
Panel surveys go mobile

Michael Weber*

Vienna University of Economics and Business Administration
Nordbergstr. 15, A-1090 Vienna, Austria
E-mail: michael.weber@wu-wien.ac.at
*Corresponding author

Michaela Denk and Klaus Oberecker

EC3 – E-Commerce Competence Center
Donau City Str. 1, A-1220 Vienna, Austria
E-mail: michaela.denk@ec3.at
E-mail: klaus.oberecker@ec3.at

Christine Strauss and Christian Stummer

University of Vienna
Bruenner Str. 72, A-1210 Vienna, Austria
E-mail: christine.strauss@univie.ac.at
E-mail: christian.stummer@univie.ac.at

Abstract: In order to take panel surveys into the ‘mobile age’, a careful analysis of their characteristics is conducted. Core issues of mobile surveys and panel designs are addressed and contrasted to their respective alternatives. Moreover, the use of mobile technology for carrying out panel surveys is discussed. Thereby, necessary actions and actors involved are identified, which provides a guideline for realising the potential of ‘mobile panel surveys’. Essentially, the benefits are due to enhancements in the areas of survey quality, management and technology. The recommendations made can contribute to the development of a new business model in market research.

Keywords: data collection; empirical social research; internet surveys; market research; mobile computing; mobile services; online surveys; panel surveys; ubiquity.

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Biographical notes: Michael Weber received a Masters degree in Economics as well as in Commerce from the Vienna University of Economics and Business Administration where he is specialised in Business Informatics and Strategic Management. Currently, his research concentrates on innovative services for digital business in a Networked Economy at the same university.

Michaela Denk holds a Master's and Doctoral degree in Statistics from the University of Vienna, with a specialisation in statistical meta-information and data integration. She is a Senior Researcher at EC3, focusing on statistical analysis and market research, and External Lecturer for Statistics and Data Analysis at the University of Vienna.

Klaus Oberecker graduated in Business Informatics from the University of Vienna where he specialised in network computing and object-oriented technologies. His research interests at EC3 cover online market research through panels, as well as online advertising and tourism research. He also runs a market research company.

Christine Strauss is an Associate Professor of Management Science at the University of Vienna. She holds a Master's degree in Business Informatics and a Doctoral degree in Economics from the University of Zurich. She is the Head of the Research Group on Digital Business at the E-Commerce Competence Center.

Christian Stummer is an Associate Professor at the Department of Business Administration, as well as the Head of the Research Group on Digital Business at EC3. His research focuses on innovation management (particularly investment planning and market introduction), and has been published in more than a dozen scientific journals.

1 Introduction

The internet's relevance as a medium for data collection was discovered soon after its introduction in the late 1980s. The advantages of making use of the internet seem quite obvious and include cost reductions, the quick and simple distribution of questionnaires and the ability to gather data directly into a data analysis tool (e.g. Dillman and Bowker, 2001; Solomon, 2001; Watt, 1997). Of course, internet surveys also suffer several shortcomings when compared to such traditional survey modes as personal or telephone interviews and mail surveys (e.g. Dillman, 2000). Some of these disadvantages (e.g. the oft-cited lack of representativeness) are losing their relevance in light of the ever-increasing internet penetration rates, which have already reached a level of about 60% of the population in developed countries (e.g. approximately 50% in the EU or about 68% in the US and Canada; cf. InternetWorldStats, 2006).

Similar to the internet, mobile phones have become a part of everyday life. In Western Europe, the mobile phone penetration rate is above 80%, and in some countries it even exceeds the 100% mark (IPSOS-INRA, 2004), e.g. 104% in the UK (Analysys Research, 2005), where several individuals own multiple mobile devices. New mobile technologies such as UMTS/WCDMA are being offered by telecommunication providers, and are starting to be adopted by consumers. Now that more than 80 operators in 27 European markets have chosen UMTS/WCDMA as their 3G standard (Hearnden, 2004), the consumer base for this technology is growing (Carlsson, Walden and Bouwman, 2006): Italy and the UK are leading the 3G league, with approximately 3.56 million and 3.00 million 3G customers, respectively (Telegeography, 2006). At the same time, fixed-line phones are losing ground, and their market share is decreasing as more and more people choose to rely solely on mobile phones. Traditional Computer-Assisted Telephone

Interviewing (CATI) cannot be used to reach these mobile phone users, who are particularly prevalent in the younger generations (teenagers and young adults). Furthermore, conventional CATI faces the general problem of declining telephone survey participation rates. The willingness to answer (delicate) questions on the phone is decreasing, and the rejection of calls (from unknown or unwanted callers) is facilitated by functionalities such as call identification and answering equipment.

The digital convergence of web-based and mobile services as predicted in ubiquitous (Weiser, 1991), as well as pervasive (Burkhardt et al., 2001) computing and commerce scenarios, leads to increased possibilities and extended services for empirical social research and decision-making. Mobile surveys that make use of these converging technologies can therefore be seen as a promising field for research on decision support. Even though ideas presented in this paper are applicable for empirical social research in general, the following focuses on market research and decision support applications in business contexts.

In particular, experiences gathered with online market research (e.g. Bowers, 1999; Grossnickle and Raskin, 2001) provide a starting point for the following considerations, which address the shortcomings of both enhanced (by means of information and communication technology) and traditional ways of collecting and analysing data in terms of efficiency, administration and quality, as expressed by explanatory power, reliability and representativeness. The ideas developed in this paper are based on the assumption that ongoing technological convergence favours ubiquity and therefore standardisation and increased bandwidth for mobile devices.

