

## The Future of Mobile Technology: Findings from a European Delphi Study

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### Abstract

*Mobile business relies on complex, competing, if not incompatible, and sometimes unreliable technology. These aspects have therefore often dominated its research assessment. This paper, however, reports from a primarily business application oriented study of the field.*

*A Delphi study, adapted for qualitative data and scenario building, was carried out across German-speaking Europe during 2002 and 2003. 52 'experts' participated in the study, giving their considered opinion on what, over the next 5 to 7 years, the dominant mobile technologies, user structures and applications would be. The key response to the technology question was that WIFI would be dominant, with cellular 3G still at least 4 years away. Furthermore, 2.5G will remain in full use as it is adequate for most B2E/B applications for the mobile workforce, which will account for 75% of users. The most likely users of 3G broadband are teenagers – who cannot pay for them. Very few consumer applications other than small payments and ad-hoc ticketing/reservations services were given a chance of success. These findings are in marked contrast to the 'official line' taken by the 3G providers in Europe.*

### 1. The importance of 'mobile business'

The wide distribution and availability of mobile technology resulted in many new opportunities for computer-aided applications. These mobile applications range from location-based service offerings to ubiquitous access to information, covering a broad

spectrum indeed. In general, the application of mobile technology allows an elimination of the spatial dimension of business processes, which subsequently can lead to a flexible integration of connected business transactions between different business entities. Mobile business is expected to have very high growth rates, with some predictions [17] showing that by the end of 2003 some 80% of information technology users will have come into contact with mobile applications during their daily work – in several contexts:

- Order taking and stock enquiries at customers' locality;
- Access to information systems and their data without reliance on traditional information technology infrastructure;
- Travel reservations over a (WAP<sup>1</sup> enabled) mobile telephone;
- Access to (personalised) mobile news and information services;
- Mobile marketing;
- Location-independent access to supply-chain management systems;
- Transport fleet management;
- Job-dispatch and scheduling to travelling/mobile personnel (such as service/maintenance, care givers, security personnel, delivery services, etc.);
- Sales/service people support, such as Mobile Customer Resource Management (MCRM) applications;
- Access to telemetric/remote control applications via a mobile handset;
- Support of software products and/or electronic components.

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<sup>1</sup> For fuller definitions of acronyms used in this paper please resort to [12]

It is a widely acknowledged opinion that inadequate knowledge of the opportunities presented by mobile technology is an inhibiting factor to mobile business in Europe. A Datamonitor study (cited in [17]) shows that a third of enterprises in Europe does not have a clear idea of how to use mobility in their business – although there is a clear expectation that the technology will be of great importance in the coming years. Across Europe, half of the respondents see the use of mobile technology predominantly in CRM, whereas two thirds of German respondents see it's main potential in business-to-employee (B2E) applications, such as data access to company internal information systems. Logistics is another area of expected growth. Generically, the concept of *Mobile Business* comprises technologies designed both to improve business processes and also to open new business opportunities for the enterprise. In both cases, mobile technology offers capabilities that go beyond the 'traditional' e-business concepts. In particular, these stem from three dimensions of the technology, namely:

1. Localisation of the business transaction partner – at a minimum to the cell his handset is in at the time and, in combination with geographical positioning systems (GPS), to much closer radius;
2. Ubiquitous access of business transaction partners, customers and/or employees;
3. Clear identification of the other party.

In addition, the existence of a – common – network operator can be used as an integral part of new business models, which can include such functionality as charging and billing through the operator's existing business operations and information systems.

However, the observed lack of a clear understanding of the technology is furthermore reflected in the lack of business strategies for its use in most firms. This is in conflict with the fact that mobile technology is used by more and more employees, in part also for business purposes – pointing to a growing risk of uncontrolled proliferation of the technology with all the related issues of standards and platform incongruence this may bring.

