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Inhalt:

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Kontakt

Safari GmbH Office Mannheim
Goethestraße 18 D-68161 Mannheim

Safari GmbH Office München
Reitmorstraße 4 D-80358 München

Tel: +49 - 621 - 18 144 720

Fax: +49 - 621 - 18 144 740

info@safari-gmbh.de
www.safari-gmbh.de

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The Compass Acceptance Model for the analysis and evaluation of mobile services

Michael Amberg, Markus Hirschmeier and
Jens Wehrmann*

Department of Economics,
Friedrich-Alexander-University of Erlangen-Nuremberg,
Chair for Business Information Systems III,
Lange Gasse 20, 90403, Germany
E-mail: amberg@wiso.uni-erlangen.de
E-mail: hirschmeier@wiso.uni-erlangen.de
E-mail: wehrmann@wiso.uni-erlangen.de
*Corresponding author

Abstract: User acceptance is increasingly regarded as a critical success factor for mobile services. Although several acceptance models exist and help to increase understanding the different influencing factors on user acceptance, they are not suitable to support the development of mobile services.

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Keywords: mobile services; user acceptance; acceptance models; TAM; TTFM; Compass Acceptance Model; service design.

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Biographical notes: Professor Dr. Michael Amberg, born in 1961, is the chair holder of Business Information Systems III at the University of Erlangen-Nuremberg. Earlier, he headed the chair for Business Information Systems at the Technical University of Aachen (RWTH). His research interests focus on business engineering, business information technology and mobile business.

Markus Hirschmeier, born 1973, is working as a Teaching and Research Assistant at the Chair for Business Information Systems III at the University of Erlangen-Nuremberg since October 2001. He studied physics and economics at the Technical University of Aachen. His topics of research include the evaluation of new technologies and the economic evaluation of IT investments.

Jens Wehrmann, born 1975, is working as a Teaching and Research Assistant at the Chair for Business Information Systems III at the University of Erlangen-Nuremberg since October 2001. He studied electrical engineering and business economics at the Technical University of Aachen. His main research topics focus on context aware applications, development of adaptive software, mobile application management and mobile business.

1 Introduction

The mobile market is currently in the phase of restructuring. The introduction of the UTMS network was related to high expenditures. These expenses have to be compensated with revenues from successful applications and mobile services, which contribute to a positive ROI in the nearest future. The past has shown many successful and non-successful mobile services. On the one hand, mobile services like traffic navigation or videoconference services are still waiting for their economic breakeven. On the other hand, multiple mobile services like short message service (SMS), ring tone and logo download services can be found, which have not been predicted to have a strong economic success. It becomes obvious that one of the most important factors for the success or failure of mobile services is the user acceptance. In order to minimise the barriers to success, a substantial and in-depth consideration of the critical factors for the user acceptance is necessary.

Since the introduction of computer systems, researchers developed several theories and models for user acceptance (see Figure 1). Different aspects have been considered to explain the user acceptance. In one of the most common acceptance models, the Technology Acceptance Model (TAM) [1] the perceived usefulness and the perceived ease of use have been considered as relevant factors for the evaluation of user acceptance. The Technology Task Fit Model (TTFM) [2] explains the acceptance as a consideration of the performance of a system in relation to the specified tasks. The acceptance model of Degenhardt [3] is based on the acceptance analysis of videotext applications. The TTFM-related factors, i.e. tasks, system and user characteristics, are expanded by factors of the contextual conditions. Kollmann [4] categorises the acceptance in three different segments: attitude, behaviour and utilisation. Herrmann [5] separates acceptance factors from general factors, the basic conditions.

Most acceptance models concentrate on some aspects of user acceptance and provide a detailed analysis structure for these aspects. An analysis is very time consuming and the in-depth results are not adequate to improve application design. The existing models were also not designed to integrate the acceptance analysis and evaluations into an overall methodical approach for the development of services.