The possibilities of mobile data collection can best be exploited by using a panel design, rather than a single or repeated cross-section (i.e. trend) design. Sophisticated and informative panel designs are characterised by a repeated use of a single survey while using a persistent control sample. Trend designs, in contrast, feature repetitive surveys with differing samples. In market research, panel members might be current customers, sales managers or members of an identified target segment. For example, panel surveys enable a thorough analysis of the effects of the actions taken by a company on its target group. Unlike the trend or cross-section designs, a panel design also provides the information required to study the respondents' dynamics, such as the change in consumer behaviour, on the level of the individual.

The realisation and management of a panel is a complex and time-consuming task. This is particularly true for long-term panel studies with a higher risk of panel mortality, an issue that might be due to a specific dropout pattern. However, mobile devices and information and communication technologies can be applied to reduce the costs and time involved in administering the panel and to counter systematic dropouts.

The objective of this paper is to demonstrate the potentials and limitations of the use of mobile devices for the improvement of empirical data collection through panel surveys. Therefore, central issues of panel surveys are examined and contrasted to the characteristics of mobile technologies to the end of deriving a general statement on the applicability and adequacy of mobile devices for panel surveys. The managerial implications of this potential mobile service are subsequently analysed from both a procedural and a structural perspective.

Relevant design and management issues of panel surveys are addressed in Section 2, whereas the essential components required for conducting a mobile panel survey are described in Section 3. Section 4 discusses the relevant issues of mobile panel designs, as well as the methods for mobile data collection, and outlines the benefits and drawbacks

of combining mobile technology and panel designs, from the viewpoint of both the panel operator and the panel members. Finally, Section 5 develops a mobile panel scenario to illustrate the actors as well as the interactions involved, while Section 6 presents conclusions and suggests areas and topics for further research.

2 Panel surveys

A panel survey is a longitudinal statistical study in which a (relatively) stable group of individuals (collectively referred to as 'panel') is interviewed recurrently over a given period of time. These interviews usually revolve around a certain topic (Diekmann, 2002). In contrast to this statistical definition, some practitioners understand the term 'panel' as a loose pool of individuals, with panellists being selected ad hoc and contacted to participate in surveys. However, this paper uses the term in its statistical definition.

A panel design has two main advantages over cross-sectional and trend designs: it makes it possible to analyse the dynamics on the level of the individual; and provides increased efficiency, mostly as a result of handling larger data sets. Because it aims to capture individual dynamics, a panel is a flow concept that takes the heterogeneity of its observation units into consideration; this characteristic enables, for instance, a thorough analysis of social processes over time. The gains in efficiency are largely attributable to the higher number of responses and, consequently, observations over time, which leads to an increase in the degrees of freedom and smaller standard errors.

The quality of the data collected from a panel survey (e.g. as measured in terms of explanatory power) can reach a higher level and is less volatile than the data quality of cross-section or trend studies. For example, due to the relative stability of a panel sample (which is usually composed of a fixed set of quotas, with or without considering changes in the population), the probability of maintaining a certain quality level with a panel is higher than with trend studies, which are subject to fluctuations in data quality that can lead to *ex ante* unclear expressiveness. Another advantage of data collected from a panel design over trend or cross-section data lies in the coincidence of the time of inquiry with the time of measurement of the item surveyed. Therefore, retrospective questions, which are problematic due to the limited capacity for remembering, become unnecessary. As a consequence, current attitudes, sentiments and other dynamic values or data can be collected, analysed and used as a measure for the assessment of actions taken or events that have occurred (e.g. advertisement campaigns in particular and marketing strategies in general), the effects of new policies as well as other short-term or sporadic activities and impacts.

Furthermore, trend data and cross-section data can be extracted from panel data by means of anonymisation and/or through the selection of certain points in time. Even event data, i.e. data on the occurrence of a specific event, can be captured via a panel design. Panels can therefore be used as a very flexible and comprehensive instrument for market analysis, given that the data gathered through this approach can be processed efficiently with little to no media discontinuity and, hence, with a high degree of interoperability.

Crucial questions concerning the quality of a panel – including reliability, representativeness and explanatory power – revolve around the recruiting process in combination with the incentives set, the composition of the panel, the complexity of the questionnaire, panel effects, as well as panel mortality.

Incentives are an important means of enhancing the quality of a panel because they help to motivate the respondents to participate in a panel and/or to respond to individual panel surveys. Due to the omnipresence of market research, the recruiting of panellists has become more and more challenging. The willingness of people to join market research activities seems to be continuously declining. Intrusive practices of arguable salespeople are on the rise, and many people do not differentiate by whom they are approached. This is particularly detrimental to market research that is based on information and communication technologies and could be remedied by the setting of appropriate incentives and trust-building measures.

Literature on the topic of incentives offers several – partly contradicting – suggestions on how to set incentives best in order to avoid distortion effects (Batinic et al., 1999; Diekmann, 2002). Direct (and monetary) incentives are commonly the objects of criticism. However, practitioners dealing with online panels (Thun and Untiedt, 2001) frequently favour direct (e.g. concurrent or cumulated allowances) over indirect incentives (e.g. lotteries or point systems), as direct incentives are more effective in motivating the panellists and maintaining the panel's composition.