## 2. Selecting the Research Approach

This discrepancy between the conviction that mobile technologies will be of great import on the one hand, but a great lack of understanding of how and where to use it on the other creates a significant ambivalence among business people. For them, the field of Mobile Technology is characterised by

- Uncertain technology, often changing unpredictably (e.g. as forecasts of vendors are 'updated');
- High complexity of the applications themselves, which often involve several, not always fully compatible, technologies;
- Multiplicity of actors involved in mobile applications, of different size, stability and 'maturity'<sup>2</sup>, often with uncertainty about their ability to deliver or perform to specification/expectations.

Linstone and Turoff [13] maintain that a research approach based on multiple question and feedback techniques, such as a Delphi study, is appropriate in situations where:

- The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis;
- The problem at hand has no monitored history or little adequate information on its present and future development;
- Addressing the problem requires the exploration and assessment of numerous issues connected with various options where the need for pooled judgement can be facilitated by judgmental techniques;

This seems to encourage the use of a Delphi approach for the investigation into the future of mobile technology and its applications.

Traditionally, the Delphi method had been applied with a quantitative bias [8] often with the declared aim of consolidating the frequency distributions of related answer clusters and to reduce the variance among the responses. It involves a multi-stage process that requires the collection and synthesis of data from a panel of experts within the field of study interspersed with controlled, summarized information and feedback of

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<sup>2</sup> After the concept of '*vendor life-cycles*' set out in [18]

opinions derived from earlier responses ([21], [5, p. 10]). Since its development in the 1950's by the Rand Corporation for use in military planning and forecasting [19], the Delphi method has been applied many times to problems ranging from governmental planning and policy making [2] to healthcare [1] to climate change ([6];[20]). However, asking questions about such – practically – non-quantifiable issues as technology standards, application types and business models makes a quantitative approach inappropriate. Applying open coding methods (in the Grounded Theory tradition) for the conceptual analysis of qualitative responses seemed therefore a good complement to the iterative, feedback driven data and information capture inherent in the Delphi approach. In combination, both methods worked well in tandem. Arranging the ‘forecasts’ and ‘positions’ into interlinking scenarios (following a set of practical directions collated by Mißler-Behr [15]) seemed the best way to present and analyse the findings.

### 3. Purpose and design of the study

The Delphi approach chosen had as its main objective the systematic gathering of comments, judgements and ‘positions’ from ‘experts’ (academic researchers as well as practitioners) on a broad front of topics. The overall aim of the study was to bring about a better understanding of the situation and to arrive at a clearer picture of which technologies and applications will prevail in future.

Directed from the *Centre of Mobility and Information* at the *Universität Regensburg*, the first phase of the multiphase Delphi study was started in the second half of 2002. The panel of participants comprised researchers and academics, industry people from ‘application’ providers, in a ‘user’ capacity and representatives of the ‘supply’ industry (telecommunications companies and network operators) across German-speaking Europe<sup>3</sup>.

<sup>3</sup> i.e. Austria, Germany and Switzerland; a qualitative Delphi study is very language

The composition of the panel is shown in Table 1 below.

**Table 1. Panel of Participants**

Type	Organisations	Respondents
Practitioners <sup>4</sup>	26	37
Academics	8	15
Total	34	52

The Delphi approach selected was an iterative process of gathering opinions from the participants in a qualitative way, i.e. free-form answers (via e-mail) to six broad topics, namely:

1. Technology
2. User/customer structure
3. Applications
4. Business models
5. Market structures (eg alliances)
6. Influence of national/cultural factors

An argued prognosis was elicited about what would be dominant in each topic area in 5 to 7 years time. The combined results, summarised into scenarios, was then given back to each participant with a request for comment and an opportunity to adjust their position in the light of the other views/scenarios. This process was repeated twice in early and mid 2003, by which time positions had sufficiently solidified, showed minimal variations and thus warranted cessation of the iterations at this stage.

