A Marketing Model for Mobile Wireless Services[1]

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Abstract:
Mobile data services integrate handheld and Internet technologies to create new value propositions (Keen and Mackenzie 2001), in a social context, over time (Rogers 1995). Yet, this value can only be realised through new behaviours, including acquiring the enabling technology, learning to use it, applying it to solve problems or add value in everyday life, and communicating what one has learned about it to other prospective users. This article explores the recent emergence of the mobile data services phenomenon in Malaysia and Singapore, and analyses survey data from over four hundred cell phone subscribers to identify a marketing model that targets the needs of early adopters, identifies the information channels that reach various types of innovators, then examines the linkages among early adopters and other segments over time and across markets.

Introduction

Mobile data services (MDS) applications deliver content and enable transactions, but unlike the Internet, can serve users while they are on the move. The Internet plays an important enabling role in the MDS phenomenon: for WAP and i-Mode as an enabling technology and source of content. Both use mark-up languages derived from the Web, with features to accommodate the limitations of cell phones. The messaging capabilities built into GSM were not originally intended for subscriber use, and Internet chat serves as an inspiration and role model for the extension of the SMS standard to EMS and beyond. As communications devices that accompany owners, cell phones have characteristics in use that differ sharply from personal computers: they are truly portable, seldom used by others, and increasingly, constantly connected to an "always-on" network (Raisinghani 2001). The rapid diffusion of digital mobile networks, first to Europe, then throughout Asia, and now North America, enables data delivery to various types of "anywhere, anytime" personal terminals. However, while SMS adoption is growing exponentially, the technically more sophisticated WAP services have generally failed to attract a critical mass of users.

MDS are a current example of technology-enabled discontinuous innovation, similar from the economic and behavioural perspectives to the Internet. Such innovations will succeed only if adopted by a critical mass. To attract this critical mass, MDS must create new value, and generate new behaviours, in specific social contexts, over time. Such behaviours include acquiring the enabling technology, learning to use it, applying it to solve problems or adding value in everyday life, and communicating what one has learned about it to others.

The Context of the Study

Adjacent Southeast Asian nations Singapore and Malaysia share a colonial heritage, and were briefly a single nation. Despite similarities in culture, they vary greatly in terms of geographic, demographic, political, and economic structure. Home to about four million residents, Singapore is a compact and entirely urban city-state. Malaysia, with its far more widely dispersed population of about 20 million, has a strong agricultural sector. Both developed modern urban infrastructure, to support a wide range of industries including electronics manufacturing. To enhance its main economic role as an entrepôt trading centre, Singapore deployed analogue mobile technology in the 1970s, followed by digital wireless voice services in the 1980s, with Malaysia not far behind. Malaysia opened fixed-line and mobile markets several years before Singapore's "big bang" liberalisation in early 2000. In Malaysia, mobile subscribers double every 18 months, and SMS traffic accelerated following operator agreements to interconnect SMS services so subscribers to one operator can send messages to those subscribing to another.

In the relatively saturated Singapore mobile voice market, operators use SMS as a source of

differentiation. Local operators have the second highest (after the Philippines, where SMS is a substitute for expensive intra-city voice traffic) percentage of revenues from SMS, and SMS-based information services such as information services, taxi orders, and logo and ringtone downloads are gaining market acceptance.

The MDS phenomenon has roots in the store-and-forward short messaging service (SMS) model. This soon evolved to the broadcast "push" mode, followed by interactive or "pull" SMS. MDS infrastructure is evolving rapidly. In Europe and much of Asia, GSM (Global Systems for Mobile communication) is the current *de facto* wireless network standard. Designed for voice, GSM carries data over a relatively slow, circuit-switched signalling channel. Today, data rates are being upgraded through General Packet Radio Services (GPRS) and Enhanced Data for Global Evolution (EDGE) technologies. In perhaps five years "Third-generation" (3G) infrastructure will be deployed throughout the region, offering far higher mobile data rates. The resulting increase in spectrum capacity, combined with new functionality, will drive the diffusion of mobile data communications (Gruber and Verboven 2001). Merrill Lynch views the Asia Pacific (outside Japan) as a promising region for MDS growth, riding on continuing growth in adoption, and operator upgrades to support Enhanced Messaging Services (EMS). Even today, premium SMS services could easily double current revenues from mobile data services, according to Strand Consultancy (2002).