The *composition of the panel* should reflect the population targeted for the survey and should ensure representativeness, while taking both cost and time efficiency into consideration. Conventional offline panels lack (competitive) methods that address the respondents efficiently and parsimoniously. As a result, collecting and processing the data with traditional offline methods (Diekmann, 2002) is comparatively time-consuming and costly. Online panels, in turn, are frequently criticised for being merely applicable to specific designs, because only a distinct fraction of the population can be reached through this approach; this fact increases the probability of a biased survey and raises issues of representativeness (Bradley, 1999; Batinic et al., 1999). Even if particular offline and online recruiting procedures are used for addressing a larger, diversified sample, it is usually difficult to ascertain reachability and maintenance of the sample over time.

With the topics of surveys becoming ever more *complex*, one can argue that a panel study is more apt to gather meaningful data than cross-sectional or trend surveys. This proposition is supported by the fact that panellists, by definition, deal with a certain subject more intensely and frequently than an average cross-section or trend survey respondent. Basically, the panel operator can take care of the panel or the panel members, respectively, with better means than other survey types. This is due to the direct flow of communication with the individual panellists over time.

However, this advantage can turn into a disadvantage as far as the issue of *panel effects* is concerned: panel effects describe panel members' change in behaviour resulting from their awareness of forming part of a survey (Batinic et al., 1999). Because extensive communication with the panellists may lead to a biased study, communication with the respondents should be kept on a balanced level, with possible distortion effects always being taken into consideration.

Concerns about panel effects and the danger of developing professional panel members through recurring questionnaires must be kept in mind when planning the maintenance intervals. These concerns can be outbalanced, though, by means of sophisticated panel administration and maintenance that considerably increases a survey's response rate. In general, the response rate of panels varies between 30% (which typically is about the maximum for internet surveys; cf. Batinic et al., 1999) and 90% (Batinic and Moser, 2001) depending on the maintenance effort involved.

Panel mortality is another crucial factor for panel surveys and basically corresponds to the non-response of (former) panellists to a panel survey. Keeping the mortality rate as low as possible is evidently important for the panel's representativeness. Panel mortality can arise from neutral environmental impacts or from denials. Neutral forces are usually (depending on the topic of the survey) not systematic and can be attributed to a missing or faulty link to the panel members, resulting, for example, from missing information on the panellist's address, technical disturbances or death. Denials can be classified into either active or passive rejections. The refusal of panel members to participate in future panel surveys provides an example for an active rejection, whereas passive denials are due to the incapability of the respondents to fill in the questionnaire, e.g. for medical reasons, cancelled or incomplete interviews, or varying reachability of panellists. However, it is difficult to prove whether denials are systematic. Commonly, socio-demographic data is used to detect patterns in denials, but this approach is probably insufficient as patterns could also ensue from other factors. Therefore, it is important for every panel to make use of the appropriate means for investigating different factors by analysing the data collected, e.g. through data mining techniques. As stated by Diekmann (2002), panel mortality occurs predominantly with people who cannot be reached at work, panel members who relocate frequently (a factor that is particularly problematic with younger generations) and as a result of respondents dying. The appropriate approach to the replacement of panellists ought to be subtle, and should also seek to hold down management costs while keeping panel mortality low. According to the literature on panel mortality (e.g. Birkelbach, 1998), reachability, a general lack of willingness to cooperate and a decreasing interest in the topic of the survey over time are particularly relevant reasons for dropouts. The majority of dropouts can therefore be linked to some pattern that can be identified by using advanced statistical techniques, for instance, classification methods such as those used for churn prediction in the telecom sector (Kleissner, 1998; Ferreira et al., 2004).

The main benefits of a panel design can be further exploited by taking advantage of technological developments in the context of ubiquitous computing that enable the use of questionnaires via mobile devices, such as cellular phones. Basically, the crucial characteristics of mobile devices – mobility and reachability – may provide auspicious preconditions for an improved panel design, whose conventional shortcomings should be eased.

3 Mobile surveys

The usage of mobile devices for data collection makes it possible to fully exploit both the advantages offered by internet surveys and the additional benefits attributable to the characteristics of mobile devices, such as the increased flexibility and reachability of respondents. In the following sections, mobile surveys are considered as a further development of 'internet surveys', with 'internet surveys' subsuming both e-mail and web-based surveys. It should be pointed out that web surveys can provide direct and indirect access to respondents, whereas e-mail and mobile surveys typically offer direct access via pools of potential survey participants. The following considerations mainly build upon a comparison of mobile with internet surveys.

There are basically five different ways a mobile phone can be employed in market research:

- ‘Conventional’ interviews, which in essence are the same as CATI using fixed-line phones.
- SMS-based interviews, which are text-based and can be conducted with every standard mobile.
- MMS-based interviews, which offer multimedia communication, but place higher technical requirements on the device and the provider (as SMS and MMS use one-way, simplex communication, a continuous dialogue is not possible: an SMS/MMS has to be sent for every information exchange, which increases transaction costs and reduces usability).
- ‘Mobile internet’ interviews, which enable real-time, interactive, multimedia questionnaires; mobile internet interviews are similar to contemporary internet surveys, but they place higher technical requirements on both the device and the provider.
- Surveys on client-site application execution platforms, such as J2ME (Java 2 Platform, 2006), or on client-site operating systems, e.g. Symbian OS (Symbian, 2006), Microsoft Windows Mobile (2006), that make it possible to run survey applications on mobile devices.

