

# Understanding Hybrid Wireless Device Use and Adoption: An Integrative Framework Based On An Exploratory Study

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## Abstract

*In this paper, using data from a set of exploratory interviews, we inductively develop an integrative framework identifying key enablers and inhibitors that influence the process of use and adoption of hybrid wireless devices by subjects who participated in three-week long trial studies. A number of intended as well as unintended consequences of the use and adoption of the technology also emerged. The primary contribution of this paper is that it sensitizes the reader to the complex nature of the use and adoption process that is influenced by and influences a variety of factors, and provides a map for future researchers to identify, isolate, and study "variables" and relationships among the variables based on their theoretical interest and methodological orientations.*

## 1.0 Introduction

There is little doubt that mobile electronic commerce (m-commerce) is one of the hottest areas of interest in information technology (IT) circles today. There is also little question that it is a poorly understood phenomenon, which is particularly concerning in light of the belief among researchers that the ability of buyers, sellers, device providers, and network providers to arrive at a shared understanding of the challenges and opportunities is crucial for m-commerce to proliferate. Specifically, there is a need to understand the motivations, antecedents and consequences of mobile device adoption by consumers, since without widespread proliferation of such mobile devices/services, m-commerce would fail to fulfill its potential [19]. An observation that appears perplexing, for example, is that in some parts of the world, certain mobile applications are embraced, whereas in other regions of the world, the very same applications are seldom used. For example, one can compare text messaging in the USA and Europe. According to the

Mobile Data Association, Europeans sent approximately 35-40 text messages per person per month. In that same time frame, Americans sent about .25 messages per person per month, or about 1 message for every four users. Penetration rates for the devices are also higher in Europe (about 70%) than the USA (about 50%). Several potential explanations are offered for the difference, including pricing structure and network ubiquity [3]. However, specification of some isolated factors provides little ability to comprehend the phenomenon systematically, and to build or test causal explanations.

Within the MIS research community, there is a strong orientation to apply and test well-accepted existing academic theories such as the Technology Acceptance Model [5], Task Technology Fit [12], and Adaptive Structuration Theory [9] to explain socio-technical phenomena such as technology adoption (even when the unique capabilities of a new technology and its potential impacts of the social fabric are not well understood). Within this paradigm, it would seem natural (and even desirable), then, to empirically assess the validity of these admittedly excellent theories to the new context of mobile or wireless device use and adoption. Yet, such an approach would hardly address meaningful questions such as what mobility means, what are the consequences (intentional and unintentional) of mobility, and how overall work and life patterns may change. This is key to understanding user motivations behind use and adoption in different socio-economic contexts.

In order to alleviate these concerns, we felt it necessary to study the use and adoption of *hybrid* wireless devices (i.e., consisting of both voice and data features) from *the point of view of real users* interacting with the technology, not from the point of view of a theorist with pre-commitment to a certain conceptual lens. Also, because our objective at this stage was not so much to test well-reasoned propositions with maximum possible confidence, but rather to discover concepts and generate plausible explanations regarding the phenomenon by linking those concepts, we sought to conduct our study in

a naturalistic rather than in a controlled lab setting.

As stated earlier in this section, the popular press extols ideas regarding m-commerce, and manufacturers seem busy churning out mobile devices based on their conception of what the mobile user might value. However, the factors behind the transformation from a desk-bound end-user to a mobile end-user remain in the domain of speculation. Our study takes a first step towards filling this void in the existing body of knowledge by attempting to address the following research question:

***What are key factors affecting the use and adoption of hybrid mobile devices?***

## 2.0 Research Design and Methodology

### 2.1 Description of the Study

For the purpose of our research, three groups of individuals were drawn from the population of a large university in the Pacific Northwest:

- 5 (out of 7) officers (all from the US) of a large student club (the "MIS Club").
- 5 members of an exchange student group from a Northern European country (Norway)
- 5 members of an international business group from the Asian-Pacific region (3 from Thailand, 1 from China, and 1 from S. Korea).

These fifteen students, belonging to three separate cultural, social, and work groups, were provided with a mobile device (Samsung SPH-N300) and airtime for a three-week period. Subjects attended a 90-minute training session in the use of the phone in the features that we wished them to explore: WAP browsing; text-messaging; connection to other Internet services; and, voice services. Subjects were required to meet once a week with the researchers for 30 minutes. During this time, subjects answered semi-structured interview questions (which were taped and later transcribed), and also completed a questionnaire. A similar follow-up study was conducted at the conclusion of the first study to further explore some of the emergent concepts and (relationships among concepts). This second study utilized all 7 officers of the MIS club, as well as a four-person *ad hoc* project team for an undergraduate E-Commerce class. As in the first study, subjects were asked to meet with the researchers weekly to describe their usage of the devices and to discuss relative changes (or lack thereof) in their lifestyles once they were using the devices.

