

Mobile Data Technologies and SME Adoption and Diffusion: An Empirical Study on Barriers and Facilitators

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Abstract

The technological environment in which Australian SMEs operate can be best described as dynamic and vital. The rate of technological change provides the SME owner/manger a complex and challenging operational context. Wireless applications are being developed that provide mobile devices with Internet content and E-business services. Will SMEs who have been reluctant to adopt e-commerce technologies in the past be more ready to go on-line with the merging of the Internet and mobile data technologies? This exploratory study identifies attitudes, perceptions and issues for mobile data technologies by regional SME owner/managers across a range of industry sectors. The major issues include the sector the firm belongs to, the current adoption status of the firm, the level of mistrust of the IT industry, the cost of the technologies, and the applications and attributes of the technologies.

Keywords

Mobile data technologies, e-commerce, SME, adoption, Internet

INTRODUCTION

The technological environment in which Australian SMEs operate can be best described as dynamic and vital. The rate of technological change provides for the SME owner/manger a complex and challenging operational context. Whilst IS literature discusses the adoption of new technologies amongst SMEs, the latest technology, the mobile data technologies and associated 'wireless' applications, presents new problems for adoption and diffusion for SME owner/managers. The primary appeal of these mobile data technologies apart from mobility is that associated 'services' are delivered on existing devices such as mobile phones, palm-tops, and personal digital assistants (PDAs). In the literature little empirical work exists on applications and services that would encourage the adoption of mobile data technologies by SMEs. This study provides empirical evidence on attitudes of SME owner/managers in a regional setting to mobile data technologies, and identifies the most significant facilitators and inhibitors to adoption.

Early studies addressing the adoption of IT provide insight into reasons why decision-markers adopt or do not adopt innovations. The Diffusion of Innovation theory posited by Rogers (Rogers 1995) suggests that characteristics of innovations help to persuade potential adopters to embrace or reject an innovation. Other researchers have since completed work resulting in modifications to Rogers' original theory that provide numerous models that address IT adoption and usage within an organisation.

The Technology Acceptance Model addresses IT adoption, implementation and diffusion in terms of perceived ease of use and perceived usefulness based on behavioural intentions (Davis 1989). Belief about the system, perceived usefulness and perceived ease of use is posited as directly affecting attitude to use (Rogers 1995, Agarwal and Prasad 1997). Further studies suggest that behaviour is a direct function of behavioural intention and perceived behavioural control that will impact on decision-makers choosing whether to adopt an innovation (Ajzen 1991, Taylor and Todd 1995). Therefore in the adoption of mobile data technologies, will the same behavioural/psychological factors impact on the decision by owner/managers to adopt mobile data technologies?

Constructs used in the above models are generally based around perceptions, beliefs, attitudes and intentions of the decision-maker. More recent studies have identified other factors in addition to these that will impact on an owner/manager's decision to adopt new innovations such as mobile phones and Internet technologies.

Adoption of IT/Ecommerce by SMEs

Empirical studies have identified a variety of factors thought to affect e-commerce/Internet technology adoption in small business (Julien and Raymond 1994, Brooksbank et al 1992, Kirby and Turner 1993, Iacovou et al 1995, Thong and Yap 1995, Harrison et al 1997). From the adoption factors identified in earlier studies a model (figure 1) was developed based on the study on the adoption of e-commerce technologies thought to facilitate or inhibit technology adoption by SME owner/managers (Van akkeren and Cavaye 1999). It was on this basis that attitudes and perceptions of SME owner/managers were assessed on the adoption of mobile data technologies for this current study.