All four types of text-based mobile interviews can be combined with other market research activities, e.g. internet surveys, since they can be used with the same back-office IT systems and brought to the front end (i.e. the mobile device) in a comparatively cost-effective manner.

Making use of mobile internet interviews (in both online and offline modes) or survey applications on mobile devices offers two evident advantages compared with other mobile survey approaches: first, the device’s computing capability allows for the automation of the navigation through the questionnaire; for example, filter questions can easily be implemented. Second, the questionnaire can be answered in offline mode, i.e. no internet connection is needed when completing the survey, which implies that respondents do not necessarily need to answer all questions at once. Survey applications that have to be installed (and updated) on the respondent’s device are less suitable for ad hoc surveys with unregistered respondents. For mobile internet surveys, additional functionality has to be included to fill in the questionnaire in offline mode where particularly complex questionnaires might give rise to sophisticated functionality and programming efforts. A customisable survey that requires the insertion of a brand name chosen from a list in a preceding question into the text of a succeeding question, where that specific brand in question is the subject of an evaluation, may serve as an illustrative example. Although the lack of industry standards currently still affects the interoperability of applications, one can expect this problem to be solved over time, since several organisations, such as W3C MWI (W3C, 2006), 3GPP (3rd Generation Partnership Project, 2006), ETSI (European Telecommunications Standards Institute, 2006), are working on appropriate proposals for standardisation.

Even though the sector is still in its infancy, some suppliers of mobile surveys already exist (e.g. McDonald and Adam, 2003; Perseus, 2006; Raosoft, 2006), and CAMI (Computer-Aided Mobile Interviewing) – following CAPI (Computer-Aided Personal Interview), CATI and CAWI (Computer-Aided Web Interview) – has already been registered as a trademark (Kinesis Survey Technologies, 2006). Little research is

available on mobile questionnaires, despite their obvious advantages. Nevertheless, there is empirical evidence that mobile questionnaires are a promising method of market research (e.g. Couper and Nicholls, 1998; Friedrich-Freksa and Liebelt, 2005).

In a recent study comparing SMS and MMS interviews (Tjøstheim and Thalberg, 2004), only 15% of the SMS respondents suffered from technical interruption, while 56% of the MMS respondents did. Furthermore, the interviewees' willingness to participate in future surveys was higher for participants of SMS-based interviews than for those of MMS-based interviews (75% vs. 49%). These findings indicate that SMS surveying is more readily accepted by interviewees because they are already more familiar with this mobile phone feature. On the other hand, technical adoption changes over time as people get used to new and beneficial applications.

Literature comparing existing and widely used survey modes [for instance, basic market research or empirical social research books (e.g., Diekmann, 2002; Hammann and Erichson, 2000, or IPSOS-INRA, 2004) and work on online research, respectively (e.g. Batinic et al., 1999; Ilieva, Baron and Healey, 2002; McDonald and Adam, 2003; Theobald, Dreyer and Starsetzki, 2003)] usually considers data quality (including issues such as (non-)response, data accuracy, sample quality or representativeness), characteristics of questionnaires (e.g. possible length, possibility of open questions), survey costs, temporal efforts, flexibility and privacy (for a more statistically oriented discussion of data collection modes, see Groves et al., 2004).

Response rates and measures to increase response rates are of high importance to data quality. However, none of the data collection modes is superior to the others with respect to response rates. Some comparative studies report higher response rates for postal surveys than for internet surveys, others suggest the opposite (e.g., Ilieva, Baron and Healey, 2002; Mehta and Sivadas, 1995; McDonald and Adam, 2003; Yun and Trumbo, 2000; Bradshaw, 2002; Cook, Heath and Thompson, 2000). In most cases, e-mail surveys show higher response levels than simple web surveys, a fact attributable to the importance of personalisation for high response rates (Dillman, 1991), whereas telephone surveys frequently show higher response rates than postal and internet surveys (Fricker et al., 2005). The motivation of addressees and, consequently, the response rates, are also influenced by interest in the topic, incentives and the degree to which respondents enjoy filling in the questionnaire (e.g. Singer, van Hoewyk and Maher, 2000). Higher response rates are expected for mobile surveys because of the more or less permanent and individual reachability of the participants and the higher stimuli potential (mobile surveys can employ the multimedia features found in internet surveys and thus increase the 'fun-factor' of questionnaire completion). However, it should be noted that technical standardisation in this field is not very advanced yet; for instance, visualisation capabilities still depend on the producer of the mobile device. Moreover, the multimedia capabilities and therefore the stimuli potential of mobile devices are limited.

In addition, mobile surveys are also supposed to benefit from the advantage of a reduced item-non-response (i.e. respondent's refusal to answer particular questions) featured by internet surveys. However, the answers to mobile surveys are unlikely to reach the high level of detail that is found in the answers to open-ended questions in internet surveys unless voice entry is used for this type of questions; the keyboards of mobile devices are not (yet) sufficiently comfortable to allow for such extended answers.

Another potential problem with mobile surveys lies in the degree of perceived seriousness for the medium (e.g. Mahatanakoon, Wen and Lim, 2006); i.e. addressed persons might be reluctant to participate in the survey because of trust and privacy issues.