### 2.2 Data Collection and Analysis

Each participant was interviewed at the end of each week. In most cases, at least two researchers conducted the interviews in order to ensure their reliability and to facilitate the interpretation of the conversations and surrounding cues. Also, accepted guidelines for designing/conducting interviews [11, 16, 27] were utilized for "getting honest and open information" [27] that is valid and reliable [32].

The analysis was primarily interpretive in nature, though we adopted more of a realist than an impressionist stance in general. Data analysis proceeded simultaneously with data collection, and the analysis followed the logical sequence of coding recommended by grounded theory methodologists [31] and illustrated by IS researchers [29]. First, the transcripts were carefully read and important concepts were identified (open coding). Thereafter, the concepts were all organized within meaningful categories (axial coding). Finally, the categories were all linked to the core category of mobile technology use (selective coding) to develop the framework.

## 3.0 Research Findings

In this section, we describe the framework (see Fig. 1.) that is structured as an Input-Process-Output (IPO) model. According to the framework, individual characteristics of the proposed adopter/user, the characteristics of the task or messaging attempted, the nature of technology, the modality of mobility, and the surrounding social and economic context influence the use process. Based on the data, the adoption/use process is characterized by the media used through the wireless device (voice, text), extent of use, exclusiveness of use (i.e. extent to which a subject relied on the wireless device for his/her communication, coordination, and web access needs), and faithfulness of appropriation of the spirit (i.e., extent to which the subject utilized the mobile device for the purpose it was originally designed) [9]. The use process, in turn led to outcomes (both intended and unintended) related to the following categories of functional, psychosocial, and relational. In addition, a "positive" use experience and favorable functional, psychosocial, and relational outcomes would be associated with a decision to adopt the technology, especially if economic factors did not make such a decision prohibitive. The bi-directional arrow between outcome and use implies that not only is the nature of the use process a determinant of the outcome, but the outcomes also influence use. We would also like to highlight the fact that Fig. 1 represents a high-level conceptual framework, identifying key categories and sub-categories associated with the phenomenon, and suggesting some tentative relationships among them. Thus, the arrows should not be viewed as causal, but rather as representing tendencies regarding influence. Furthermore, the interactions between/among the categories in the framework are not shown but assumed to occur within the process box in an emergent manner, depending on the context [22]. We now discuss each of the categories in greater detail.

### Mobility

Perhaps the most significant advantage of wireless technology touted in the literature is its ability to enable mobile communication, mobile collaboration, and mobile commerce [30]. While descriptions of innovative applications of mobile technology and visions of future

scenarios abound in the literature, very few authors have attempted to systematically explore or articulate the meaning of mobility, the types of mobility, and the implications of different types of mobility on wireless tool use. Consider the following quotations from interviews conducted as part of our on-going study:

*Driving across the state .. I would have it [the mobile device] for safety reasons. (1)*

*You can check your e-mail when you are walking somewhere, which I see is a huge benefit... (2)*

*If you are at a friend's place or something, you can't, you know, just ask to use their phone [or computer] that much. If you have a cell phone, it is OK if you step outside for a second and use it... (3a)*

*I can't just check my e-mail [in the place I work]. [One time].. I really needed to know if I am meeting with him [a professor] at this certain time, so this [ability to check e-mail using the mobile device] is a great feature... (3b)*

Each of these strips of data implies a different kind of mobility. Kristoffersen and Ljungberg label the three types of mobility as traveling, wandering, and visiting respectively[15]. Traveling is defined as "the process of going from one place to another in a vehicle". Clearly, a five-hour drive from one city to another across the state, as described in quote (1) above, would belong to this category of mobility. Wandering, on the other hand, refers to "extensive local mobility in a building or local area. A wandering person spends considerable time walking around". This is the kind of mobility referred to in quote (2). Finally, visiting refers to stopping by at some location and spending time there, before moving on to another location. A short visit to a friend's home, workplace (that does not provide easy access core communication channels of an individual), or, for that matter, to Kona, Hawaii to attend the HICSS conference all fit into this category. The type of mobility is often associated with different motivations and consequences (e.g. *safety* during traveling versus *freedom* from the desk in wandering) and to different characteristics of technology used (e.g., the *optimal size* of a mobile device associated with wandering is necessarily lower than an acceptable size when visiting or traveling, and one needs a *larger reach* of the technological network when traveling than when wandering).