In responding to this opportunity, mobile service operators face several uncertainties. First, the specific types of MDS products that will meet marketplace desires are not well understood (Evans 2001). Until the value propositions are established, it is impossible to source and price content. Next, the underlying structure of this market, which is the basis for its segmentation, is not likely to resemble current markets. In any case, operators are not effectively segmenting mobile markets, as evidenced by high churn rates. Finally, several years and billions of dollars will be needed to deploy 3G. Given that these factors are the basis of a viable business model (Afuah and Tucci 2001), and that fixed costs are likely to dominate the MDS cost structure, MDS investment risk will remain high until these knowledge gaps are filled.

Approach

This work integrates two perspectives on market segmentation. Diffusion research, by categorising adopters according to their intended and actual adoption behaviour, creates segments derived from factors such as perceived value, time, and access to information (Rogers 1995). Needs-based segmentation emerges in information intensive contexts, where competing demands for attention (Simon 1971, Goldhaber 1997) shift marketing and communication activity from the traditional mass media orientation toward a personalised approach, enabled by information technology (Hoffman and Novak 1996). To successfully introduce new products to emerging markets, it is necessary to acquire an understanding of the underlying phenomena: consumer behaviour, market segmentation, product life cycles and positioning, and competitive behaviour (Urban and Star 1991). This work explores the first two of these phenomena.

Needs-based Market Segmentation

Originating in diffusion research, different adopter groups perceive innovations and thus behave differently. Miller (1993) finds that prior knowledge of potential adopters can focus the use of resources to prevent an innovation from failing. The three dimensions for segmentation analysis are based on Weinstein (1994):

Table 1: Segmentation Dimensions

| Demographic	Psychographic	Behavioural
Age, occupation , gender, income, religion, nationality, education, marital status, ethnicity	Values, lifestyle, interests, opinions, activities	Product use patterns and perceived benefits

Innovation theory can be applied to identify the attitudes and behaviour of early adopters, as a dynamic basis for a market segmentation model.

A Research Framework for MDS Deployment

The figure below models interactions among supply factors, demand factors, and the contextual forces that mediate supply and demand, from the dual perspectives of the MDS operator and its subscribers. Contextual forces – the flow of wealth, new tools, public policy, and culture - shape both the supply of new technology-based services and the demand for them (Urban and Star 1991). The marketplace is mediated by these macro forces. Supply factors for operators include both internal and external

resources, marketing activities, and operational activities such as customer care. An operator's current subscribers represent both opportunities and constraints, in that perceived subscriber needs and expectations tend to influence both the value proposition and pricing structure for new offerings. On the demand side, adoption and use of MDS are driven by various types of personal needs and by institutional forces such as employer or client expectations. Adoption of new MDS may be constrained by commitments - brand loyalty, a lack of number portability to a new operator, or the expiry date of a service contract - to their current mobile operators, or simply by a lack of awareness regarding the availability and features of new services.

Figure 1:
A Research Framework for Mobile Data Services
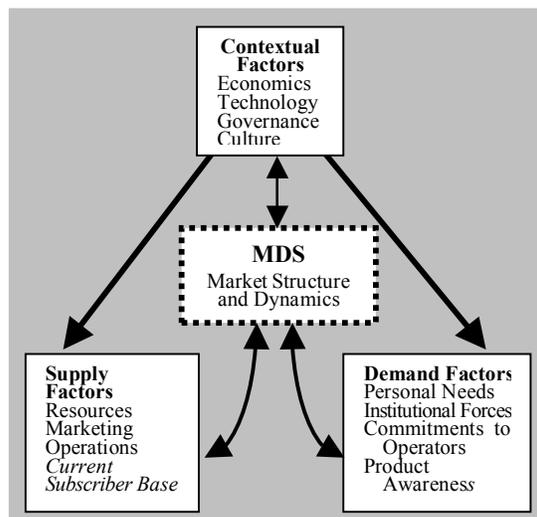
This framework is multidisciplinary and atheoretical, in the sense that it is possible to map it to any one of several theories. From a strategy perspective, it is compatible with the Porter diamond (Porter, 1990), while from a behavioural perspective, the Rogers (1986, 1995) model of innovation adoption is a good fit. The framework is also dynamic: changes in any cell are likely to influence others. For example, when MDS technology enables a new value proposition on the supply side, its emergence in the marketplace may alter market structure, tap latent user needs, or reveal new governance issues, and its use is likely to impact the operator's current resource base, marketing activities, and operations.