Incentives, for example, the provision of survey results, the participation in a lottery or the provision of mobile devices on an instalment plan that is settled by regular panel participation, help to increase response rates; yet, they also may decrease data quality by stimulating people to take part in the survey even if they are not interested in the topic (such participants might then give irrelevant answers), or to give multiple responses to increase their chances of winning. While the former cannot be overcome with mobile surveys, the latter can be prevented (analogous to internet surveys) because of the comparatively straightforward identification of respondents on the basis of their mobile device's IMEI (International Mobile Equipment Identity). While the ability to hold a telephone number irrespective of the operator(s) supports this advantage, anonymous mobile phone users with pre-paid contracts cannot be identified. Cooperation with mobile network operators makes it simpler to offer incentives, for instance, by providing invoice rebates or free SMS/MMS. A further conceivable incentive, the provision of mobile devices (Sugai, 2007), can help to mitigate technological gaps or to attract (selected) panel members. Dropout rates, which are usually only measured for internet surveys, are also impacted by incentives, personalisation, technical aspects and the length of the questionnaire. Typical dropout rates for internet surveys are about 10–15% (e.g. Theobald, Dreyer and Starsetzki, 2003). In order to keep dropout rates this low, mobile questionnaires must not exceed a certain length and their questions have to be particularly short and rather straightforward. In general, the amount of data that can be collected via mobile devices is smaller than for traditional surveys or internet surveys. As a result, panel surveys, for which the master data of respondents is already known, or ad hoc surveys are predestined to be conducted via mobile devices. Simple ranking or preference questions ('one-click' responses) as required for typical market research methods like multi-dimensional scaling or conjoint analysis are perfectly suited for mobile surveys.

Another determinant of sample quality – and one especially relevant for web surveys – involves the self-selection of respondents, an aspect that often leads to a sample bias. Actually, this is not a problem related to the data collection mode, but rather one of recruiting. It can be solved through screening questions. Moreover, mobile surveys do not suffer from this drawback unless recruiting is carried out in a non-personalised manner (e.g. via pop-up invitations on websites).

The validity and general applicability of survey findings depend heavily on the representativeness of the sample where particularly internet surveys are often criticised since they are restricted to a computer-literate subpopulation with internet access. However, internet penetration rates nowadays have reached a level which indicates that internet users are representative for the general population (with the exception of the elderly) in most Western European and North American countries (Ilieva, Baron and Healey, 2002; Theobald, Dreyer and Starsetzki, 2003). The same holds true for mobile surveys, as mentioned earlier. People without a fixed-line telephone and/or internet access can be reached through mobile surveys, which is a factor that is becoming ever more important in times of transition of customers from fixed-line to mobile connections (e.g. Kuusela and Simpanen, 2002; Ofcom, 2004). In Finland, for instance, about a third of households were already 'mobile only' in 2001; this number is expected to increase to 50% by 2007 (Lakaniemi, 2005).

Besides, mobile surveys grant representativeness at the level of individuals, which is not automatically provided for in phone surveys that involve the sampling of households, as opposed to individual persons. Households, however, more often than not do not share

one mobile device, but rather, each member has his or her own cell phone or PDA. Moreover, non-delivery rates, which are rather high for e-mail surveys, decrease significantly in mobile surveys, as mobile numbers change less often than ('junk') e-mail addresses. Note that not all cell phones today support MMS, mobile internet and/or Java and therefore the availability of the communication method in the target population should be considered when setting up a survey. Other technical problems, such as insufficient network coverage, troubles with SMS/MMS/WAP gateways, or server overload, can be critical as well. Nevertheless, these issues will decline with increased standardisation.

In general, self-administered surveys have a very high rate of data accuracy, which measures the degree to which captured data really represents the response of the interviewed person. This is particularly true for computerised data collection modes (e.g. Hammann and Erichson, 2000; Ilieva, Baron and Healey, 2002) in which transcription errors cannot occur, as well as for mobile questioning. Respondent errors are a closely related class of errors; they are typically due to either a misunderstanding or a non-familiarity with the technology employed. Ease of contact and/or built-in respondent support makes it possible to clarify any ambiguities during the completion of the questionnaire and, thus helps to avoid respondent errors. Of course, misunderstandings or uncertainties can be immediately clarified in personal interviews. All computer-aided survey modes, including the mobile mode, allow integrated automated respondent support. The interviewer effect is excluded in all survey modes without direct interviewer-interviewee contact, while the opposite is true for influence exerted by third persons.

Some authors claim that time and financial expenditure per sampled person are less for internet-based surveys than for traditional ones (e.g. Ilieva, Baron and Healey, 2002; McDonald and Adam, 2003) and that the per capita expenditures decrease with the increasing size of the sample. This enables either larger samples or cost savings. Mobile surveys are also supposed to show this advantage, though the communication costs (e.g. SMS and/or mobile internet) of the respondents have to be borne by the empirical social researchers. In addition, incentives (for example, based on agreements with mobile network operators) and technological requirements incur costs. Internet surveys usually take less of the respondents' time, since the complexity of the questionnaire can be hidden from the respondent by integrating it into the survey software; for instance, conditional questions are only presented to the respondent if the respective condition is satisfied. In addition, online questioning shortens the turnaround of questionnaires, i.e. the retention period. For example, McDonald and Adam (2003) observed an average response rate of 40% in the first 24 hours and 75% in the first 4 days. Due to the ubiquity of mobile users, surveys via mobile devices are expected to show even higher speed of data collection. This general flexibility on the part of the respondents to receive invitations to surveys anytime, anywhere, and to respond anytime, anywhere is the most important feature of mobile surveys, allowing the usage of 'niche times' (e.g. the travel time of commuters) for answering questionnaires.