Figure 1 Overview of existing acceptance models

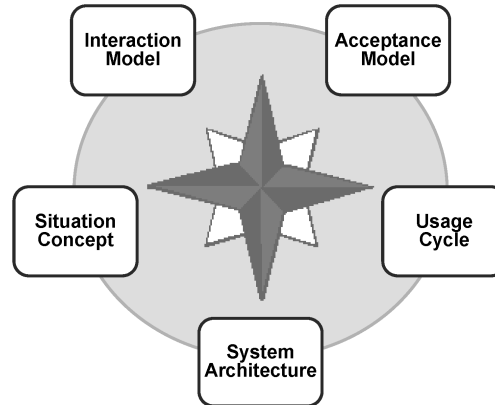
	Regarded Influencing Factors	Short Summary	Suitability for mobile Services
Technology-Acceptance-Model (TAM), Davis, 1989	(perceived) Usefulness, (perceived) Ease of Use	Disjunction between Benefit and Effort as basic criteria for Acceptance Decision.	Suitable, but insufficient consideration of Mobility.
Technology-Task-Fit-Model (TTFM), Goodhue, 1995	Technology, Task, Individual	Task oriented Approach, that addresses the Employee's Acceptance of IT-Solutions.	Factor "System Capability" is difficult to transfer to mobile Services.
Degenhardt, 1986	Tasks, System, User Characteristics	Regards the Acceptance of Communication Services at the example Videotex (BTX).	Difficult to transfer because of the Task Orientation (cp.TTFM).
Kollmann, 1998	Acceptance of Attitude Acceptance of Behavior, Acceptance of Use	Regards the Introduction of Telecommunication and Multimedia Systems.	Concerns different Targets Multi Level Hierarchy is suitable for mobile Services.
Herrmann, 1998	Widespread Catalogue of criteria	Regards the Acceptance of Media Services concerning the User Competence	Disjunction of "Acceptance-" and "General Factors" is suitable for mobile Services.

2 The Compass approach

Compass (a COoperation Model for Personalised and Situation dependent Services) is a methodological approach that specifies a conceptual framework and the fundamental requirements for a service platform to cooperatively develop and provide situation-dependent mobile services. This approach pays attention to the special market situation and considers legal, economical and technical conditions, which are relevant for developing and providing mobile services. Such specialised approaches may affect productivity and service quality positively and finally lead to higher usage intensity of mobile services and increase the revenue of service providers and mobile network operators.

The Compass approach integrates five major components (see Figure 2) and is presented in [6,7] in more detail. The consideration of these components in a balanced way is proposed to be a critical success factor for the development of mobile services:

- the *Compass situation concept* structures the mobile usage context and makes the situation information accessible for the cooperative service production
- the *Compass interaction model* describes the flow of services and information between the cooperation partners
- the *Compass usage cycle* specifies the process to provide situation-dependent mobile services and describes several service types
- the *Compass system architecture* details the technical adoption of the situation concept and proposes an underlying system infrastructure
- the *Compass Acceptance Model (CAM)* provides an instrument for the analysis and evaluation of user acceptance in order to improve the design of mobile services.

Figure 2 The Compass approach

The CAM is belatedly added to the Compass approach in this paper because of the importance of user acceptance analysis and evaluation during the development of mobile services. The results of user acceptance analysis are considered to have a significant impact on all other components of the Compass approach. If, for example, the acceptance analysis reveals that the costs of a mobile service have a strong affect on potential users, the cooperation partners may look for strategic alliances to lower these costs (Compass interaction model) or further customise their services (Compass usage cycle). If the acceptance evaluation reveals that potential customers feel uncomfortable with the retrieval of their personal data, the accessibility to personal data might have to be limited (Compass situation concept). Users with concerns about data security might be satisfied with higher technological security standards (Compass system architecture).

3 The Compass Acceptance Model

The CAM is an instrument designed for the analysis and evaluation of the user acceptance of mobile services. The fundamental design criteria can be summarised as follows:

- *Applicability during the whole product lifecycle.* The analysis and evaluation of the user acceptance is important in all phases of the product lifecycle. In the early phases of service development, the derived knowledge can be used to influence the service design (*ex ante* analysis). In the late phases and during the usage of a service, the derived insights can be used to determine exactly the strengths and weaknesses of a service regarding the user acceptance and reveal customising potentials (*ex post* analysis).
- *Balanced consideration of relevant influencing factors.* For a differentiated analysis and evaluation of user acceptance a balanced consideration of relevant influence factors plays an important role. An acceptance model has to support a systematic identification of important, measurable and independent acceptance criteria.