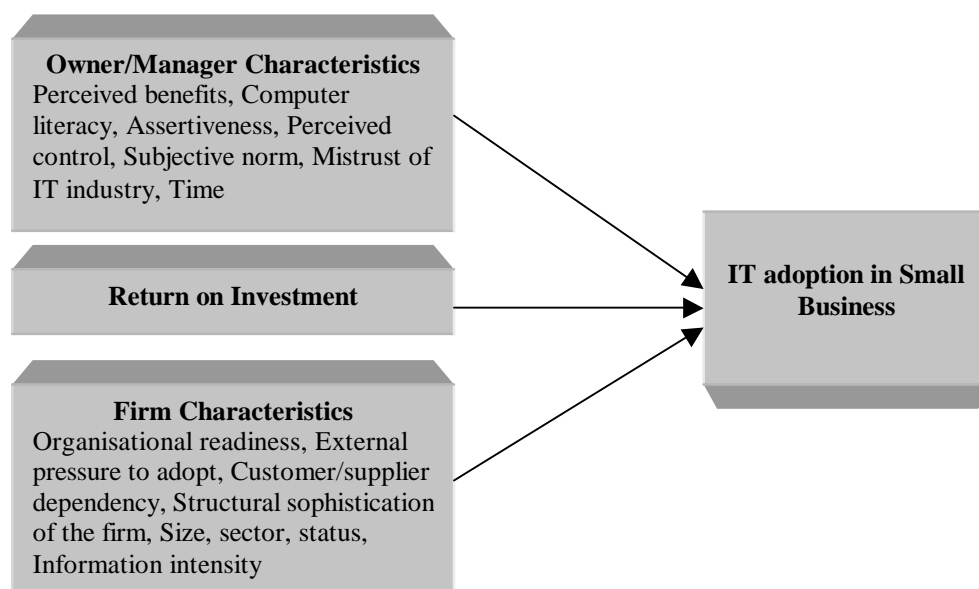


Figure 1: Framework of SME Adoption of Innovations (Source: Van Akkeren and Cavaye, 1999)

The three categories presented in the framework, thought to impact on the adoption of IT innovations, provided areas of discussion for the focus groups in the exploratory stage of this research. Participants were encouraged to discuss their attitudes and perceptions of IT adoption in general and mobile technologies in particular.

Recent studies on reasons why SME owner/managers adopt or do not adopt information technology (IT) and e-commerce technologies have highlighted both inhibitors and facilitators to adoption and are similar in content to the factors described above. SME adoption is discussed as being determined by decision-maker characteristics, information system (IS) characteristics, organisational characteristics and environmental characteristics (Thong 1999). Owner/manager characteristics, planning orientation, and the existence of alliances/networks are suggested by as influencing technology adoption by SMEs (McGregor and Gomes 1999). Specifically in terms of alliances/networks, previous literature also suggests that the decision to adopt or not adopt IT will be influenced by the network within which the small business operates, particularly if time, cost and operational efficiencies can be realised (Piovesana and Raush 1998, Lawrence 1998, Sillence et al 1998).

In an Australian study on IT adoption by SMEs, adoption decisions are identified as having three distinct phases (Fink 1998). These are: assessing IT benefits, organisational culture and firm-suited IT; assessing internal resources and procedures; and evaluating external environment, support and services. In terms of mobile data technologies, one could argue that owner/managers would need to assess what, if any benefits can be derived by adopting the technologies and whether their firm was suited to their adoption.

Adoption and Diffusion of Mobile Data Technologies

Major innovations may have to 'prove themselves' in new markets before they can displace other technologies (Friar and Balachandra 1999). It is the early adopters or innovators who will initially experiment with these technologies. In addition, the usefulness and ease-of-use will impact on owner/manager acceptance of the technologies (Agarwal and Prasad 1997). The acceptance of web-based technologies is also influenced by ease of use and perceived usefulness in terms of current IS sophistication, complexity of the new technologies, and perceived costs and benefits (Nambisan and Wang 1999).

Discussion on the adoption of mobile data technologies posit lack of speed as a barrier as they are slow and hence inefficient (Taylor 1999, Saunders et al 1999). Another barrier is the lack of standardised IT environment for developing mobile data applications as impeding the growth of the mobile data market (Harrison 1999, Axby 1998). It is possible therefore that adopters are 'sitting back' and waiting for at least some of these problems to be corrected before entering the mobile data market. Most literature on the adoption and marketing of mobile data technologies is limited to discussing the technologies in terms of their application to business and adoption barriers and is not empirically based. This current study will provide a deeper understanding of the facilitators and barriers to the adoption of mobile data technologies by SME owner/managers in a regional setting. Insight will be provided on the types of applications that potential business customers require

Methodology

Two focus groups were conducted with respondents in each usage group, non-adopters, partial-adopters and full-adopters of information technology, covering a variety of industry sectors. Limitations of focus groups such as the influence participants have on each other, and the intimidation some participants' experience within a group situation were considered. However given the newness of the technologies, and the exploratory, interpretative nature of this research, it was determined that an open discussion would provide the depth required for this preliminary study. Descriptions of each group are:

- **Full-Adopter:** Used computer and Internet for business, email, e-commerce, Web Site.
- **Partial-Adopter:** Used computer for business, some use of Internet for business/home but no Web Site.
- **Non-Adopter:** No use of computer for business purposes.