Due to the failure of WAP-based services to attract users, nearly all consumer-oriented MDS offerings in Singapore and Malaysia are SMS based. While this will change, as a critical mass of local users acquire cell phones that take advantage of the superior performance offered by GPRS and EDGE, current links between context and supply are relatively static. Thus, the current work focuses on interactions among contextual factors, demand factors, and market structure. The research seeks an understanding of how to segment the MDS market so that it is possible for operators to match specific MDS with target users, over time. Four primary sets of variables make up the model:

1. The independent variables are reported behaviours and demographic data.
   These include age, income, education, residence, technology ownership, and uses of respondents. These data constitute the general structure of demand for MDS.

2. The dependent variables are product preference and channels for information. If these can be related to the attributes of subscribers, market segments emerge.

3. Time of adoption alters market structure over time.

4. The Social System is a contextual variable (in this work either Singapore or Malaysia), that mediates among MDS market factors.
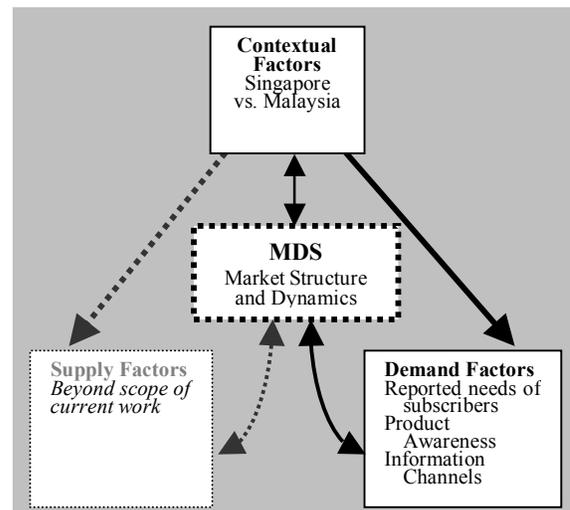
Figure 2: Research Model

Figure 2 maps these variables to the research framework, which reveals that the current work explores only a small subset of the total set of relationships captured by the framework.

Fieldwork and Analysis

This exploratory work is intended to surface emergent behaviour patterns rather than confirm well-established cause-effect relationships. The research objective is to seek an understanding of how to segment the MDS market so that it is possible for operators to match specific MDS products or services with target users, over time. It is unclear whether this will be based on demographic or behavioural traits, or both.

The researchers selected innovation theory as the primary lens through which to view the MDS phenomenon, in two study rounds. The initial study examined WAP services as the most widely available interactive platform in use at the time (Gilbert and Sungawan 2002). The second study round extended the research scope beyond the Singapore market and took a more general look at mobile data services. The idea is not so much to develop a predictive model of MDS diffusion (e.g. Rai, *et al* 1998) but more to understand underlying segments.

All field research followed the general protocols below:

5. Review recent industry research and mass media to surface current market trends.
6. Organise focus groups to explore emerging issues, refine research questions, and gather impressionistic data.
7. Design survey instruments to capture data about the most interesting research questions, from the perspective of the relevant theory.
8. Field-test survey questions with members of the target groups, and refine research instruments.
9. Collect survey data, avoiding systematic bias whenever possible.

