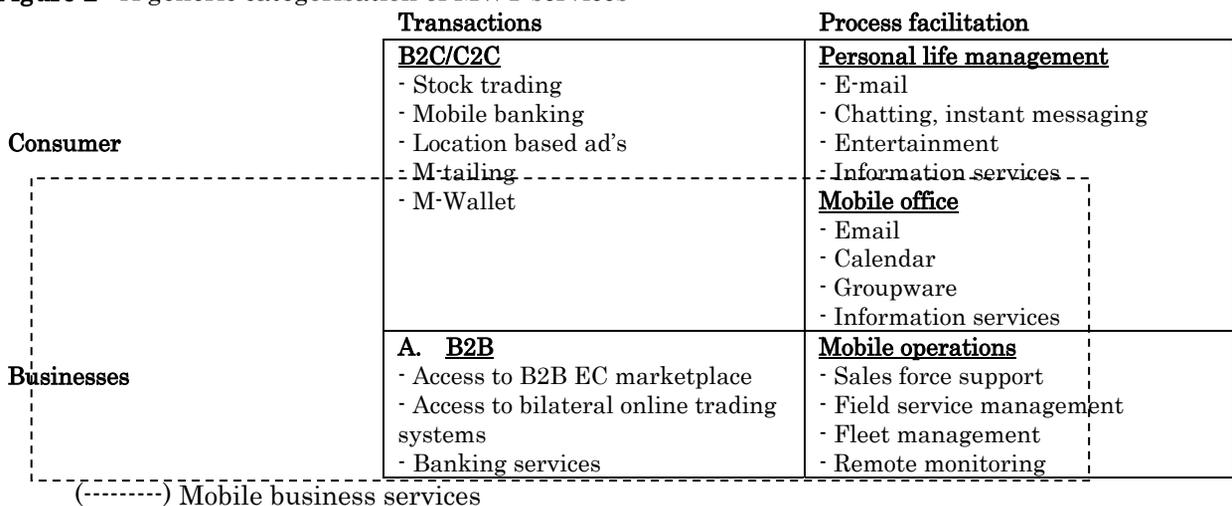
**Figure 1** A strategic framework for MWT-value realization



Alanen and Autio (2003) introduced a categorisation of MWT services extended from the McKenzie research (p. 168) (Figure 2), which could explain these options. They found that most of the MWT applications were concentrated in the (dashed box area) areas of field service dispatch, sales force support and fleet management (B2E).

However, MWT faces a number of obstacles due to either technical restriction in the wireless communication medium or mobile devices or to business and legal concerns (Keng et al., 2001) where speed, bandwidth, lack of standards, rigidity of existing processes and practices, change management, financial risk, lack of interest in mobile data, “burnout” effect for workers, devastating social and environmental impacts, privacy and security, and viruses are some of the challenges (Anonymous, 2000; Keng et al., 2001)

**Figure 2** A generic categorisation of MWT services



### **Adoption and Usage Theoretical Framework**

Since this research concerns adoption and usage of MWT, theories extrapolated from social psychology such as the technological innovation theories represent a good foundation to progress theoretical development of adoption and usage (Harrison et al., 1997) of MWT in SMEs and to improve their competitive position. The Theory of Planned Behaviour (TPB) (Ajzen 1991; Mathieson, 1991), the Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975), the Technology Acceptance Model (TAM - an adaptation of the TRA: perceived ease of use (complexity) and perceived usefulness (relative advantage) of the system) (Davis 1979, 1989), and Rogers' (1995) Innovation Diffusion Theory (IDT – characteristics of the innovation: relative advantage, complexity, compatibility, trialability and observability) are the four most applied and validated theories investigating the impact of IT in organisations (Taylor & Todd, 1995; Tingling & Parent, 2002).