4 Towards a mobile panel: combining mobility and panel surveys

Embedding questionnaires in mobile devices for a panel study can help to tackle the issues raised in Section 2 and expand the established online and offline approaches for

conducting a panel survey. Based on the assumptions in Section 3 concerning the advances in standardisation and mobile bandwidth, the relatively high penetration rates of mobile devices lead both to a convincing cross-population representation and facilitate savings in costs and time by taking advantage of the previously mentioned characteristics of mobile devices. As a consequence, conventional panel survey modes should not be completely removed, but rather supplemented where appropriate. Elements of an online panel, such as the additional opportunity to maintain master data online, could provide particular assistance to a mobile survey where necessary.

Establishing a pool of potential panel members is a prerequisite to realising a (mobile) panel. This pool forms the basis for the subsequent selection of actual panel members. A broad discussion exists on how to set incentives to motivate respondents without distorting a survey. Pro and contra arguments concerning direct incentives apply to mobile panels as well. In day-to-day panel management, incentives could, for example, be set via the mobile user's invoice in a way that the panellists can directly attribute the time and effort they spend on the panel; such incentives should provide an obvious but moderate advantage (e.g. 'free' message services, 'free' talk time). This can be done without any direct financial interaction between the parties, thereby mitigating scepticism regarding the merits of direct (and monetary) incentives. To realise these benefits, the panel operator must cooperate with one or more mobile network providers. Along with the participation of a mobile network customer in the pool, permission should then be given to access specific data entries required for contacting pool (and panel) members.

The advantages of a mobile approach for tackling issues concerning representativeness, cost and time, as identified in Section 3, also hold for mobile panels. As it is becoming increasingly feasible to tag real-life objects (e.g. with a semacode (Rondeau and Wiechers, 2005) or an Radio Frequency Identification (RFID) chip (Finkenzeller, 2003)) and thereby provide links to internet contents on-site, 'location-based recruiting', i.e. the recruiting of particular target groups at specific locations, can be realised. Object tagging at specific locations or events makes it possible to approach special interest groups and to invite them to participate in a panel.

The ability to collect current attitudes, sentiments and other dynamic values through panels can be further expanded by using ad hoc panel surveys that reach the panellists on their mobiles. This enables a quick collection and analysis of the effects of certain events in a market or in society as a whole. The availability of master data for the panel members, as provided for in a mobile panel, is an important precondition for realising this kind of ad hoc panel questionnaire.

Using a mobile device for data collection and directly transferring the data to a central storage represents an important step forward in the ability to collect and analyse data efficiently and swiftly. In addition, cohort, life cycle and periodical effects can more easily be determined from longitudinal data, such as panel data, with the assistance of information technologies. In the past, such effects had frequently been estimated on the basis of cross-section data (Diekmann, 2002), an approach that has often resulted in poor data quality.

Mobile surveys supplemented with other communication channels, such as e-mail, internet websites, or even traditional channels offer improved opportunities for contacting and interacting with the panellists. In particular, panel maintenance and administration can benefit, leading to enhanced panel quality and, in particular, higher response rates. Double entries, invalid numbers or addresses, wrong declarations and other incorrect or frequently changing data on the panel members can be identified, clarified and updated

more efficiently, if the mobile device is the primary link to the respondents. In principle, changes of the panellists' mobile telephone numbers are critical; yet, the ability to retain the number in case of changing the mobile operator, as well as cooperations between the panel operator and mobile network providers, lessen the seriousness of this problem. The mobile questionnaire approach requires regular updates of the master data; separating the maintenance questionnaire from the standard questionnaire is recommended, as doing so avoids lengthy questionnaires. Moreover, the ability to clarify questions that arise during completion of the questionnaire is higher in a mobile panel due to the panellists' increased reachability and the ease of contacting them.

The characteristics of mobile questionnaires can also be applied to reduce the effort and costs involved in controlling and preventing systematic panel mortality. In particular, the information and communication technologies involved and the direct interaction with the panel members provide efficient means for detecting and rapidly reacting to dropout patterns, as well as for replacing a panellist if necessary. Data collection via mobile devices eases response and thus decreases response time. This increases data availability and enables the application of classification algorithms that detect usual dropout patterns and thus allow the identification of dropout candidates in time.

By means of three criteria (technology, management and quality), Table 1 gives a synoptic summary of the advantages and disadvantages of mobile panels from the viewpoints of the two key players, viz. the panel operator and the panel member. Note that some advantages like providing the panel members with the latest (technological) gadgets may turn out to be of fleeting nature, because over time the novelty effect can decrease and the gadgets may lose their ability to motivate and the protection they offer against mortality may decline quickly.

5 Use case and managerial implications of a future mobile panel scenario

Following the description of panel surveys in Section 2 and the classification of mobile surveys in Section 3, this section captures the structural and process-related aspects of a typical mobile panel scenario by providing role descriptions for the actors involved and presenting a detailed use case description in UML (Booch, Rumbaugh and Jacobson, 1999). The scenario is based on mobile internet surveys and survey applications on the mobile device, which enable real-time, interactive, multimedia questionnaires similar to contemporary internet surveys. From the analysis of the scenario, managerial implications are inferred.