### Individual Characteristics

Individual differences in terms of demographics, personality traits, skills, and culture have been identified as important determinants influencing the implementation and acceptance of technology [8, 20, 28]. Data from our study appears to be consistent with this stream of research. In particular, the age of the potential adopter emerged as an important factor determining whether or not an individual was likely to use data features. According to a Thai participant, data features such as text messaging *..might be so complicated for most people because the middle age people start using cell phones but they are not*

*familiar with high technology computers and things like that.. so they use voice [communication].*

Consistent with the views expressed in the quotation, a participant suggested that, based on his experiences in Norway, the best strategy to ensure widespread adoption of mobile phones in a society is to provide free phones to students aged 13-19. Another point that was consistently highlighted in many interviews, as also in the above quotation, was the importance of prior exposure to and confidence in the use of high-tech devices in general (technology self-efficacy) [26, 23].

Interestingly, we found those with prior exposure to mobile devices to be rather reluctant in trying out new features of the device, and these individuals remained convinced that the quality of the device provided as well as the network service subscribed to were substantially inferior to those they had earlier used. For example, one interviewee said:

*Even for people who know how to use it [similar devices], it is a struggle...*

In other words, for these individuals, it appears that adopting and using the mobile technology provided in the study seemed to require switching for their earlier technological frames [25] to different set of features, sequence of keystrokes to accomplish a task, and expectations of performance.

Cultural origin also seemed to play a role in individuals' perceptions regarding the degree of informality of text messaging, thereby suggesting different patterns of usage. For example, a participant originally from Korea, a high power distance culture [14], seemed to feel most strongly about the inappropriateness of text messaging in a formal context:

*It is informal, absolutely! It is impossible to send a message using this device to a professor [one worthy of respect]. In my country, it is rude... If we use this kind of device for messages it can be kind of rude to older generations.*

Even Norwegian respondents, coming from a culture associated with very low power distance, indicated discomfort regarding the use of text messaging to communicate with a superior. For example, one indicated that messaging was "too informal" while another Norwegian respondent wondered if his discomfort regarding messaging was partially due to the use of short words and abbreviations in text messaging, which might not be appropriate with superiors. For US students, also coming from a low power distance culture (though higher than that of Norway), the importance of social definition regarding the acceptability of text-message use in their culture seemed less salient than the Korean individual and higher than the Norwegian students. For example, an American student indicated that he used text messaging "on an informal basis mostly," and would not consider sending text message to say, a potential employer, "because it [text messaging] is newer and less acceptable... most people wouldn't be accustomed to receiving to receiving that sort of a notification." Another

American student indicated she would rather call than send a text message in a formal setting, "*just to be safe.*"

It is worth noting that for the Korean student, text messaging to people of respect was a serious offense, while for the American students, the avoidance of text messaging to a superior seemed motivated not so much by fear of offending, but more by not wanting to surprise them. Finally, for (one of) the Norwegian students, the media (i.e., text messages) was not seen as inherently inappropriate for communication with superiors. Instead, a "rational" explanation regarding messaging behaviors (i.e., use of abbreviations such "c" instead of "see" and "u" instead of "you") typically associated with text messaging was offered. The preceding discussion would suggest that culture (specifically the power distance dimension) would have some influence over the use and adoption of text messaging in certain contexts, such as communication with superiors or elders.

The amount of disposable wealth available to subjects also recurred as a major theme, with many, irrespective of national or cultural origin, emphasizing that while they valued mobility afforded by wireless technology, 30 USD monthly was just too steep a price to pay for it. Some suggested that they would certainly get the technology once they obtained a professional job, or if their parents offered to pay for it. Security during traveling and staying connected with a significant other while traveling, wandering, or visiting seemed the most likely reason for valuing mobile connectivity higher than the change associated with the technology.