Of the 52 participants that followed the initial invitation, 20<sup>5</sup> participated in all three rounds. The return rate was consistently good, as Table 2 shows:

**Table 2. Return rates across the Delphi rounds**

Participants	Round 1	Round 2	Round 3
Academics	53%	60%	53%
Practitioners	71%	68%	55%
Total	65%	65%	54%

In the first round each participant supplied (often very extensive) free-form prognoses,

dependent and therefore best conducted over areas in the same language region

<sup>4</sup> The practitioners came from the following organisations (respondents): 6 service providers (8), 7 application providers (10) and 13 ‘users’ (19)

<sup>5</sup> 6 Academics and 14 Practitioners

opinions and comments to each of the topics. In the second round, in addition to prognoses, participants were also asked to give an ‘agreement score’ from 1 (“full agreement”) to 4 (“full dis-agreement”) for each of the summarised scenarios. In round three, each participant was asked to comment specifically individually on areas where s/he disagreed with the majority consensus opinion. Comments on agreement or equivocal factions of opinion were optional. Round one yielded some 350 distinct elements of opinion/prognosis, in reasonably distinctive clusters of consensus. The existence of such clear and often conflicting ‘camps’ solicited a massive reflux of comments, adjustments and new opinion in round two: nearly 10,000 individual items were received. Allocating the returns as to whether there was on balance agreement or not shows the following picture (Table 3):

**Table 3. Agreement Score Distribution**

<i>Agreement Score Range</i>	<i>%</i>
All Agreement	3%
Mostly Agreement	27%
Some Agreement	27%
“Agree to Dis-Agree”	34%
Some Dis-Agreement	6%
Strong Dis-Agreement	2%
All Dis-Agreement	0%

This shows a truly opinionated populus: whilst there is broad agreement in about half of the comments, there is, however, also some significant element of disagreement in two thirds (67%) of the comments. The strongest single group (more than a third) contains comments that were often diametrically opposed in content. Perhaps not surprisingly, some of the comments in the last round were quite emotional – participants were “shattered” and expressed “dismay” about the degree of opposing prognoses.

#### 4. Results of the Delphi Study

Only a minority of – often very general – statements enjoyed universal consensus, as the following examples show:

- Different (transmission) technologies will be available in parallel;

- A minimum of security standards will be present;
- Consumer applications such as ticket purchases will be successful;
- Network operators will use their billing systems to handle charges from third parties;
- Network operators will enter into revenue-sharing arrangements with third parties;
- Some mobile technology will be used to take on supervisory functions without human intervention;
- The large magazines and newspapers will extend offerings such as scene-guides, programme information (cinemas, theatres) to the mobile medium;
- Telematic services in the automotive sector – such as location-based grid-lock warnings – will use mobile technology;
- Developers of mobile applications will influence their customers to enter into a multi-channel strategy – similar to E-Commerce at present;
- Mobile technology offers start-ups joint-venture business opportunities with larger firms;

However, these topics are very general and mostly reflect the status quo – a point not lost on some of the participants:

*“It is interesting to see that consensus seems only obtainable on the present situation and it’s well known context”*

*“Consensus, alas, is only visible in statements that reflect certain generally accepted facts – but maybe that is what is needed to form a basis to build on for the future and therefore they could be – despite the generality – quite useful”*

*“A very thin consensus, really, [despite the numerous statements] it just describes the situation as it is now.”*

On most other topics, the participants separate into a number of largish ‘camps’ – dissent being defined as topics where there is neither a two-third majority agreeing nor an equal group disagreeing with a specific prognosis. A third of all the topics is within this definition – but as can be seen from the

sample of topics listed below, disagreement reigns strongly on some of the most significant developments in the mobile technology field:

1. No agreement could be reached on whether 2.5G or 3G will prevail (in the 5 to 7 year time window covered by the study), despite full acknowledgement that network operators are contractually bound to implement a 3G network during the prognosis horizon;
2. Despite the fact that it is consented that saturation coverage of WIFI<sup>6</sup> is highly unlikely, no agreement could be reached whether, and how significant a danger it poses to 3G (especially UMTS) technology;
3. The potential for *BLUETOOTH* is greatly disputed;
4. Discussion rages equally strongly about the significance of the “*public fear of radiation*” factor and whether this is centred on the handsets or the transmission masts;
5. The statement that only Internet/Web based technologies will prevail was advocated by half the participants – an equal number disputed it;
6. The shape, form and nature of future handsets covers the whole spectrum between specialist equipment for each function at one extreme and ‘one-handset-does-it-all’ technology prognosed at the other; colour versus monochrome, JAVA versus the rest, thin versus fat client technology were other points of spirited differences;
7. Protocols proved another area of contention; neither WAP, nor SMS/MMS (amidst debate whether MMS would ever appear at all), nor integrated service bundles like iMode could attract a majority of backers from the panel; conservative prognoses such as “*SMS will stay the main data medium for mobile technology a least until 2007*” or “*Next generation WAP will integrate iMode*”

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<sup>6</sup> This is the Anglo-American equivalent expression of ‘WLAN’ (Wireless Local Area Network), the more common label used in German speaking Europe. In the following sections, however, WLAN will be used – as this is the term the participants actually used

were strongly refuted by others and emotional comments like “*that would be truly horrible*” and “*never in a month of Sundays*”<sup>7</sup> up to “*God help us!*” accompanied the technology debate in this topic area;

8. User profiles differed widely; teenagers/young people, housewives, middle-aged professional people and employees of large companies at all levels were all equal contenders for the ‘prevailing user’;
9. Specific contention surrounded the argument that expectation of high sales for value-added – and thus more expensive – services were excessive; two examples are
  - (a) Location based services – seen as attracting high direct sales as a convenience product on the one hand and as a –free- entry-product for higher priced downstream products/service on the other;
  - (b) Mobile electronic markets are seen as a logical extension of the successful E-Commerce business model by one group – and as unsuitable for both technology and character of use by the other;

The role of the network operator was another very disputed topic as was the way in which revenue should be generated through advertising. This overlapped with some of the prognoses in the area of which business model would prevail over the next seven years. Whilst on the whole it was accepted that the new technology will necessitate the development of new business models, some of the more innovative uses of mobile technology were strongly disputed:

- Customer scanning in supermarkets combined with home delivery was questioned as a feasible assumption for retail behaviour;
- Revenue sharing between customer and provider, e.g. “...[a service provider] *say, a tailor, gets an order over the phone and sends/pays for a taxi to pick up alteration*”

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<sup>7</sup>Substitution for the German idiom “*nie und nimmer*”

*item*” is often roundly dismissed as “*far from reality*”;

**5. Future Scenarios**

In the following section we firstly provide an overview of the main trends in the ‘forecasts’ and ‘positions’ on technology, the user community and business applications. In the second part we attempt to bring all this together into a – more or less – coherent scenario of a possible future of mobile technology.

**5.1.Views on the Future Technology Trends**

Seven conceptual groupings emerged from the answers to the technology question.

The key response was that firstly, wireless technology would be dominant in the near future, long before 3G<sup>8</sup> (UMTS is still assumed to be 4 to 7 years away) will have found widespread acceptance. Furthermore, WLANs<sup>9</sup> are expected to dominate the urban landscape, relegating 3G to the countryside – a reversal of what is seen as the only economically feasible way of rolling out 3G. The other technologies too will remain in use: 2.5G seen as adequate for most B2E/B applications, which account for 3 out of 4 users. This makes it imperative that ‘roaming’ between technologies is possible.

There is a split of opinion whether specialised handsets for different applications or one type of general-purpose appliance will dominate the market. Table 4 below shows this summary.