Attendance at the focus groups was vital to the integrity of the research, thus a rigorous procedure was adopted to increase response rates. Research assistants developed a database of SME contacts on the Sunshine Coast and a recruitment screening questionnaire was crafted by the researchers. The questionnaire succeeded in categorising respondents into usage groups and industry sectors and an incentive of a \$50 gift voucher, redeemable at a local coffee shop, or restaurant, or cinema was used to encourage people to attend. The groups were scheduled towards the end of the working day and in the evening, which were found to be the times that best suited this type of business-person. A letter of confirmation was mailed and faxed to willing participants on the day of recruitment and a telephone call made on the day of the group to ensure attendance and alleviate any concerns.

It is common practice to over-recruit for focus groups as there is a natural dropout rate of 3-4 people on the day of the group but this was not found in this project, using this protocol.

Category	Group Time	Respondents
Non-adopters	5pm Wednesday 24.11.99	10
Non-adopters	7pm Wednesday 24.11.99	9
Partial-adopters	4pm Monday 22.11.99	15
Partial-adopters	7pm Tuesday 23.11.99	11
Full-adopters	7pm Monday 22.11.99	14
Full-adopters	4pm Tuesday 23.11.99	12

Table 1: Focus Group Attendance

The focus group topic guide was informed by the model developed from the literature review (figure 1) and in collaboration with Nortel Networks. Data analysis was conducted using the content analysis approach.

FINDINGS¹

Problems with, and praise for, IT

After a brief introductory session, full- and partial-adopter respondents were asked to discuss any problems with, and praise for, IT in general.

Problems with IT

Whilst there was some overlap in the areas of problems with IT cited by both full- and partial-adopters, certain issues were mentioned by only one group.

For example, 'pricing and costs' were areas of concern for full-adopters only, and they perceived a link between IT and these areas. Combining new ways of trading (for example on the Internet) with the move to relocate manufacturing plants to offshore locations, full-adopters felt that competition has risen to new heights:

¹ Where direct quotations are made from respondents, the reference is given as 'full-adopter' (F), 'partial-adopter' (P), 'non-adopter' (N), followed by an industry descriptor and number of employees.
'partial-adopter' (P), 'non-adopter' (N), followed by an industry descriptor and number of employees.

“there’s always a cheap copy available somewhere ... people appreciate the quality but they’re not prepared to pay for it” (F, Clocks, 3)
“people will access the Internet, find the cuckoo clock they want ... press their button and they’ve got it there!” (F, Printing, 25)

A second area of problems with IT, recognised by both full and partial-adopters, related to the ‘reliability and support’ of IT products and services. There was criticism about the rate of change in the area of innovation and, in more practical terms, strong feelings of frustration about the usefulness of IT manuals:

“the gap between the promises and the deliverables is quite huge”
(F, Health Foods, 2)
“it’s the pace of change – six months and it’s out of date” (F, Retail, 2)
“I’m on the phone constantly every 2 or 3 days, ‘how do I do this?’”
(P, Convenience Store, 2)
“I’d like to be able to read a manual” (F, Apartments, 2)
“the information on how the hell the damn thing works is a nightmare!”
(P, Travel Agent, 5)

However, there were useful suggestions to address the latter concern:

“an instruction manual on a video disk ... instead of words there’s a picture of someone” (F, Electronics, 2)

Similarly, both full- and partial-adopters cited ‘compatibility’ as an area of frustration with IT. This related to computers, consumables (such as printer cartridges), and attachments in email: *“you get something that’s sent by email and you can’t open it up and that’s a real pain” (P, Signage, 3)*

A key difference between these two groups of adopters was the issue of ‘fear’. Full-adopters did not display any fear about working with technology, however partial-adopters realised they needed to use IT to demonstrate the currency, and therefore dynamism, of their business, in spite of their reservations:

“one good thing IT gives is the appearance you know what you’re doing”
(P, Hairdresser, 5)
“if I present something into one of my shops which is a little bit high tech the girls will look at it and think ‘I’m a hairdresser, not a computer whiz’ so they’re a little scared of this technology” (P, Hairdresser, 5)

Understandably, there was also the issue of ‘fear’ with non-adopters; fear of buying the wrong technology, or about their own ability to learn new technology:

“if you write things out you don’t have to worry if you press the wrong button and something gets lost” (N, Home Maint., 2)

All of these problems were couched in business terms, that is, all of the areas were felt to negatively affect business practices.