### Communication/Task Characteristics

The use process appeared to be significantly influenced by the nature of communication/interactions. Participants repeatedly noted that the features of the wireless device and the service subscribed to was useful in dyadic interaction, but very inconvenient for group interaction, especially because a "broadcast feature" was not available. Text messaging was seen as very suitable for conveying straightforward information [7] such as "*yes or no*" and for coordinating a time/place for a meeting between two individuals. While most subjects indicated that text-messaging using the wireless device would not be a preferable mode for coming to a shared understanding, some agreed that it was possible for two individuals to converge to a shared understanding by sending a number of messages back and forth rapidly (implying increased synchronicity of communication). Situations requiring high volume of communication were viewed to make wireless text messaging very undesirable, partly because of technological limitations and also to avoid the painful process of typing on the telephone keypad:

*[message would be] nothing more than a few words... All of the messages I sent got cutoff partway through the message.. on the website it says that the limit is 160 characters.. and I stayed within the limit on the website. I sent three fairly long short messages to [the president of*

*MIS Club] and he said that all three of them got cutoff.... It was a little frustrating.*

Urgency of the situation seemed to dictate a media choice (among voice, text-messaging, e-mail) for many subjects: *I may try text-messaging because I am not sure if he will be able to check e-mail very often. I think he has the phone all the time.. if it is very urgent, I would use the text message.*

*If there is something that is not really important that I need to make a phone call about but you want the person to receive to receive it right away and not have to check e-mail, then text messages are good.*

As discussed at length in the previous subsection, wireless text-messaging was, in general, viewed as unsuitable for formal communications even when practical or convenient. The value of mobile communication (voice or text) seemed greatly enhanced in situations where immediacy of interaction was essential (e.g., tasks such as idea generation or brainstorming by two individuals at a time):

*When it comes to ideas, I definitely think that it is more beneficial to take care [of the issue] then and there.. you have all the excitement of all the fresh ideas.. but if you wait until 10 o'clock at night [i.e., much later when you have access to tethered devices], you are already tired, and you are.. well I had this idea and it sounds stupid now.*

Situations involving information access or unidirectional communication where the subject was the recipient (e.g., reading e-mail, checking stock quotes and news headlines) were viewed as tasks that were well suited to the mobile device/service provided, especially when such tasks could be done to fill time. Participants suggested different improvisations in their communicative practices by which they could perform relatively unsuitable tasks without much difficulty. For example, participants indicated that when high volume of information had to be communicated to a recipient who had access to a mobile but not a tethered device, they would compose and send an e-mail using a desktop, and use "*the phone as a trigger to alert some one [them] about an important e-mail.*" Another instance of improvisation suggested related to using the fundamentally dyadic technology as a group communication technology. A participant suggested that in the absence of a broadcast feature, group communication could be effectively accomplished with members connecting to each other as a "ring," and forwarding messages around the ring.

### Technology

Current mobile devices, particularly the devices used in our study (phones with voice and data features) are seen to have many limitations compared to wired or tethered devices. Some of the shortcomings of the devices and networks quoted from Siau et al. [30] are: *small screens and small multifunctional pads*, less computational power, limited memory and disk capacity; shorter battery life; *complicated text input mechanisms*; higher risk of data storage and transaction errors; lower display resolution; less surfability; *unfriendly user interfaces*;

*graphical limitations; less bandwidth; less connection stability; less predictability; lack of standardized protocol; and higher cost. We have italicized the aspects of technology that appeared prominent in the minds of our study's subjects, and categorized their concerns as interface characteristics and network characteristics. Frustration with different aspects of the device interfaces emerged consistently during the conversations with study participants:*

*They need to make it easier for normal people to use, not just techno-geeks.*

*Even for people who know how to use it, it is a struggle.*

*Eventually they could do something like a PDA where you have a little pen and you can write it*

*I just used the voice dial, and it dialed the wrong number every time!*

Interviews indicated that it was the logical interface, rather than the *physical* interface of the mobile device (in our case, Samsung SPH-N300) that bothered almost every participant in the study, regardless of culture.

*.. you don't know which sub-menu you will find something under. And before you can browse the submenus on the web you have to get on the web, even though it doesn't actually connect until you start transferring information.*

*One of the problems I encountered was when you go into the short mail function it is really hard to get back to say to the web-browser...every time that I need to get back to the browser, I have to disconnect and reconnect. So the interface is. confusing at that point..*

*.. it is hard because you can't search your phone book and just say send it to THAT person... it asked me for the number and I had to go get a piece of paper and type it in, which kind of defeated the purpose of having the phone book in the phone.*

*Drop all the bullshit.. there is just too much going on [..in] the messaging system.. if you send a message with my phone [in Norway], it is two presses away... you go on the menu, it says "message"; you go in there, you type it, you send it, that's it.*

All the interface issues discussed above appeared to seriously reduce the participants' intention to use and eventually adopt especially the data function feature of the mobile device. However, we realize that the problems experienced by the subjects may be more associated with the specific model of a mobile device, than with mobile devices in general.