- *Use as a permanent controlling instrument.* The analysis and evaluation can be conducted either once or multiple times. The analysis at a specific point of time can be seen as an overall position reckoning to reveal the strengths and weaknesses of a mobile service. An iterative analysis and evaluation monitors the effects and impacts of the actions taken. By this, an acceptance model contributes to the quality assurance of a mobile service.
- *Adaptability to individual requirements of a service.* An acceptance model should be able to provide a generic framework that can be specialised according to the individual requirements of a mobile service. For example, users in private and business life may have completely different requirements and needs. Private users might focus more on playability, while business users concentrate on job performance of a mobile service. An acceptance model should be flexible enough to provide a methodical framework for mobile services independent of the special aims.

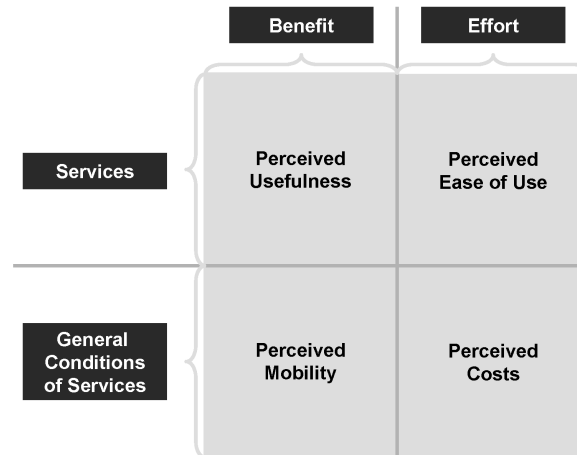
We assume that the listed design criteria are helpful to integrate user acceptance analysis and evaluation effectively and efficiently into the development of mobile services. In the subsequent sections, the Architecture and the Process Model of the CAM is outlined.

3.1 Architecture of the Compass Acceptance Model

The structure of the CAM is based on the principal idea of the balanced scorecard (BSC) [8]. Accordingly, the acceptance model helps to define a balanced set of individually measurable acceptance criteria for the analysis and the evaluation of the user acceptance. The CAM uses a meta-structure to provide a sharp and clear definition of relevant acceptance dimensions. The meta-structure of the CAM consists of the following complementary and orthogonal categories:

- *Benefits and Efforts.* We distinguish two categories that include all positive and negative aspects for the user acceptance. The categorisation in *Benefits* and *Efforts* is confirmed in many models for user acceptance as a fundamental cognitive consideration in human decision processes.
- *Service and General Conditions of Services.* The product-specific aspects of user acceptance are subsumed in the category *Service*. In the complementary category *General Conditions of Services* all surrounding social, cultural, economical and technical conditions are considered, which also play an important role for the user acceptance of a service [3,5].

These categories lead to four dimensions that are relevant for an in-depth analysis of user acceptance: *Perceived Usefulness*, *Perceived Ease of Use*, *Perceived Mobility* and *Perceived Costs* (Figure 3):