Empirical Evidence: Round One

The first round, completed in early 2001, explored the early stages of mobile data services deployment on the SMS and WAP platforms (Gilbert 2001; Chia, *et al* 2001). The first stage began with a focus group composed of 20 GSM subscribers who were non-users of WAP. The focus groups helped clarify research issues and refine the survey, later distributed to 300 undergraduate and postgraduate students. The unit of analysis was the individual decision to adopt WAP services, rather than the device. Of the 300 forms distributed, 198 were returned, for a 65% return rate. The survey population was evenly distributed along age, gender, and occupational lines. More than 85% owned and used cell phones.

WAP subscribers in the survey panel were likely to be male, and perceived themselves as technologically savvy persons to whom others turn for guidance. They were also more likely to use SMS and personal organiser functions on their cell phones. Subscribers were also more likely to use cable and wireless modems to connect their personal computers to the Internet.

For access to information about technology and technology-based services, WAP subscribers were significantly more dependent on mass media channels, and less dependent on advice from family, friends, and colleagues, compared to non-subscribers. These findings confirm the need to match the communications channel to the intended target (Rogers 1995), over time.

Table 2: Factor Loadings for Exploring Needs-based Segments

Rotated Factor Matrix[a]

	Factor				
	1	2	3	4	5
i am willing to pay an additional MONTHLY charge for WAP services of		-.154	-.151	**.619**	
i change my mobile phone every		-.147		-.114	**.572**
keeping in touch with family and friends			**.796**		
work	.199	**.448**			-.156
SMS	.315	-.394	**.547**		-.294
games	**.677**	-.238			-.198
data services	**.804**		.141	.148	.191
organizer/notepad	**.877**			.139	
I travel for business	.132	**-.664**		-.172	
i know about the latest technological developments		-.109		-.372	
i tend to adopt the latest technology		-.129	-.102	-.282	
age group	-.103	**.736**			
monthly income	-.121	**.719**		.137	-.136

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations. n = 149

Subsequent exploratory R-type factor analysis was used to investigate relationships among key survey interval-scaled questions regarding the intention to use WAP services. The subset of participants indicating such use totalled 149. Principal axis factoring was carried out, followed by varimax rotation with Kaiser Normalisation. Rotations converged in 6 iterations. The KMO measure of sampling adequacy and Bartlette's tests of sphericity provided support for the validity of running factor analysis on the data set. Varimax rotation facilitated interpretability. Initial runs showed, on the basis of a scree plot and eigenvalues, support for five factors, which explained 48% of the total variation.

The factor analysis, combined with the focus group findings, helped identify segments within the markets for each service The analysis revealed relationships among the intention to use WAP services, specific service requirements, and demographic variables, resulting in the identification of five early adopter segments. In particular, five needs-based segments emerged from factor analysis:

1. **Mobile Professionals:** these services create new value related to work life, including calendaring, and access to mobile email and intranet/extranet services.
2. **Sophisticates**: filling needs for status, in terms of material style.
3. **Socialites**: filling needs to keep in touch with family and friends while on the go.
4. **TechnoToy**: filling needs for hands-on knowledge about technological developments.
5. **Lifestyle**: these services, partly overlapping the categories listed above, fill convenience needs related to mobile lifestyles, such as delivering information or directions to people who are in an unfamiliar location, and helping people fill "dead time" with time-critical tasks. Examples of such tasks include bill paying while waiting in line or on public transport, or facilitating meetings among friends who are on the move.

Two added segments, containing those whose needs were unlikely to motivate them to adopt, emerged:

6. **Misers**: members of this segment were unwilling to pay for wireless data services.
7. **Laggards**: were the last to know about and adopt new technologies.