The lack of coverage in many areas tended to reduce the sense of freedom and safety in many subjects' minds. For example, a Norwegian participant stated:

*.. here, you only have coverage where you actually have normal phones so it doesn't give you that extra dimension of freedom.. so you can't go to some mountain top and go skiing or whatever, and be connected.. you have to go to the coverage area.*

Lack of reliability and reduced responsiveness of the network also eroded subjects' trust on the mobile technology. For example, on the day of a scheduled wireless meeting among MIS club officers, text-messaging

feature was found to be down significantly reducing the level of communication, causing disruption in the group-meeting:

*The SMS wasn't really working yesterday. You could just see it and kind of read a little part of the line but when you click it to view the whole thing I would get a message stating that the service is not available at this time...*

*I am never really confident whether or not that person.. got the message.*

The limited reach of mobile technology due to lack of (or limitations in) capability to communicate across networks also inhibited the use process and enthusiasm for adoption:

*The Verizon customer can receive mine [messages originating in Sprint's network] but can't send them back, so there is a problem here.*

Another pattern discerned by us, the researchers, was that the Asian and European participants complained much more about the quality of voice on the wireless network, especially when calling from one mobile phone to another. It is difficult to say at this point whether this was related to the device, the network (Sprint), or was a cultural issue related to the frequencies and tones of voice used in normal conversation, and this bears further investigation.

## Context

Undoubtedly, the most significant aspect of the context emerging in the study related to the economics of use. Being college students on a tight budget, a lot of use patterns were driven by economic considerations as well as their adoption decisions. Most indicated that while they found mobility convenient, it was not worth the additional expense (equated to the extra Saturday of work to pay for the service each month, or foregoing of the opportunity of fine dining with a date). Some participants also went to the local stores to check out "deals" on the mobile devices, and contemplated signing up at the end of the study or wondered if their parents would pay for them to have the mobility. Many US subjects stated that the pricing strategies were not conducive for student adopters, provided suggestions in this regard, and called for aggressive introductory promotion plans that would involve distribution of free phones without the mandatory 2-year contracts. Cost was also cited as a reason for text-messaging being popular in Norway (quote 1 below) and not in Thailand (quote 2, below):

*We are in a campus here and you can phone for free, and in Norway you would have to pay.. therefore you just send a text mail that is short and convenient [and inexpensive compared to a call]. (1)*

*I don't think they [people in Thailand] use it much, because you have to pay extra (2)*

The second-most prominent aspect of the context related to the norms (both real and perceived) of wireless device use. While the first two of the following quotes show concern about violating norms of immediacy of response and round the clock availability, the third shows

peer pressure (approval) as a factor in use and eventual adoption.

*If they [your employers] give you a cell phone, you are expected to have your cell phone on, and if it rings, you are expected to answer it. (1)*

*I didn't turn it off, because I thought it would be rude...(2)*

*They [peers/friends who already had similar devices] were excited that I was finally up to date with technology (3)*

The norms of availability and immediacy of response however appear to change over time in societal/cultural contexts where over-penetration and relentless use of mobile devices seem to drive individuals to seek temporary respite from the connectedness:

*When I get home, I turn the phone off.... Yeah that's a pretty common reaction now. The penetration of the devices is very high, that you are kind of protecting your territory in some sense, a psychological insulation.*

Interviews revealed interesting differences<sup>1</sup> attributable to cultural contexts. The Korean participant, for example, revealed that “*Koreans emphasize fancy and attractive nature*” of the device and would be willing to pay a premium for the looks. In fact, the subject felt confident that a marketing strategy emphasizing low cost would not facilitate the adoption in Korea, and cited Nokia’s relatively poor performance in the country. The Thai participants provided interesting insight regarding the proliferation of mobile devices (primarily voice) in their own country, citing relatively poor traditional telecommunication infrastructure, low accessibility of public phones, frequent traffic jams wherein people are “stuck” in their car, and social practice of engaging in “more or less meaningless conversation” as a leisure activity. In contrast, a Norwegian participant reflected on his understanding of the US culture and offered the following insight:

*I think it [mobile devices] would be a huge benefit to the American economy because that is just the way the culture is... everything is fast paced.. it seems like people want to work 24 hours a day. They want to have access to information when they are not at work. So I think if you had a strong network that supported that, it might increase efficiency.*

Related to norms and culture, was the category of symbolism. This refers to the meaning (beyond functionality) that members in the culture hold about possessing and using a mobile device. It is clear from the interviews that symbolic meaning varies in different cultures (and sub-cultures, professional or socio-economic strata), and also tends to change with the passage of time: *There is a huge symbolism right now in American culture.. it's a young thing and it is a rich thing. I know my father got his [mobile phone] after all the kids moved out, and it was like his little perk.*

<sup>1</sup> Of course, whether or not the differences suggested are generalizable is an empirical question that needs to be investigated in the future.

*I feel professional that I have a cell phone especially for work. I feel important because I need a cell phone so that they can get a hold of me... it makes me feel cool.*

*In the beginning when it was new in Norway, it was a sign of status, especially having the latest fashion and type...it is not any longer a status symbol as it is here [in the US] because not so many people have it here, but in Norway everyone has it.*

The hazards of technology drawing attention in media also appeared to be a minor factor influencing use. While most subjects appeared to dismiss fears of brain cancer, because studies were not seen as “super conclusive,” the potential of car accidents seemed to be of concern for some subjects, including one participant from Norway.

Last but not the least, interviewees raised the issue discussed within the critical mass theory<sup>2</sup> [21]. The international students consistently indicated low extent of use and limited enthusiasm to adopt, even though many of them had been frequent users of similar devices prior to arriving in the US. On further inquiry, we realized that this was because the international students had few members of their social circle accessible using the mobile network. Similarly, for the US students, the concern was that many of their friends did not have mobile devices, and in addition, the limited interoperability among the different service providers further reduced the size and value of their network (in cases where their friends were signed up with a different service provider).

### User Outcomes

A central concern in the field of IS has been on the “dependent variable” [6] – that is on the outcomes of technology implementation/adoption. In earlier studies of relating to MIS implementation, outcomes have been measured in terms of extent primarily as the extent of use and user satisfaction [2, 10], while in case of GSS/EMS technologies, quality of solution, process satisfaction, group cohesion, and change in social structure are often used. In our study, we believe that it is important to adopt a broader view for two reasons – first, the open-ended nature of the study wherein participants use (or don’t use) the technology for a variety of tasks in a variety of contexts over several days/weeks makes it impossible to anticipate possible intended or unintended outcomes. Second, the nature of the technology (novelty, ability to free from time space constraints) is such that it has a high degree of interpretive flexibility wherein subjects are likely to discover new applications of the technology in different walks of their lives, beyond the “standard” or known applications.

Participants described a wide variety of outcomes of using mobile technology, ranging between the obvious

<sup>2</sup> A similar idea regarding the exponentially increasing value of a network with increasing number of people on it is widely known as Metcalfe’s law.

(being reachable any time) and completely counter-intuitive (e.g., arriving habitually late in meetings because mobile technology provided the option of forewarning meeting participants about delays even at the last moment). The outcomes may be categorized into four groups: Effectiveness in accomplishing tasks, psychosocial satisfaction, changes in the social interaction patterns, and the adoption of the technology.

***Effectiveness, efficiency, and other functional concerns:***

A large proportion of subjects pointed out that “convenience” due to the fact they were reachable “anywhere” (whether traveling, visiting or wandering) was the primary outcome/advantage of mobile technology adoption. One participant asserted that “*mobility means efficiency.*” Another key point that emerged in some interviews was that mobile technology allowed subjects to “fill” time:

*I enjoy it. It can be efficient and enjoyable.. a good time filler.*

“Filling” time refers to calling someone, checking e-mail, or sending a text message in time slots between other scheduled activities or while wandering from one point on campus to another or traveling from home to work. Sometimes, filling of time is equivalent to “killing” of time when the subjects used the mobile device merely to keep themselves engaged in that free time; otherwise, subjects used access to mobile device as a way to “shift” the time. A number of study participants indicated that while traveling short distances on bus, they would check their e-mails and send short messages that would otherwise take up their times at home or on arrival to work.