**Table 4. Summary of forecast technology trends**

<i>Technology Trends</i>
UMTS/3G is still 4-5 years away before useful “industry-strength” applications will be available

<sup>8</sup> For fuller definitions of acronyms please resort to [12]

<sup>9</sup> Wireless Local Area Network(s)

<i>Technology Trends</i>
WLAN will dominate in the near term
WLAN and UMTS will co-exist; WLAN will dominate in the urban centres (“Hotspots”) and UMTS will be available in the remote/country regions
2.5G will be enough for most B2E/B applications and will dominate (70%)
Roaming between 2, 2.5 and 3G as well as WLAN will be of key importance
Small handsets, using a mix of technology standards and running specialised applications will emerge: <ul style="list-style-type: none"> <li>• Voice still on 2G,</li> <li>• WAP types services on 2.5G and</li> <li>• Multi-Media-Services (MMS)/“I-mode” type on 3G</li> </ul>
<b>Significant minority view:</b> The dominant appliance will be a hybrid of mobile-phone-type handset and personal-digital-assistant (PDA) - will be designed to cater for all applications;

**5.2. Who will be the dominant users?**

A similar conundrum for the network suppliers characterises the forecasts about the user community: the most likely users to want to avail themselves of the 3G wideband applications such as audio, video and multimedia messaging are the teenagers – who cannot pay for them. The user group with the largest growth rate are believed to be the young(ish) professionals, male and aged 25 to about 40. Their business uses can, however, be supplied adequately with 2.5G technology and they, too, will not pay for wider bandwidth.

This is borne out by current developments: The German and Belgian ‘i-mode’ networks (the closest approximation of 3G network services) will only be signing up some 300,000 users in their first year – compared

with Japan’s 30 million in three years. At an annualised rate, Europe this is a take-up rate of less than 3% of what i-mode experienced in Japan some three years ago ([4]; [16]). A significant minority view looks at a group of special-needs users as a major application area for 3G services (see Table 5.).

**Table 5. Summary of the forecast trends in the user community**

<i>User Community Trends</i>
UMTS users will be teenagers and young adolescents – however: majority of this age group will not be able to afford the cost of UMTS services on a broad base
Majority users will be male, 25-40 age group, professional/business executive types; using B2E type functionality – will run on WLAN and/or 2.5G; this will be where the large growth in mobile applications usage will come from;
Wideband services (WLAN/UMTS) will stay a minority; traditional telephone on 2G, occasional 2.5G application on a pay-by-transaction basis;
<b>Significant minority view:</b> Large group will comprise of special needs users: Handicapped, aged, convalescents, parents of children/adolescents;

**5.3. Forecasting Mobile Technology Applications**

When it comes to predicting what will be the most successful/useful, i.e. the “Killer” applications, there is no easy consensus visible. This is in line with postulates in the literature where a number of researchers (e.g. [3];[14]) dispute the existence of any specific singular ‘Killer Application’. Instead, Carlson et al. [3] point to a number of potentially ‘lethal’ bundles, which they characterise by whether the components can be distinguished and by the amount of synergy the components

generate<sup>10</sup>. They conclude that the synergy provided in such bundles will have a greater propensity to satisfy users’ demands within the limits of technology as well as within sensible economic boundaries.

There is some accumulation in the view that business applications will dominate, of the type that not only sales people can use, but also application clusters that will be of assistance to mobile workers, such as repairpersons and travelling supply contractors. In general, these applications will be useful, interactive and often essential for the mobile workforce in a wider context. There are very few consumer applications named that would provide a feasible customer base for mobile technology. Small payments and ad-hoc ticketing/reservations services are the more commonly mentioned consumer-type applications. This trend is summarised in Table 6.

**Table 6. Summary of the forecast trends in the mobile applications area**

<i>Application Trends</i>
B2E/B type applications centred around messaging: voice, e-mail, short-message-service (SMS) – will be upwards of 70% of all applications
Specific sub-group of B2E, B2B, E2E will involve applications for the mobile workforce (MRO <sup>11</sup> type work as well as Marketing/Sales type work
Small payments (B2C) and ticketing/reservation type applications (C2B)
<b>Large number of “Other” applications</b> (often information services of various types, sometimes with a Location-Based-Service characteristic; and multiple <b>minority views</b>

This aggregation of applications, however, can be seen as a close extrapolation of the existing applications on offer. Diederich et al.