5.1 Mobile panel actors

The following set of actors and roles are prerequisites for outlining a use case of a future mobile panel. These elements provide the structural basis for the mobile panel use case in Section 5.2:

Mobile Access Panel Member (MAPM): A MAPM is a physical person who has provided his or her general permission to participate in mobile surveys from time to time. The possible actions of a MAPM are: joining a mobile panel, cancelling the access panel membership.

Table 1 Advantages and disadvantages of mobile panels

	<i>Panel operator</i>		<i>Panel member</i>	
	+	-	+	-
Technology	enhanced reachability of persons without fixed-line telephone and/or internet access high (technical) speed of data collection, processing and analysis multimedia capability	adoption bias (only gradual acceptance of new communication technologies) lack of standards (e.g. visualisation dependent on producer of device) additional risk due to technical equipment	self-determination of where and when responding process is performed niche time-periods can be used for responding (limited) multimedia capabilities as additional stimuli one-click responses	respondents might interpret requests on mobile as obtrusive act various technical sources of error: mobile phone, mobile net, server, SMS/MMS/WAP gateway, survey application, etc.
Management	short retention time improved reachability of individual panel member increased response rates ease of contact built-in respondent support	cost of equipment and infrastructure (procurement and maintenance) dependence on mobile network operator expenses on means to provide trust, privacy, anonymity and security lack of perceived seriousness and trust	no necessity of personal interaction use of (own) mobile (fun and convenience factor) Responding process can be scheduled (e.g. into niche time-periods)	lack of personal interaction transaction costs
Quality	increased representativeness through high penetration rates no transcription errors low non-delivery rate less item non-response no influence of interviewer real-time interviews prevention of multiple responses via IMEI	limited length of questions and questionnaire due to technical reasons user errors due to new technology	easy comprehension (text vs. voice) complexity of questionnaire hidden from customer (e.g. conditional questions) built-in respondent support	lack of trust, privacy, anonymity and security sluggish familiarity with mobile technology

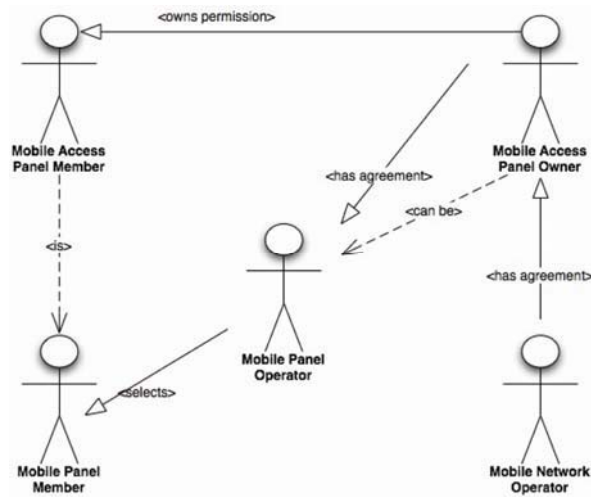
Mobile Panel Member (MPM): A MPM is a MAPM who has agreed to regularly participate in a particular mobile survey. The possible actions of a MPM are: taking part in a mobile panel survey, which includes retrieving a questionnaire, filling in a questionnaire or submitting a questionnaire, and cancelling the mobile panel membership.

Mobile Network Operator (MNO): MNOs provide network access for mobile devices. They have contracts with one or more mobile access panel owners and provide the link to their customers (the end-users). MNOs are responsible for collecting access panel permissions on behalf of a mobile access panel owner and for constantly synchronising and updating user data. A MNO can be a mobile access panel owner itself; however, independent, neutral intermediaries who have contracts with all mobile network operators are more flexible and thus more likely to succeed in a free market – a point proven by the technical solution providers for SMS- and MMS-messaging applications. The possible actions of a MNO are: passing on data to mobile access panel owners, establishing contracts to mobile access panel owners.

Mobile Access Panel Owner (MAPO): The MAPO is the party that owns the permissions to contact users of mobile devices in order to send them invitations to mobile surveys. One MAPO can have partnerships with one or more MNOs. The possible actions of a MAPO are: establishing contracts and agreements with mobile network operators, exchanging access panel member data between access panel members and mobile network operators, providing a technical infrastructure for mobile panel operators to set up a mobile panel and inviting mobile access panel members on behalf of mobile panel operators to join a mobile panel. To a certain extent, the role of the MAPO is comparable to today's SMS gateway operators, which have contracts with all mobile phone operators and act as intermediaries between SMS/MMS service providers and mobile network operators. In comparison to SMS gateway operators, the role of the MAPO is more sophisticated: the MAPO is responsible not only for providing the technical infrastructure for sending and receiving questionnaires but also for keeping data up-to-date. Every time a panellist changes his/her profile, either at the mobile phone operator or within the online access panel, the panellist's data must be updated in the database. The MAPO takes care of the data exchange.

Mobile Panel Operator (MPO): A MPO selects mobile panel members from the pool of available mobile access panel members. The MPO is also responsible for providing and sending questionnaires to all mobile panel members. A mobile panel operator can be either the online access panel owner or its customer. Examples for typical actions of a MPO are: defining a panel structure through software provided by the mobile access panel owner, sending surveys to mobile panel members as well as setting incentives.

Figure 1 depicts the set of mobile panel actors described and shows the organisational framework by denoting their relations to each other.