*You can check your e-mail when you are walking somewhere, which I see is a huge benefit. When I sit down at my computer , it can take 15 minutes for me to just read e-mail because I get distracted by so many things, whereas if I have it [email] on my phone [when] I am only walking there is less distraction.*

Another interviewee indicated that prior to the use of the mobile device, she spent an hour or so every evening after returning from schools/work responding to voice messages on her home answering machine (from missed calls) throughout day. Having access to her mobile device allowed her to respond and “take care of business” throughout the day as the calls came in, almost in “real-time,” rather than “batch” all the messages and respond to them later in the evening. In her view, this made her more effective in responding to the callers’ concerns, and also freed up her evening for other activities, such as homework! In addition, there were other advantages associated with asynchronous media (ability to converse without being co-present either in time or in space) were also apparent to some study subjects:

*One of the benefits of doing it [conducting the MIS Club meeting] through text messaging is that my schedule in*

*particular is really difficult to work in order to be able to meet with everyone when we have a planned meeting.*

Some members also believed mobile technologies, like other ICTs, have the potential to include certain sectors of the population in social and economic interactions, thereby empowering them:

*People who are a lot more recluse and private will have better opportunities.*

However, some participants also raised doubts about the functional value of mobile phones enabled with text-messaging features, stating:

*I think it can make you more efficient, but just like anything else, like a toy, it can slow you down just as much.*

*Whether it makes [people] more efficient, I don’t know. For personal use it is good.. short messages on a personal level.*

Some also warned about the possible negative effects on professional and social relationships, such as unmet expectations regarding responsiveness (1) and encroachment on personal time (2):

*People can get hold of you at more times... [so if] you turn it off but you are expected to have it on, it can create a even more negative effect.. (1)*

*People can reach you 24 hours and that means they are using your time.. that gives you less “slow time” to do things yourself.. (2)*

***Psychosocial outcomes:*** In addition to the more tangible impacts of mobile technology use discussed above, interviewees mentioned a number of psychosocial impacts. Several individuals mentioned feeling a sense of safety/security during traveling:

*It’s a safety thing too.. if something happened you could call the police... if there is a car accident or whatever.*

Another interviewee, a student from Norway, indicated a feeling of irritation with society’s addiction of mobile technology:

*It is convenient but it is also annoying.. you sit at a bus, all the people are talking on their phones.. you become addicted to it after a while because you bring it everywhere.*

Others mentioned feeling a sense of elevated self-worth, professionally or socially:

*I feel professional that I have a cell phone especially for work. I feel important because I need a cell phone so that they can get a hold of me... it makes me feel cool.*

Interestingly, participants were divided over their views regarding feeling “free.” To some, mobile technology freed them from being tied to their desks or from being close to a tethered device. Yet, for others, the compulsiveness of responding to communication initiated by others at any or every time was viewed as serious constraint on their freedom, ascribing a role of domination to the mobile technology [24]. One subject seemed paranoid about missed opportunities:

*It was frustrating because I felt that I couldn't leave [the proximity of a tethered phone or computer] and go do stuff and miss out on something... you never know when somebody's gonna call you or when something cool is going on that you might be invited to.*

Yet another student indicated that not having a mobile device with him gave him a great sense of freedom:

*When I came over to United States it was bad in the beginning.. but not having a [mobile] phone, I felt freer cause you don't have to check it every time.*

Another interesting outcome related to the subjects' bodily and emotional attachment to the mobile device, as evident in the following quotation:

*Usually I carry [the device] in my back pocket. If I don't wear the coat that day, then I put it in my back pack and I can't feel it vibrating and I feel a little more detached. One day I forgot it at home, and I felt totally out of the loop.*

**Changing relationships among individuals:** Many respondents also indicated significant positive influence of the wireless technology on their social networks. Having the device in-hand readily available prompted subjects to make “extra” calls (“beyond the necessary call”) and send messages to individuals with whom they would normally not have communicated, thereby establishing or re-establishing their “weak ties” which have been found to be valuable for professionals [13]. Some also expressed that the mobile device, particularly voice features, had facilitated closer relationships with friends and family, both due to increased frequency of calling (“filling time” and easy availability) and the increased quantity of communications (due to economic factors such as pricing plans associated the mobile service).