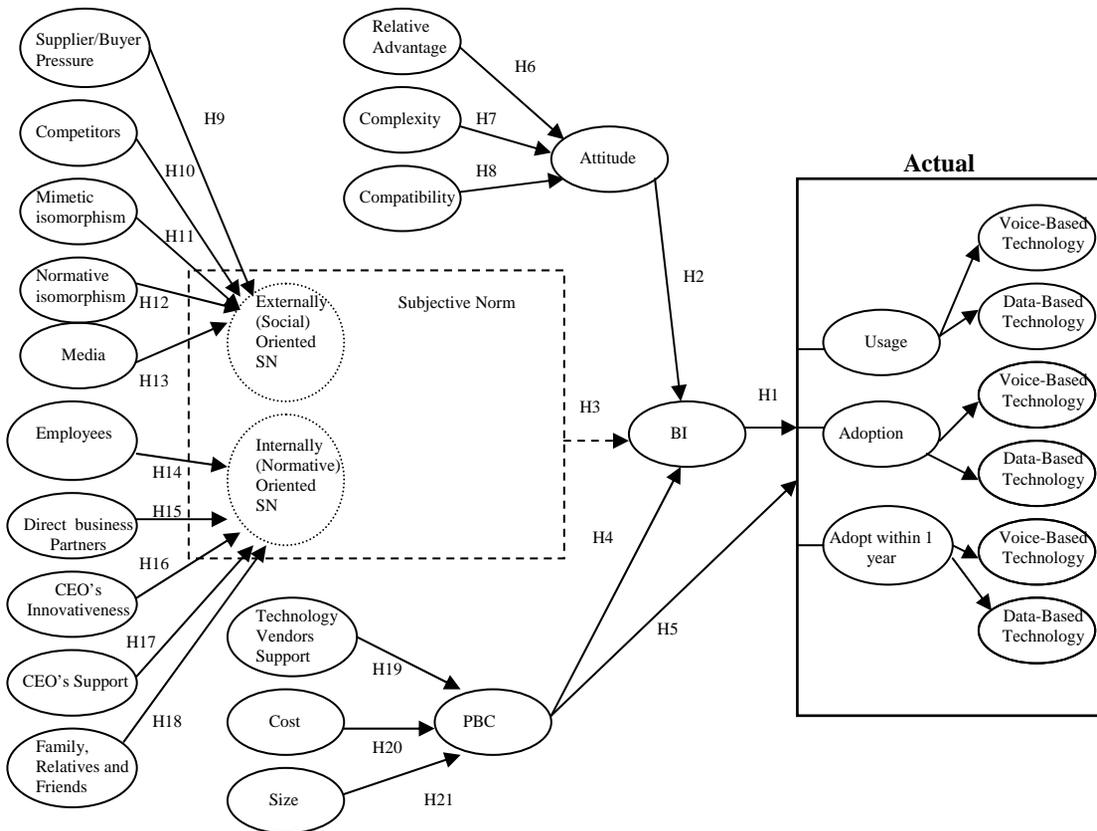
TRA contends that an individual's Attitude (A) and Subjective Norms (SN), or the perceived expectation from important others for the individual to perform the behaviour of interest, will influence the individual's Behavioral Intention (BI) which will in turn determine the individual's Behaviour (B). TAM adapts TRA to model user acceptance of IS.

TAM proposes that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) will influence Behavioural Intention that, in turn, determines Behaviour (Davis 1989). TPB, which focuses on Attitude (A), Subjective Norms (SN), and Perceived Behavioral Control (PBC), provides a good theoretical foundation to understand the adoption and usage of MWT. TPB deals with the behavioural limitations over which people have limited volitional control and providing greater specificity in both prediction and explanation (Ajzen, 1991).

TPB expands and strengthens TRA and TAM by incorporating a third belief construct, PBC, to represent the internal and external barriers in performing the behaviour (Ajzen 1991). Combined approaches have been used by different researchers. For example, Moore and Benbasat (1991, 1996) combined concepts from TRA and IDT in determining end-user computing. Taylor and Todd (1995) contrasted the intentions and innovations literature and hence, decomposed the TPB to draw upon constructs extended from the innovations characteristics literature to cover the dimensions of SN (i.e., social aspects) and PBC – by decomposing them into specific belief dimensions. Venkatesh and Brown (2001) followed the same approach as well in decomposing TPB.

One of the major strengths of TPB over TRA and other approaches is its ability to analyze a situation where individuals do not have volitional control over their behaviours and providing greater specificity in both prediction and explanation (Ajzen, 1991). Due to its comprehensiveness, the decomposed TPB which includes constructs from IDT is well positioned to provide complete understanding of usage (Taylor & Todd, 1995) and it tends to capture information about social and behavioural control in the implementation process (Mathieson 1991; Taylor and Todd 1995). Accordingly, the decomposed TPB approach was adopted in this research to explain the adoption and usage phenomenon (Taylor & Todd, 1995) of MWT in SMEs in NZ. Figure 3 presents the research model and hypotheses, explained next.