Figure 3: Revealed Segmentation for MDS

Empirical Evidence: Round Two

To extend the research scope beyond local markets, the next step was a comparative survey of attitudes and adoption behaviour in Singapore and Malaysia. A survey instrument was created and pre-tested in English, Chinese, and Malay languages to reach out to all respondents. To ensure that the survey conveyed the same information in each language, a multilingual panel cross-checked the translations.
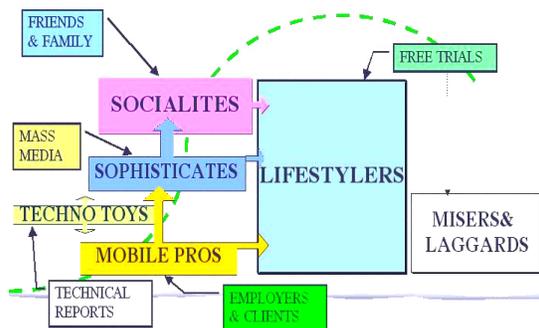
The target population was hand phone users between the ages of 15 and 60 living in major metropolitan areas in Singapore and Malaysia— where wireless networks are fully developed. The sampling frame consisted of hand phone users walking in busy city street areas in Singapore, Kuala Lumpur, and Johor Bahru. To reduce sampling frame error, participants were screened for whether or not they used a hand phone. A central location-intercept quota sampling technique was used. Quotas were based on ITU estimates of user demographics (Weinstein 2001). The technique, even though non-probabilistic, enjoys conditions roughly similar to that obtained under probability sampling (Kalton 1983) in being representative of the population. However, given the exploratory nature of the investigation inferences about the population must be treated with extreme caution.

Survey data was entered into spreadsheets, checked and edited, imported into SPSS (SPSS 2001) and then analysed to reveal segments based on attitudes or needs (Urban and Hauser 1980). The resulting sample was evenly balanced in gender terms, and approximates the demographic profiles of cell phone users:

Table 3: Cross-border Survey Participants

	n	Age	Males	Current MDS user
Singapore	291	25	53%	51%
Malaysia	142	22	61%	52%
Total	433	24	56%	52%

The potential value of the needs-based approach to market segmentation is based on an assumption that simpler methods based on demographic variables such as age, income, and education are less useful than psychographics in predicting behaviour. As an initial test of this central assumption, two-way ANOVA was performed on the dependent variable of primary interest to operators (average monthly mobile bill) and the mobile subscriber information likely to be available to them (age, gender, education, and city). The Levene statistic revealed acceptable homoscedasticity, and the ANOVA output revealed that only city location significantly influenced revenue ($p < .05$).

Interaction effects among the independent variables were significant only for age-gender, age-education, city-gender-education and when all four independent variables were combined (p < .05). The adjusted R^2 was 10%.

The next step was to determine links among prior and current behaviour. An index of innovation behaviour was constructed by combining age segment with number of years of mobile ownership to reflect early adoption within an age cohort, and breaking the resulting index into quartiles. The relationship between this index as the independent variable, and adoption of GPRS phones as the dependent variable was significant (p < .05), consistent with innovation theory (Rogers 1995) The final step required comparing the predictive power of a model based on demographic data to a competing model based on behavioural and psychographic data.

To establish links among what an operator would know about its customers and the bundles of services it could offer to them we explored the questionnaire data using non-causal statistical techniques including cluster analysis and factor analysis. Cluster analysis allowed us to classify cases into relatively homogeneous groups or segments. Cases within these groups have objects similar to each other but dissimilar to other groups (Malhotra, *et al*, 2002; Arabie and Hurbert, 1994). Cluster analysis allows the data itself to suggest these groupings; and we can then attribute meaning to the groups through inspection, utilising information in Round One (Figure 3).

We derived three sets of cluster variables using the clustering analysis procedure within SPSS across the combined Singapore and Malaysia observations. One set was based solely on demographic information, another set was based on behavioural characteristics and the final set combined demographic information (average monthly mobile bill, gender, age, education, income) and personal characteristics, including derived indices (categorised) for social, thrift, status and time-saving needs. Hierarchical clustering (using Ward's Method with Squared Euclidean as the interval distance measure) identified four segments as broadly consistent with the data and with segmentation theory (Figure 4). In particular tentative support was found for identification of Socialites, Lifestylers, Misers and Mobilepros segments.

Addressing the remaining piece of the puzzle required use of factor analysis. Factor analysis enabled exploration of how well the responses to the new mobile data services survey questions distiled down to bundles of services. These factors, embodying the essence of the survey questions, grouped by attribute, then provide us an instrument through which to map back to types of users identified earlier, using one-way ANOVA and post hoc tests.