On one occasion, one of the participating groups (i.e., the officers of the MIS club) decided to hold a virtual meeting using text messaging using the mobile devices. An interesting though unexpected outcome emerged in that the president of the MIS club who normally plays a facilitative role in face-to-face meetings came to be perceived as being more autocratic. The one-to-one communication imperative using the devices resulted in the president become the central node in the communication, with all members sending their responses to him, and he communicating the “decisions” to them:

*Normally, we would bring up something, everyone would say what they thought and then we would go with the general consensus. But by giving it one-to-one communications, he ends up being the decision maker.*

**Technology Adoption:** Finally, participants indicated that a positive experience with the use process and favorable functional, psychosocial, and relational outcomes would be associated with a decision to adopt the technology:

*I am going to buy one.. it is the experience of this whole project [the research study] that is convincing me.*

#### 4.0 Limitations, Contributions, And Future Implications

Like virtually every other study, the research on which this paper is based may also be potentially faulted on a number of grounds. The subjects were students in a rural university (in a small compact campus town) in the Pacific Northwest region of the US. They were provided with a particular wireless device and a specific level of service from a specific vendor. 21 students participated in the study. The methodology afforded minimal control to “manipulate” variables, thereby leading to some concerns about the internal validity of proposed relationships. Thus, a critic could argue that the subjects’ experiences and our observations of their experiences more the particular situation (e.g., participants in the study were students in a rural campus where tethered devices are always easily accessible), than on the nature of phenomenon itself. Finally, our findings are based not on empirical observations of behavior, but on co-constructed texts during interviews. The relationship between talk (interviews) and subsequent action may be questioned. While each of the above criticisms has some merit, we would like to point out that we were able to utilize natural controls [17] for variables such as culture, level of prior exposure, and nature of tasks/messaging. Furthermore, the longitudinal nature of the study ensured that the students acted not as artificial subjects in an academically motivated study but as a genuine potential user, and it is common practice to assume that interviews reveal theories of action of individuals [1]. Nevertheless, we acknowledge that the study’s findings are tentative and thus, should not be treated as definitive at this stage.

Despite some limitations, we feel that the paper does make an important contribution to the body of knowledge in this area by inductively unearthing a number of factors that influence the extent and nature of use of hybrid wireless devices, and presenting them in an organized form as a framework (Fig. 1). Due to the “grounded” nature of the study, the factors are not theoretically imposed, but emerge from the actual experiences of subjects interacting with the technology. Too often, due to the (misplaced) belief that “true science” should be deductive in nature [18], there is a tendency to apply and test existing theory without sufficient adaptation to a new context. For example, initially, we ourselves had every intention of testing the Technology Acceptance Model [5] in this new context of mobile device use and adoption, and started collecting data using the standard instruments associated with well-established TAM constructs. Yet, as the study progressed, we realized the futility of this endeavor, since the TAM constructs did not correspond to key factors and outcomes emerging through our qualitative analysis, or the TAM propositions being examined were so generic that they did not provide any specific insight about the particular technology we were studying, or its use and adoption. In our enthusiasm to establish the timelessness and universal applicability of an existing theory (in this case, TAM), perhaps we were being guilty of pursuing research that did not add any

value at all to the body of knowledge *on wireless technology use and adoption*.

As a remedy to this potential pitfall, we felt that, as a first step, it was important to pay attention to the discovery or the inductive phase of the “wheel of science,” especially because we were investigating the implementation of a new generation of technologies (wireless) with capabilities to transform interactions (e.g., enabling mobility) in ways that are potentially very different from earlier technologies (tethered communication and computing devices). Having developed an understanding of the phenomenon from the subjects’ points of view, and identified the pertinent enablers and inhibitors (e.g., pricing plans, intended formality/urgency/volume of communication, symbolic meaning associated with the use and adoption), specific items discovered with respect to outcome (e.g., sense of security and freedom), and the apparent connections between the different factors, the nature of adoption/use, and the outcomes of adoption/use (e.g., the use of text messaging appears to be used when communication is intended to be dyadic, low volume, urgent, not very formal, and focusing on conveyance) would *then* be appropriate to evaluate the applicability of existing theories, to adapt the theories, constructs, or measures based on inductive findings, or propose altogether new theories, and then shift to the deductive phase of the wheel of science to develop the confidence in the explanations.

In conclusion, we would like to reiterate that ensuring the adoption of wireless devices by societal members is a *prerequisite* to developing a mobile society, with m-communication, m-collaboration, m-commerce, and so on. Given that little is known about the motivations and consequences of use and adoption of mobile technologies, we believe that the discussion offered and the holistic framework proposed in the paper can be valuable to all the different stakeholders engaged in research and practice in this area.

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**Figure 1: An integrated framework**