Figure 3 Research Model



**Theory of Planned Behaviour: Hypotheses Development**

In TPB, the actual behaviour is a direct function of BI and PBC and it is examined in this research alongside three forms of actual behaviours: (1) behaviour to adopt MWT, (2) behaviour to use MWT and (3) intent-behaviour to adopt MWT within 1 year. Each of the three types of behaviours is examined alongside two dimensions: (1) voice-based technologies and (2) data-based technologies. BI here refers to intention to adopt/use or intent to adopt/use MWT. BI is formed by ones attitude (A), which reflects feelings of favourableness toward performing a behaviour; SN, which reflects perceptions that significant referents desire the individual to perform or not perform a behaviour; and PBC, which reflects perceptions of internal and external constraints on behaviour (Ajzen, 1991) (resources (time, money), opportunities, confidence/ability to use IT, self-efficacy, voluntariness (Moore & Benbasat 1996)). Taylor and Todd (1995) observed from the literature that:

- in order to have a clear link between SN and BI, there should an actual behaviour with real consequences.
- SN has been found to be more important prior to, or in the early stages of, implementation.
- The belief structures (A, SN, PBC) are combined into unidimensional constructs which may not be consistently related to A, SN, PBC.
- The belief sets relating to attitude are idiosyncratic to the empirical setting, making it difficult to operationalise the TPB.

The first 2 observations are important here in investigating the impact of SN on BI alongside the three forms of actual behaviours in the research model. The last two were address in Taylor's and Todd's (1995) decomposed model.

The above discussion informs the following hypotheses:

- H1: Behavioural Intention will positively influence Behaviour (actual).
- H2: Attitude will positively influence Behavioural Intention.
- H3: Subjective Norms will positively influence Behavioural Intention.
- H4: Perceived Behavioural Control will positively influence Behavioural Intention.
- H5: Perceived Behavioural Control will positively influence Behaviour.

#### *Attitudinal Belief: Technology facilitation conditions*

As explained above, to overcome the problems relating to attitude beliefs, Taylor and Todd (1995) and Moore and Benbasat (1991) suggested including dimensions that can be derived from the literature describing the perceived characteristics of the innovation (Rogers, 1995) and TAM, where they introduced the relative advantage, complexity and compatibility factors.

Innovation adoption and diffusion studies have found the relative advantage (perceived usefulness) characteristic influencing innovation adoption and usage significantly and positively (Davies, 1989; Mathiesen, 1991; Rogers, 1995; Taylor & Todd, 1995; Tornatzky & Klein, 1982). This fact has been suggested by recent EC research in SMEs (Abell & Black, 1997; Abell & Lim, 1996; Deloitte, 2000; Poon & Swatman, 1997; 1999a, b; PWHC, 1999). Compatibility refers to the degree to which using technology is perceived as being consistent with the existing values, and past experiences of the potential adopter. Moore and Benbasat (1991, 1996), Rogers (1995), Swanson (1994), and Tornatzky and Klein (1982) found the compatibility factor influences innovation diffusion significantly. The compatibility factor was found to influence Internet (Teo et al., 1998) and IS (Thong, 1999) adoption and usage significantly and positively. Complexity represents the degree to which an innovation is perceived to be difficult to understand, learn or operate (Rogers, 1995), which was found to influence adoption and usage negatively (Moore & Benbasat, 1991, 1996; Taylor & Todd, 1995).

Based on prior literature and theory, we state the following hypotheses:

- H6: Relative advantage will positively influence Attitude.
- H7: complexity will negatively influence Attitude.
- H8: Compatibility will positively influence Attitude.

#### *Normative Belief*

The explicit inclusion of SN makes the TPB a useful model for IS in areas where social effects (i.e., pressure toward compliance or homogeneity) that are not linked directly linked to job-related outcomes could cause unique variance (Mathieson, 1991). Earlier research was found to suggest approaches to the decomposition of normative belief structures into relevant referent groups: peers, superiors and subordinates (Taylor & Todd, 1995), although these are predominantly internally focused (Tingling & Parent, 2002). The inclusion of these groups provide many advantages of TAM by recognising that normative beliefs are not monolithic but result in a more complex and less parsimonious model (Taylor & Todd, 1995). Family and friends are suggested to be important groups that influence individuals' BI as well (Venkatesh & Brown, 2001).