Factor analysis utilised the principal axis factoring method in order to identify underlying constructs (Malhotra, *et al* 2002). The KMO measure of sampling adequacy and Bartlett's tests of sphericity provided support for the validity of the factor analysis of the data set. varimax rotation facilitated interpretability.

Deciding the number of factors to retain is difficult. Initial runs showed, on the basis of a scree plot and eigenvalues, strong support for two factors but it seemed justifiable, both on the basis of evidence, as well as theory and interpretability, to retain three factors; we acknowledge that the third factor was a borderline case in terms of the scree plot and eigenvalue. The three factors together explained 53% of the total variation.

The high correlations of the questions, Movie guide, Street directory, Ticket reservation, Order Taxi, Restaurant guide and Yellow pages indicates an affinity with the construct mobile entertainment services (factor 1). The high correlations of the questions Sports results and News indicate a similar affinity with information services. The high correlations of the questions, Car parking and Flight information would indicate an affinity with functional services. Finally, the roughly equal and lower correlation for Banking services seems to straddle both Entertainment and Information factors which could be explained by the fact that it is a needed component in both service bundles. Similar arguments may be able to be made for Mobile payment (across Entertainment and Function) and possibly News (across Information and Entertainment).

Table 4: Factor Loadings for Service Bundles

Rotated Factor Matrix[a]

	Factor		
	1	2	3
22a Banking Services	**.468**	**.412**	.202
22b Check stock quotas	.237	.364	.263
22d Movie guide	**.649**	.285	.161
22e Sreet directory	**.630**	.329	.240
22f Order taxi	**.600**	.214	.276
22g Ticket reservation	**.759**	.200	.149
22h Restaurant guide	**.679**	.304	.256
22i Yellow pages	**.584**	.324	.342
22j Sports results	.240	**.624**	.209
22k News	.417	**.680**	.236
22l Mobile payment	**.406**	.348	**.448**
22m Car parking	.288	.158	**.746**
22n Flight information	.145	.259	**.696**

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
  a. Rotation converged in 5 iterations. n = 433

The factor analysis distiled the survey questions down to three content "bundles" reflecting the values of respondents with respect to the use of MDS. The mean factor scores of Entertainment, Information and Functionality can each be compared across customer segments to see if there are significant differences. Three separate one-way analysis of variance estimates provide weak-form tests of whether behavioural, demographic data, or some combination thereof, provide adequate ability to segment customers.

Table 5:
One-way ANOVA Tests of Relationships among Content Bundles and Subscriber Data

Content bundle	Behaviour	Demographics	Combined
Entertainment	.07	.00	.00
Information	.14	.11	.07
Functionality	.37	.13	.02

The table above reveals that behavioural indices were no better across the board in ability than a traditional demographic approach to segmentation. However, these tests also present tentative evidence that segmentation validity can be improved by combining selected demographic and behavioural variables.

Detailed inspection of the Singapore data provides additional insight, revealing for example that the entertainment bundle attracts younger subscribers with lower income and less education than other service bundles, and that these subscribers are more likely to trust friends and relatives as sources of information about mobile data services.

ANOVA by itself does not allow for comparison between means within groups. Post hoc tests can assist in determining which service bundle factor score mean differs significantly for which customer segment. Tamhane's test allows for unequal variances in the multiple comparisons, which is likely to be the case given the construction of the variables. Tables 5 and 6 are based on post hoc tests. Each table compares whether or not the mean should differ from the group (the theoretical result) with the result of the post hoc tests for Singapore and Malaysia combined as well as for each country separately. The theoretical result is based on expected linkages between the customer segment and the bundle of services. For example, we would expect the cluster denoted as Socialites to have significantly different factor score means for Entertainment and Information but not for Function. Other relationships are derived using similar logic.