<sup>10</sup> They named the first group *Killer Pizzas* or *Cocktails* (recognise ingredients or not), *Fondues* or *Soups* (operator needed or not) and the second group *Killer Bouquets*

<sup>11</sup> Maintenance, Repair and Operations

[7] set out a classification matrix that maps mobile technology applications by initiators and recipients. If the applications named in Table 6 above are positioned in this applications grid between Business, Consumers, Employees and Administration (i.e. local and central government) only a few of all possible cells are seen to be viable applications markets, as Table 7 shows. This confirms the analyses of German mobile applications carried out by [10] and [11].

### 6. Scenario Synthesis

Given the great area of discrepancy between diverse groups of experts, it is difficult to paint the picture of a scenario that can accommodate the differing and often diverging prognoses. Looking ahead to the still outstanding analyses of the third round, it seems doubtful whether more consensus will appear after the complete set of data has been included in the results.

These leaves two sets of conclusions to be drawn: one is that the composition of the panel and the design of the study have fostered this opposing set of opinions – due to either strong self-interest in pronounced groups with in the panel of participants, or as the consequence of

a failure in the method to engender compromise and fusion of a natural spread of opinion among experts. This is not likely: the dissent does not align itself with self-interest groups such as in all representatives of network services suppliers painting a wholly self-serving picture of 3G/UMTS dominance, etc. Furthermore, the method allowed anonymous feedback and gave ample opportunity not only to qualify the participant’s own position with respect to every detail and nuance of each topic, but also with taking a stance in principle on every group of prognoses.

The second option is that there really is a very high degree of dissent between expert stakeholders in the technology – users, researchers, suppliers and technology developers. Accepting this, one scenario that aligns all the participants to a greater degree rather than separates them can be sketched out as follows:

*Information providers such as publishers of magazines/newspapers will offer mobile services commensurate with their on-line*

**Table 7. Forecast applications trends**

>>>>>>	<i>Business</i>	<i>Customer</i>	<i>Employee</i>	<i>Administration</i>
<i>Business</i>	<b>B2B</b> Sales & Supply	<b>B2C</b> Payments	<b>B2E</b> Marketing & Sales	
<i>Customer</i>	<b>C2B</b> Ticketing & Reservations			
<i>Employee</i>	<b>E2B</b> Mobile Workforce		<b>E2E</b> Team Management	
<i>Administration</i>				

*N.B.: darker shading indicates higher expectation of successful applications in the area*

offerings, but taking into account the specific strengths (and weaknesses) of the medium. So, location based information and services will be offered, but most likely not in full multi-media form.

In most cases the services will be offered for free and only very specialised, high-value-adding services will be chargeable.

The business models behind these services will be conservative in outlook, but will be based in most cases on some form of revenue sharing – but not in a model that involves financing through push-type advertising;

The application that will run these services will be offered by specialised mobile content developers, who will often be in partnerships and alliances - of differing and often innovative forms - with big companies;

Security is seen as a big issue for users, so a minimum level of security standards is a sine-qua-non requirement for any form of mobile application;

Seamless switching between transmission technologies (e.g. WLAN-to-WLAN, WLAN-to-UMTS or other 3G such as CDMA), i.e. “roaming” will be critical for faster penetration of mobile applications;

Automation of products and services will make increased use of mobile technology – examples quoted are the automotive sector with telematic/telemetric applications and the banking and finance sector with mobile versions of “Internet Banking” products/services.

The key result of this study was the finding that other than in these very general terms, there seems to be no common thread to the opinions of what the mobile future will hold. This suggests that in large and important areas of this technology there is but a loose conglomeration of unique, single and individual opinions, without any significant consensus among the opinion leaders in the industry. In view of the huge, far-reaching - and now already sunk - investments that have been made in this field, this is a very surprising – and astonishing – result indeed.

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