Tingling and Parent (2002) posited that although SN, the influence of social pressure or normative beliefs to perform or not to perform a certain behaviour, are known to be salient in technology related decisions, the predictive or explanatory power of adoption models would be increased if they were more broadly and externally defined, rather than their existing characterisation as internal or within a manager's direct operating environment. They proposed to address this deficiency by incorporating "institutional theory" into a technology selection model and explicitly including less visible or latent external influences and describing an influence process. They argued that firms will exhibit isomorphism as a way to reduce uncertainty by copying the

decision made by other units that face the same set of environmental conditions. This is limited here to the effect of: the following forms of isomorphism:

- Mimetic isomorphism: standardise response to uncertainty and refers to the imitation of one organisation seen by another as more legitimate or successful. Innovation here results from imperfect copying and adaptation and is often facilitated by consulting companies
- Normative isomorphism: is associated with professionalism and describes the struggle of members of an occupation to define the conditions and methods of their work and is heavily related to formal education and to the elaboration and growth of organisationally spanning professional networks.

Other external influences were identified by the technological innovations literature and recent SME's research. SMEs that exist within an intensive-competitive environment would perceive having MWT a competitive necessity to sustain their existence or to gain competitive advantage (Poon, 2000; Teo et al., 1998). Hence, if SMEs were confronted with a high percentage of customers and competitors online, this would increase the chances of adopting EC (or MWT) (Poon & Swatman, 1999a). Issues concerning buyer/supplier pressure were also emphasised as important determinants of EC adoption in SMEs (Poon, 2000; Poon & Swatman, 1998; 1999a).

Other internal influences were identified as well. Most of the literature in small businesses demonstrates the importance of the manager's role (usually the owner) as a product champion (Poon & Swatman, 1998, 1997, 1999a, 1999b). However, with the dominance of the micro business, most of the reported literature tackling IS/EC reported the lack of the IS/EC knowledge among businesses in NZ (Deloitte, 2000; PWHC, 1999) and therefore, it is suspected that using the IS/EC knowledge factor would not yield any useful results. Thus, emphasising the importance of the manager's innovativeness and involvement only (Poon & Swatman, 1998) on MWT adoption and usage would provide more interesting insights. The manager's innovativeness was found to influence IS adoption significantly and positively (Thong, 1999). Poon and Swatman (1998, 1999a) found the manager's involvement influencing EC adoption significantly and positively. Accordingly, the following hypotheses are proposed:

This discussion leads to the following hypotheses:

Externally oriented SN:

H9: Suppliers/buyers will positively influence SN.

H10: Competitors will positively influence SN.

H11: Mimetic isomorphism will positively influence SN.

H12: Normative isomorphism will positively influence SN.

H13: Media will positively influence SN.

Internally oriented SN:

H14: Employees will positively influence SN.

H15: Direct business partners will positively influence SN.

H16: CEO's innovativeness will positively influence SN.

H17: CEO's support will positively influence SN.

H18: Family, relatives and friends will positively influence SN.

#### *Perceived Behavioral Control: Resource facilitation conditions*

Ajzen (1991) decomposed PBC into internal notion of individual "self-efficacy" and to external resource constraints (cost, time, accessibility). External control refers to the facilitating factors that are external to the individual. Based on research in SMEs and focusing on the external factors, it was found that technologies that are perceived to be low in cost are most likely to be adopted (Premkumar et al., 1994; Premkumar & Roberts, 1999; Tornatzky & Klein, 1982). However, recent research found that scarce financial resources are one of the main inhibitors to IS and EC adoption in small businesses (Bili & Raymond, 1993; Poon & Swatman, 1999a,b; Thong, 1999) and hence

would influence the adoption decision negatively. Size emerges as a potential determinant of MWT adoption in SMEs, as this would imply having excess financial and human resources to invest in (and even experiment with) MWT. The larger the SME's size, the more likely it will have sufficient resources, experts, expertise, and systems in-house to adopt innovations (Alpar & Reeves, 1990). SMEs that are exploring the possibility of adopting MWT would rely on the availability of external support from vendors and consultants to assist them during the adoption stage (Alexander, 1999; Mcdonagh & Prothero, 2000). Earlier, Kwon and Zmud (1987) found the availability of external support to be positively related to adoption.

This discussion leads to the following hypotheses pertaining to external aspects of PBC:

H20: The availability of external support from technology vendors for MWT will influence PBC positively.

H21: Cost13 will influence PBC negatively.

H22: The SME's size (number of employees) will influence PBC positively.

## RESEARCH METHODOLOGY

### Item development

Data for the study was collected by means of a survey questionnaire based on the research model in Figure 1. Standard measures were used (where available) during the design of the measures adopted in this study. Similar innovations adoption and usage research has followed the same approaches by adopting well-tested measures, which have been tested meticulously assessed for validity and reliability (Premkumar & Roberts, 1999; Premkumar et al., 1994; Teo et al., 1998; Thong, 1999). Due to the novelty of the MWT, some of the previously validated measures had to be adapted to meet the constraints of this questionnaire (Chelos et al. 2001). Other items were developed specifically for this research.