Praise for IT

Many full and partial-adopter respondents were willing to tolerate the frustration of technology, given the positive impact it made on their lives. Speed was the main advantage mentioned about technology and this had implications for business practices. Many cited the increased improvement and decreased cost of technology over the years:

*“we bought a computer at approximately one third of the price of the one we bought four years ago, it’s probably ten times more valuable, fifteen times more storage”
(F, Health Foods, 2)*

Internet Usage and Adoption Behaviour

Full-adopters were Internet users and most had their own Web Site. They tended to use the Internet as a business component and competitive edge, for example to sell their goods and services, rather than buy, and to generate inquiries:

“we get a lot of inquiries on email in the holidays, from all over the world ... Tasmania, Ireland” (F, Resort, 9)

*“people say they’ve seen your web page ... that’s a positive aspect”
(F, Mobile Hairdresser, 2)*

By definition, partial-adopters were not significant users of the Internet for business purposes. Those that did use the Internet did so in response to pressure from competitors, customers, or suppliers. Non-adopters did not use the Internet and so were asked about family use; many had children who used the Internet, either as part of their education, or actually working in the IT industry. All respondents were asked to comment on their use or intended use of Teletext and Digital Televisions. Whilst full-adopters were the most aware (of all three types of IT users) when it came to Teletext, they were not supporters; indeed, those that had used it found it to be too slow and not interactive enough:

“there are over 600 pages, but there’s only three you ever want!” (F, Apartments, 2)
“it’s very ... dull” (F, Health Food, 2)

Partial- and non-adopters of IT did not use Teletext.

When asked about Digital TV, full- and partial-adopters were wary, waiting for government standards to be established before buying, and also for, what they felt would be, the inevitable price decrease after launch. Non-adopters had no interest:

“the price will be astronomical, it’ll come down ... just like the old colour TVs ... it’s like we’re changing from black and white to colour” (F, Property Developer, 2)
“when they come down to about \$1,000 after about 6 years” (P, Car Electrics, 4)

Product/Service Applications Video

The Nortel Networks video was shown in all groups and then responses elicited about product/service application needs and benefits. Full-adopters were visibly stimulated by the video, displaying knowledge of the area and being keen to discuss future applications:

“we’re not very far away from a lot of these things ... I witnessed a digital camera take a photo and he hooked it up to his mobile phone and sent it to someone” (F, Printing, 25)

Partial-adopters were unenthusiastic about the technology demonstrated in the video, being very wary, cautious and fearful:

*“I wouldn’t want one of those because it’d be ‘where are you?’ and they would be onto me”
(P, Dry Clean, 9)*
“I wouldn’t like it” (P, Signage, 3)

The reaction of the non-adopters was somewhere between the full- and partial-adopters; when asked, half of the non-adopters wanted one of the handsets, mainly to stay in touch with the youth and technology in general, whilst the other half did not see a need. However, they were overwhelmed, initially, by the technology demonstrated.

Respondents then participated in an exercise whereby the services demonstrated in the video were listed, benefits associated, and then the services ranked in order of importance (table 3).

Rank	Full-adopters	Partial-adopters	Non-adopters
First	2 way communication: video/voice/voice recognition	Remote access & security	2 way communication: video/voice/voice recognition
Second	Prioritising & screening messages	2 way communication: video/voice/voice recognition	Navigation
Third	Remote access & security	Navigation	Remote access & security

Table 3: Top Three Rankings, All Groups

In terms of service, all adopter levels saw the benefits of two-way communication using the mobile device:

“international business is a very personal thing” (F, Exports, 17)

“you can do more than one thing at a time” (P, Newsagent, 5)

“you can see who you’re talking to” (N, Hairdresser, 2)

Full adopters posit that relationship marketing, the power of face-to-face persuasion, personalised and improved customer service, speed, time, and improved planning are possible benefits of mobile data technologies. Partial adopters cited speed, improved communication, mobility, immediacy, ease of use, and the ability to build loyalty as benefits of these devices. Finally, non-adopters perceive that benefits of mobile devices as time saved on travel and answering calls, reduced freight costs and business networking opportunities.