Table 6: Singapore and Malaysia Combined

Segment	Entertainment		Information		Function	
	Theory	Post Hoc	Theory	Post Hoc	Theory	Post Hoc
Socialites	+	0	+	+?	0	+?
Lifestylers	+	0	+	0	0	0
Misers	0	0	+	0	+	0
Mobilepros	0	+	+	0	+	0

0: no impact; +: impact

Post hoc tests reveal mean Entertainment service bundle (factor scores) for Segment 1 (Socialites) and Segment 2 (Lifestylers) differ significantly from Segments 3 and 4 (Misers and Mobilepros). All other comparisons indicate a failure to reject the hypotheses of identical service bundle means.

In the Singapore sample (not shown), post hoc testing reveals that the mean Entertainment score values for the Socialites and Lifestylers segments differ significantly. All other comparisons fail to reject the hypotheses of identical factor score means. Post hoc testing reveals a failure to reject

the null hypotheses of identical factor score means across customer segments.

In the Malaysia sample (not shown), post hoc testing reveals no rejections of the null hypothesis of identical service bundle means.

Detailed inspection of the data provides additional insight, revealing for example that the entertainment bundle attracts younger subscribers with lower income and less education than other service bundles, and that these subscribers are more likely to trust friends and relatives as sources of information about mobile data services.

Segments in Singapore and Malaysia were similar to what we found in Round One above, except that it was not possible to isolate a specific TechnoToy group. This may be due to the lack of recent new technology announcements (other than GPRS, which is essentially an extension of the GSM standard). Across borders, the revealed needs profiles of members of these segments were parallel, except that Malaysians in the Mobile Professional segment were significantly more interested in mobile payment services than their Singapore counterparts, and less interested in messaging. These differences may be a result of cross-border differences in economic geography and interoperability, respectively. Singaporeans in all segments were more interested in the Functional service bundle, while Malaysians were more interested in the Fun bundle, suggesting that Singapore might serve as a lead market for some, but not all service bundles (Olsen, *et al* 2002).

Preliminary Conclusions:

Much of our thinking about the emerging mobile data services phenomenon is shaped by the immediacy of our experience with the Internet. This appears to be an error: a mobile phone inhabits a far more intimate space in our daily lives than television sets or personal computers. Thus, few of the marketing lessons from mass media or electronic commerce are likely to apply to mobile commerce. Many users of cell phones, who carry them wherever they go, pay careful attention to the incoming stream of calls and text messages. For operators who learn to manage this attention, the new channel represents an opportunity to be close to customers, and thus to deliver greater value.

There will be many entirely new opportunities. Consider the "hive mind" (Kelly 1997) created by mining cellular networks for data on the current location of millions of subscribers, in which directions they are moving, and at what speeds. The resulting intelligence might be used to redesign pedestrian walkways, control traffic signals, or react to natural disasters. Combined with information about individual subscribers, the hive mind model creates new market research and surveillance capabilities.

Empirically we could shed light on only a small part of the theory, namely exploring how to segment the MDS market so that it is possible for operators to match specific MDS with target users. Factor analysis based on combined Malaysia and Singapore survey data revealed three mobile data services bundles in the areas of entertainment, information, and functionality. The mean factor scores of each of these services were then compared across customer segments (derived through cluster analysis) using one-way analysis of variance. The results provide weak support for the fact that a combination of demographic and behavioural characteristics could segment the market on the basis of needs.

However caution is needed at this exploratory stage due to issues related to construct, internal and external validity. The formation of the segments based on cluster analysis requires additional work to substantiate their existence. Moreover, additional methods of testing causal relationships noted above are needed. Sampling techniques in Round One and, to a much lesser extent in Round Two, were non-representative as well as non-probabilistic but the intent was to generalise theoretical conclusions rather than to generalise the findings (Mook 1983). We also acknowledge that there could be interaction between the various phenomena beyond the consumer behaviour and market segmentation portion analysed here that should be considered in further research. Further refinement of the theory to derive testable dynamic implications related to Roger's innovation model might allow the existing dataset to reveal additional answers. Comparative research to identify subscriber needs for variety and reliability of mobile data services is likely to require redeveloping the survey instrument. Despite its exploratory nature, this work supports the usefulness of the research framework and reveals significant relationships among MDS use patterns and subscriber characteristics that will be useful for developers and operators.

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