Relative advantage measures were extended and adapted from Abell and Black (1997), Abell and Lim (1996), Alanen, J. and Autio (2003), Poon and Swatman (1999b), Premkumar and Roberts (1999), Roberts and Pick (2003) and Teo et al. (1998). Compatibility measures were extended and adapted from Beatty et al. (2001); Moore and Benbasat (1991); Pavlou, 2003, Premkumar and Roberts (1999); Premkumar et al. (1994); Roberts and Pick (2003), Rulke et al. (2003), Teo et al. (1998). Complexity measures were extended and adapted from Igarria et al. (1997), Premkumar and Roberts (1999), Rogers (1995) and Taylor and Todd 1995.

Internal subjective norm beliefs were adapted from Taylor and Todd (1995). The manager innovativeness measures (Miss1, Miss2, Miss3, Miss4) were adopted from Kirton (1976) as they have been proven as effective in recent IS research in small business (Thong, 1999; Thong & Yap, 1995; 1996). The manager's involvement measures were adapted from the "top management support" measures in Premkumar and Roberts (1999), Premkumar et al. (1994), Igarria et al. (1997) and Rai and Bajwa (1999) studies. As for the external ones, Mimetic and normative isomorphism measures were adapted from Tingling and Parent (2002). The measures for the competition characteristic were extended and adapted from Premkumar and Roberts (1999) and Thong and Yap (1999). The measures of the strategic orientation of MWT were extended and adapted from Porter and Miller (1985) and Teo et al. (1998). The measures for external pressure from suppliers or buyers were adopted from Premkumar and Roberts (1999).

As for PBC, the measures for external support from technology vendors (Exs1 and Exs2) were also adopted from Premkumar and Roberts (1999). The measures for the cost factor were adapted from Anonymous (2000), Keng et al. (2001) and Premkumar and Roberts (1999). The measures for the external support from technology-vendor factor were adapted from Premkumar and Roberts (1999).

As for the dependent variables, the design of the actual behaviour measures was adapted from Pavlou (2003). Attitude and subjective norm measures were adapted from Mathieson (1991) and PBC from Taylor and Todd (1995). BI measures were adapted from both Mathieson (1991) and Taylor and Todd (1995).

### **Pre-testing**

Before the questionnaire was mailed out, it went through extensive pre-testing with faculty members and other researchers in this area. Particular attention was given to wording, structure, sequence, and overall presentation of the items in the questionnaire. The questionnaire was pilot-tested with managers of five SMEs in NZ. Interviews were conducted with these managers to determine whether there was any problem with the questionnaire questions or format. On the basis of their comments, changes were made to the questionnaire to clarify wordings and increase readability. Four faculty members further revised the final version. This procedure is important to test for content validity (Premkumar & Roberts, 1999; Tang, 2000, Thong, 1999). Responses from the piloted SMEs were not included in the survey. The next phase of this research will attempt to identify a pilot/sample which could be the target for testing the research model above.

### **DISCUSSION AND CONCLUSION**

This research represents an initial attempt in this theoretical direction, to investigate the adoption, usage or intent to adopt different mobile and wireless technologies. This is important to isolate the features of those different segments of behaviour. The research is also interested in differentiating between voice- and data/text-based interactions. This is important to judge the real success of MWT in the business environment of enterprises in general and in SMEs specifically.

The research highlighted different advantages and challenges which could face SMEs in their attempt to adopt or to use MWT. The research then progresses a framework to explain the adoption/usage phenomenon of MWT and introduced different important influences which could assist the researcher in identifying the most significant ones on the actual behaviour of SMEs in NZ and at the same time, to identify salient features of the different segments as highlighted above. These issues are of interest to the general business community, SMEs, professionals (consultant, technology vendors) and policymakers interested in MWT adoption and diffusion.

The extension of prior technological innovation theories and the introduction of different factors to MWT research represent an important contribution to this literature in the first place. This approach could resemble a good foundation for future research in the MWT area. Although, it is feared that the MWT phenomenon is still emerging or is not yet developed in the SME's perspective and indeed, this study may not attract the attention of all the SME's community in NZ as such, the initial insights expected to be developed by this research could resemble a starting point in this important and contemporary research area.

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