Figure 3 Dimensions of the Compass Acceptance Model

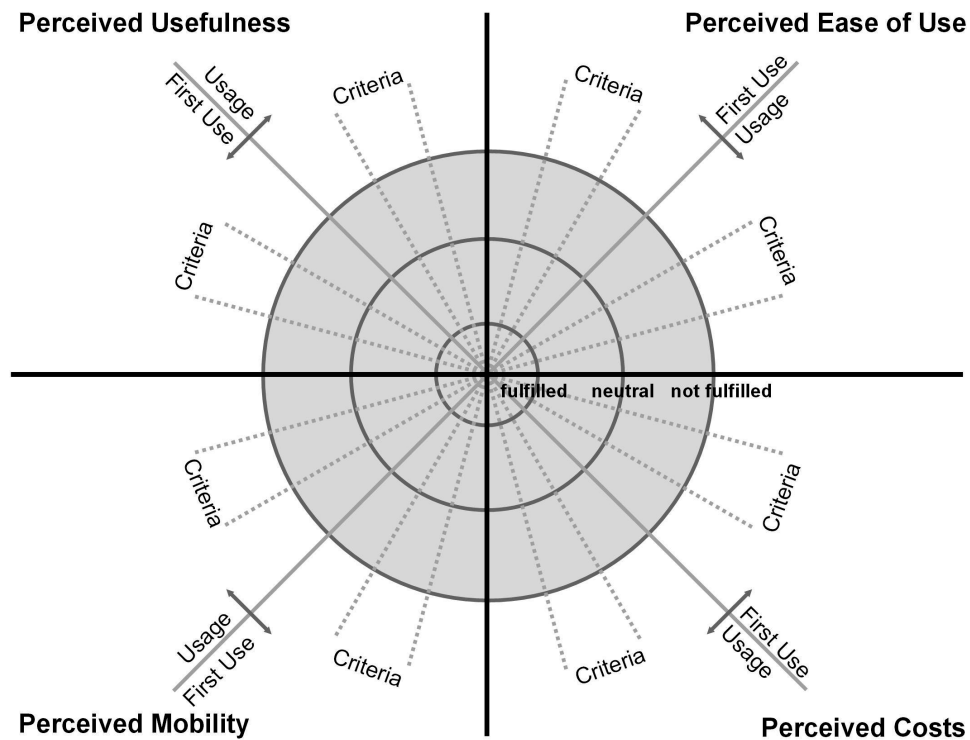
- *(Perceived) Usefulness.* The dimension build by the categories *Benefits* and *Service* describes the perceived usefulness of a service. Indicators measuring this dimension might be perceived information quality and quantity or conformity of expectations.
- *(Perceived) Ease of use.* The dimension characterised by the categories of *Service* and *Efforts* can be identified with the perceived ease of use, the degree to which a person believes that using a particular service would be free of effort [9]. In this context, the ease of use can be interpreted as an effort for the use of a service. Indicators measuring this dimension are, for example, the ease of configuration or first log-in, overall handling and menu navigation.
- *(Perceived) Mobility.* The categories *Benefits* and *General Conditions of Services* lead to the dimension of *Perceived Mobility*. The consideration of the general conditions of a service is important in the context of mobile services as their acceptance highly depends on the economical, social and technological perspectives [10]. Indicators measuring this dimension might be network coverage, accessibility, technological infrastructure, etc.
- *(Perceived) Costs.* This dimension is formed by the categories *Efforts* and *General Conditions of Services*. Mobile services can lead to profound changes in technological and social systems causing monetary and non-monetary costs. Costs transparency, data security and health risks are considered as appropriate indicators.

These four dimensions focus on the subjective perception. This emphasises the valuation of a service by the end-user's subjective point of view. The first two dimensions *Perceived Usefulness* and *Perceived Ease of Use* can be found in the TAM [9]. The meta-structure of the CAM indicates that the TAM model focuses mainly on the characteristics of a service itself. This focus is not sufficient for an advanced and balanced analysis and evaluation of mobile services as they highly depend on the contextual conditions of a service. The contextual conditions are regarded explicitly in some acceptance models as in [3,11]. The category *General Conditions of a Service* subsumes this expanded view. With the presented framework, the CAM meets the demands of completeness and balance.

The specific characteristics of mobile services require a further refinement of the dimensions. According to Kollmann [4], the subdivision in *First Use* and (*Regular*) *Usage* is reasonable. The first use is a kind of a barrier for the repeated usage of a service.

The resulting structure supports a systematic identification of acceptance criteria. According to the BSC approach, the intention is to find a few aggregated criteria with a high significance. The criteria must meet the requirements of sustainability, measurability, achievability, reasonability and timeliness. A general problem of social surveys is to translate the criteria into precisely measurable and linear independent variables. We understand the acceptance criteria as abstract class of measurement categories, which consists of one or more variables. In the following, we refer to the measuring variables as indicators according to empirical survey terminology. Commonly, interviews or questionnaires are used to survey the indicators' values. Weighting factors allow balancing the influence of the indicators. An equal number of indicators in each dimension often help to ensure a balanced analysis (e.g. as shown in Figure 4). If an inhomogeneous number of indicators in different dimensions are necessary, the model can still be applied by using appropriate weighting factors. Goals for every single indicator should be determined before the actual start of the survey, in order to compare these to the empirical results.