In terms of navigation, partial- and non-adopters see positive uses of these services:

“the courier guy ... hasn’t had to think about it, he’s done it in half the time ... made his run”
(P, Festival Org, 1)

“the map business ... I loved that, that was excellent!” (N, Boutique, 2)

Benefits of using the mobile devices are also highlighted in terms of remote access for their business by full- and partial-adopters.

“if it wasn’t okay I could push another button and get Security guys there straight away”
(F, Property Developer, 2)

“I could check the chlorine levels in my pool” (F, Apartments, 2)

“you don’t have to go into work ... just put that machine on and see what’s happening” (P, Coffee House, 12)

“I don’t need to sit at the computer ... just walk around the store chatting to it!” (P, Conv. Store, 2)

The ability for an owner/manager to check their home or business from another location was seen as a substantial benefit. In addition, security, peace of mind, and ‘working smart’ are seen as benefits of mobile data technology services.

Full-adopters had the clearest thinking about how they would use this technology – immediately. Their discussions centred around how their top three ranked services would interact and the impact this would have on their business practices. For example, they were the only group of adopters who included ‘prioritising messages’ in their top three (table 3),

with the key benefit of delegation of tasks. There was also discussion in these groups about screening of junk messages and to prioritise messages, suggestions included screening by time of day, and by different types of callers.

The partial-adopters were not keen to have this technology at all but when asked to rank their services, they included the navigation service, as did the non-adopters.

All groups raised concerns about the services on show. Partial-adopters were concerned about the reliability of the system, confidentiality, having no free time, the civil liberty issue and concerns about 'big brother'. Non-adopters mentioned the issue of invasion of privacy. Security of such a system was a recurring theme amongst all groups:

"what happens if you lose it (the handset)?" (F, Property Developer, 2)
"Someone else could access your home security before they go in and rob you"
(F, Windscreen, 4)

Remedies for the security concern included; using thumbprint recognition, retina scan or voice recognition.

A Personalised Service

The ability to personalise a service was welcomed by most group respondents, across all IT usage types. To be able to access certain Web Sites, locations and services is appealing and respondents felt that this could impact on price. Some respondents, most notably the partial-adopters, were willing to take extra advertising on their handset if this reduced the price.

Respondents demonstrated their mistrust of the IT industry by requesting a *compatible* service, one that works with other competing products and services in the marketplace, and one that is reliable:

"Telecom come out with one, Vodafone too, and suddenly you've got to be better so they add a little extra on and it's not so simple" (F, Apartments, 2)
*"you'd have to pay for a service package, but then you'd have to have the **service** to go with it" (P, Conv. Store, 2)*

Price

Many respondents made the analogous link between this type of new technology and the introduction of the mobile phone some years ago:

"It's like mobile phones ... people gradually over time realised they're not so bad"
(P, Accountant, 8)

This led to a discussion on pricing with a 'user pays' approach gaining most support amongst group members:

"the way people pay for mobile phones has been instrumental in the wide acceptance of mobile phones in this country" (F, Business Supplies, 4)

For example, people were keen to have a modular approach to price, whereby they could up/downgrade as and when they needed more or less services. Thus, a rental or lease arrangement was popular, charging on a *usage* approach, rather than a *priority of service* basis, whereby they would be restricted to using the service at certain times of the day or night:

“you pay another fee per month if you want to get to talk, change it in different languages, you pay another fee, you could pay \$100 per month or \$500 per month but if you don’t want any – you only want to pay \$50 per month’

(F, Property Developer, 2)

“leasing it ... when your job changes or your business grows, you just hand that one in and say ‘I need the next model’” (N, Café, 15)

“say, an 18 month contract but with the ability to upgrade easily” (P, Art Gallery, 2)

Full-adopters comfortable with technology were especially able to see the value and benefits of the proposed service, consequently they would be keen to acquire the service – if it was affordable:

“we’re going to rely on it more and more, that’s going to be a great marketing tool and a great money-making tool for them (Nortel) so it should be priced on usage”

(F, Printing, 25)

DISCUSSION

It is possible to argue that there are many different factors that will impact on an SME owner/managers’ decision to adopt or not adopt mobile data technologies. The industry sector the firm belongs to, the current IT adoption status of the firm, the level of mistrust of the IT industry and the cost of the technologies are highlighted in this study as possible barriers or facilitators to adoption. The features of the mobile device, including the applications on offer (which directly relates to perceived business benefits of the technologies) are also raised as having a possible impact on adoption.