Figure 1 Mobile panel actors and their organisational framework

5.2 Mobile panel processes

Following the identification and definition of actors and the description of their roles, the core processes in a mobile panel scenario can be outlined by means of use-case descriptions. Typical core use-cases for a mobile panel scenario include the following five processes:

Setting up a Mobile Access Panel: A MAPO establishes a partnership with one or more mobile network operators; ideally, the MAPO would have contracts with all of the MNOs in a country or a region. Users can sign up as members for the mobile access panel by providing their mobile phone number and other attributes, which must be specified by the MAPO.

Setting up a Mobile Panel: A MPO (e.g. a market research company, a political institution or, more generally, a ‘customer’) wants to monitor a certain target group regularly (e.g. on a weekly or monthly basis) and therefore decides to set up a mobile panel. The MPO defines the structure and size of the panel and passes the definitions on to the MAPO, which then sets up the mobile panel by inviting those mobile panel members who meet the MPO’s definitions to join the mobile panel. Panel members are usually awarded some kind of compensation for their participation in a panel survey (cf. Section 3).

Conducting a panel survey: A MPO sends an electronic questionnaire to MPMs by using special survey software provided by the MAPO. This software allows the MPO to create online questionnaires suitable for being completed on mobile devices and takes care of privacy issues. In addition, the software provides an interface for retrieving the data collected throughout a survey for further analysis.

Synchronising Mobile Access Panel Member Data: Changes of a MAPM’s address details or mobile phone number can be made either through an editing mask in the access panel account or by contacting the network provider. The MNO, knowing that the customer who changed these details is a MAPM, triggers an update in the MAPO’s database.

Replacing Mobile Panel Members: Members of a mobile panel might have to be replaced for four reasons: a panel member actively quits a panel, no longer answers questionnaires, fails to meet panel requirements during the surveying period and shows a specific answering pattern that implies panel effects. In any case, the process of replacing a mobile panel member with a new participant from the mobile access panel is performed automatically by the panel software.

5.3 *Mobile panel quality issues*

The quality of a mobile panel strongly depends on data accuracy, as well as representativeness. Panel data quality is assured if the master data is constantly kept up-to-date. There are two ways of updating data for a conventional online panel: the panellist's data can be updated by the panellist through a panel data editing mask or, alternatively, the panel owner can invite the panellist to do so through e-mail or telephone. A panellist is lost for the panel in case of an unreported change in the e-mail address. Comparing this situation to the possibilities the mobile market holds, it is obvious that mobile panels are far more likely to provide better data quality than online panels. In addition to the fact that mobile penetration is much higher than current internet penetration (cf. Section 2), there is one major difference between reaching people through their mobile phones and reaching them through their e-mail-addresses: there are numerous e-mail providers, but usually there is only a limited number of mobile network operators in a particular country or region. This makes it possible for MAPOs to promote registration into their access panels by partnering up with mobile network providers. Cooperation with mobile network providers guarantees up-to-date data that are maintained for billing purposes. The compensation offered by access panels can be communicated through the invoice and may involve free phone minutes, free text services or various other benefits as common with online panels.

5.4 *Managerial implications of the mobile panel scenario*

There are several advantages for panel operators in managing a panel using mobile devices as a channel to collect survey data and to register people for their panels. When compared with an internet service, they furthermore benefit from the composition of the mobile network provider market: due to its oligopoly character, there are only a limited number of network providers in each market, which facilitates the establishment of partnerships with operators. On the other hand, the dependence on the mobile network providers is a negative side-effect of the requirement to cooperate. Note that companies that currently provide technical solutions for sending SMS and MMS messages and act as intermediaries between network operators and customers may serve as role models for future mobile access panel operators. However, the acceptance of mobile panel surveys will eventually depend on the further development and technical enhancement of mobile devices according to the users' needs (Koivumaki, Ristola and Kesti, 2006), as well as the establishment of appropriate technological standards. For instance, the ability to provide a stable mobile internet connection must be assured. In addition, means to provide trust, privacy, anonymity and security of mobile panel members have to be implemented. Regarding quality aspects of mobile panel survey data, in particular, the limited length of questions and questionnaires as well as user errors due to their initial unfamiliarity with the new technology seem to impose restrictions.

A business model with actors and processes as outlined above requires cooperation between mobile access panel operators and mobile network providers. Companies that enable technical solutions for SMS and MMS messaging make a good case for the realisation of this idea. However, a plan for the allocation of transaction costs between mobile panel owners and mobile access panel operators seems to be crucial.

6 Conclusion

The mobile channel holds promising potential for the field of market research due to the increased reachability of mobile phone users and the high penetration rates with mobile devices, at least in developed countries. Based on a general discussion on panel surveys and mobile surveys, the paper identified how to better take advantage of the characteristics of a panel design by making use of the value added by mobile devices, viz. mobility and reachability. The benefits associated with the utilisation of mobile devices, such as higher representativeness, cost and time issues as well as improved recruiting methods, were contrasted with the potential disadvantages (e.g. the threat of people not taking mobile surveys seriously). Finally, a mobile panel scenario was outlined to illustrate the envisaged future setting.

Future research will encompass a more detailed analysis and modelling of the actors, use-cases and processes described in the mobile panel scenario as well as the development of a business model for the mobile access panel operator. In addition, the design and implementation of a platform-independent prototype for conducting surveys on mobile devices and a corresponding mobile panel management software is planned.

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