Figure 4 Visualisation of the Compass Acceptance Model

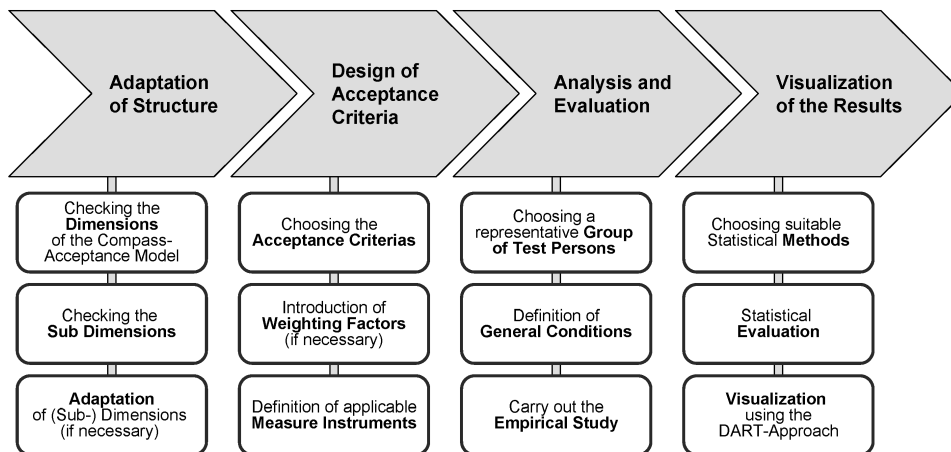


Finally, the results of an analysis and evaluation are typically visualised by a spreadsheet for detailed analysis and by a spider chart similar to a DART target for a summarised representation (see Figure 4). For visualisation by a spider chart, the eight dimensions are equally arranged. The scaling is adapted appropriately according to the distribution of the measurement results with its positive orientation towards the origin. For a better visualisation of the consequences of the results, each scale can be subdivided in *fulfilled* (positive), *neutral* and *not fulfilled* (negative) areas.

3.2 Process model of the Compass Acceptance Model

The application of the CAM requires some typical activities. The essential activities are summarised in the Process Model of the CAM. The Process Model considers all phases beginning with the development of acceptance criteria over the measurement of relevant indicators to the evaluation and visualisation of the derived results. This characteristic distinguishes the CAM significantly from existing acceptance models, which do not provide an explicit process model for the development of relevant acceptance criteria. The process model consists of four fundamental phases (Figure 5):

Figure 5 Process model of the Compass Acceptance Model



- 1 *Adaptation of structure.* The first phase adapts and refines the basic structure of the CAM according to the specific characteristics of mobile service. A verification of the chosen dimensions and subdimensions is recommended before relevant acceptance criteria are defined.
- 2 *Design of acceptance criteria.* In this phase, the acceptance criteria, the indicators, the weighting factors, the scaling (linear, logarithmic, etc.) and the survey method (questionnaire, interviews, etc.) have to be defined. The design is completed with a proof of plausibility and measurability of the defined criteria.
- 3 *Analysis and evaluation.* After choosing an appropriate (representative) test group, the conditions for the evaluation are defined. In the next step, a survey can be conducted.

- 4 *Visualisation of evaluation results.* The results of the test group are analysed and evaluated with statistical methods and visualised according to the DART approach.

The quality of the results generally depends on the time when the service is evaluated. Existing mobile services are in general easier to evaluate than abstract ideas about future products. Earlier, development stages with no existing prototypes make it hard to analyse the user acceptance. Additionally, it has to be considered that the importance of acceptance criteria can change during the different development phases. As the evaluation depends on social and cultural influences (What is currently 'en vogue'?), an iterative application of the CAM is recommended. Generally, the service provider has to decide how often and when to apply the CAM for evaluating a specific mobile service.