The focus groups found significant differences in the way different types of people view and use technology. Full-adopters of technology, for example, are very open to new ideas and innovations, compared to the partial-adopters, although they raise concerns about the cost of keeping up with the rate of technological change. Non-adopters, whilst being fearful of technology generally, have an open mind when presented with futuristic new technology, especially when compared to the partial-adopters. One reason for these differences could be that partial-adopters have been ‘forced’ to adopt technology before they were really prepared; this adoption may have been in response to customer, competitor, or supplier pressure. Thus, they are fearful; of over-reliance on technology, of being hoodwinked by IT companies, of being made to feel inadequate, and of being overtaken by others in terms of business practices.

When asked about innovation in IT in the past five years most discussion in the groups centred around the mobile phone, computers, the Internet, EFTPOS, desktop banking and the fax machine. Benefits associated with these innovations included freedom, flexibility, speed, convenience, increased information, competitive advantage, ease of use and direct communications. These reactions bode well for Nortel and the future of WAP, as the key features of WAP provide all of these benefits on a mobile device.

Full-adopters, many of whom could be considered early adopters and innovators, would use this technology tomorrow if it were available, as long as it was affordable. The service they would most like to ‘buy’ is the two-way communication with video/voice recognition. This group of adopters was the most focused in their intended use of the technology, being very business-focused and seeing a need for almost all of the services on display. The non-adopters also cited the two-way communication with video/voice recognition as their favourite service and both groups felt that this service would give them improved customer

relations with the face-to-face persuasion, increased speed and better use of time. Partial-adopters were reticent about the technology but felt that, if they had to choose, the ability to remotely access sites would be useful and the security aspect appealing. The greatest benefit for them would be control of the working environment. All three adopter groups were concerned with security of the system.

The issue of personalising the service was attractive to most focus group members as they are busy running a business and not interested in unsolicited messages or advertising. People also linked the personalisation issue to price, feeling that a user-pays system was fairest, with the ability to upgrade when they were ready or saw a need for more services. Group members also likened the new technology to the roll out of mobile phones in Australia, with rental plans and price based on usage levels. Respondents were not keen to have the services priced on a priority basis whereby they would be restricted to using the service at certain times of the day or night as this would impact negatively on their business practices.

The model used as the basis for the development of the focus group topic guides was useful in predicting the types of issues different adopter groups raised. However the level of emphasis placed on different constructs listed in the model varied depending on the adoption status of the owner/manager. For example, the level of mistrust of the IT industry was seen as an influencing factor by partial- and full-adopters. However, non-adopters were less concerned about this issue. This is not surprising given they have not purchased technologies and therefore are not experienced with the IT industry. Perceptions of owner/managers of the benefits of mobile data technologies appear to be an important consideration, as do the purchasing and on-going costs of the technology. The model also predicts that computer literacy of the owner/manager, external pressure to adopt the technology, customer/supplier dependency, and the size, sector and status of the firm will impact on technology adoption. Findings from the focus groups support these factors as influencing adoption of mobile data technologies.

To conclude, there are a number of issues that are apparent from this exploratory study that need to be included in a larger, quantitative study with a significant sample from the wider population. Limitations of focus groups such as the influence participants have on each other, and the intimidation some participants' experience within a group situation could be overcome with a quantitative study such as a survey or telephone interview. In addition, a greater cross-section of industry sectors would need to be included to improve the generalisability of this study. Findings presented so far may not be generalisable to other Australian capital cities. However including city-based small businesses in further work should overcome this problem. Benefits are very important to SME owner/managers who do not have the luxury of time to train, research, or upgrade their technology, without losing business. Thus, the quantitative study should focus upon technology use and associated benefits across different industry sectors, gauging levels of concern/comfort with technology. The study could then focus respondents on the new technology, gauge awareness, need, and services sought, building on the findings from this exploratory work.

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