4 Application of the Compass Acceptance Model

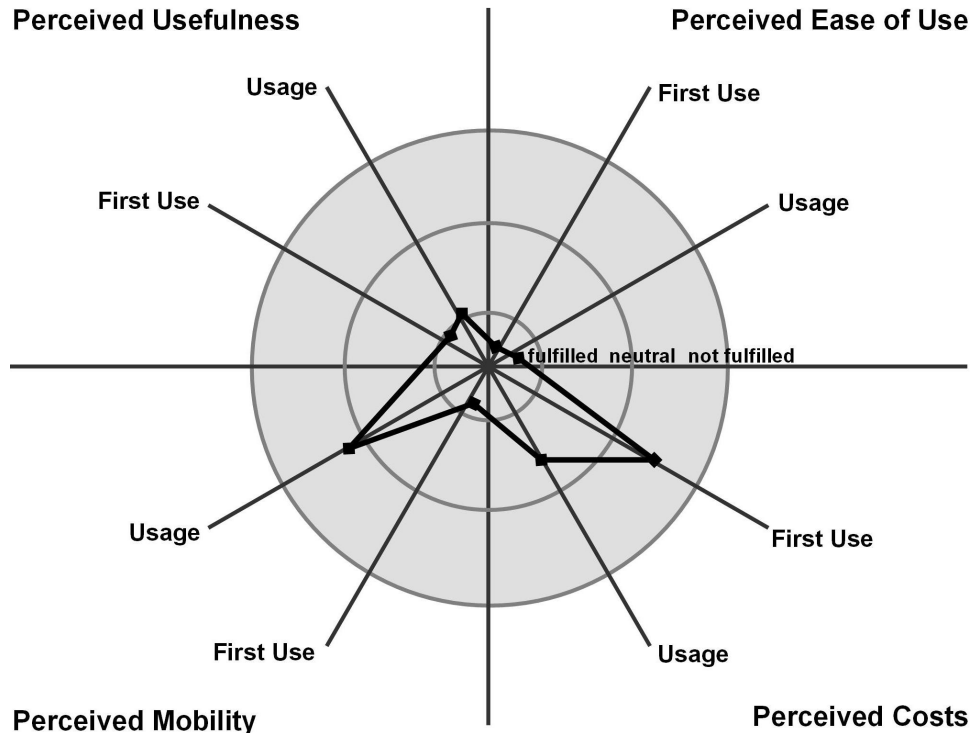
We will illustrate the application of the CAM with a fictive example of a mobile service: *Mobile Train TV*. The example represents an *ex ante* evaluation of a mobile service in an early phase of development that is intended to improve service design. The *Mobile Train TV* service provides travellers an individualised digital TV programme in trains with a variety of films, series and information via a WLAN solution. This service is planned to be received and viewed on the travellers' own small mobile devices like the Compaq iPAQ and a WLAN adapter card. The service provider wants to cover part of the costs by advertising, but probably the customer needs to pay a small fee for the service too.

For the survey, a small number of criteria were defined in order to keep the evaluation process short and comfortable for the participants. For the dimension of *Perceived Usefulness*, user acceptance, programme content and interactivity are relevant criteria, for the *Ease of Use* dimension it was navigation, display size and log-in procedure, for the *Mobility* dimension it was power supply and availability and finally for the *Cost* dimension it was willingness to pay and advertisement acceptance.

The service was evaluated in a survey by train passengers (a total of 170 participants). The demographic profile of the participants was equally distributed over age, sex, family status, profession and income. All interviewees were presented a prototype that allowed them to experience the service. The participants were then asked to rate the outlined criteria as well as to weight the criteria according to the perceived importance.

An overview of the aggregated result of the evaluation is shown in Figure 6. The perceived usefulness can be rated to be high, as 78% of the interviewees were excited about the opportunity of having an on-demand programme that can be individualised. A total of 73% stated that they were interested in using the service frequently. Details of the evaluation results can be used for further refinement of the mobile service. A service provider, for example, can come to the following simplified conclusions:

Figure 6 Evaluation of the application Mobile Train TV



- Concerning *Perceived Usefulness*: the perceived usefulness of the service is high and there is an interest in using the service. Internet access would be an interesting added value.
- Concerning *Ease of Use*: the respondents did not see a problem in connecting to the network and found the display size to be acceptable.
- Concerning *Mobility*: a critical issue in the usage of the *Mobility* dimension is the short standby time of today's mobile devices. A sufficient energy supply in the train compartments would be mandatory.
- Concerning *Costs*: the prices for the end-user devices are regarded as high, thus limiting the number of potential customers. A fee for using the service would not be easily accepted.

The negative ratings in the *Mobility* and *Costs* dimensions reveal that there are some serious business concerns, although the service itself is regarded to be useful and easy to use. The business plan has to be modified to provide rental service of mobile devices in the beginning. To determine an appropriate payment model further field studies are necessary.

Furthermore, this example explicitly shows that the evaluation of the mobile service would have been much more positive if it has been evaluated with the TAM approach. The evaluation with the CAM is more differentiated and considers some critical aspects that influence the acceptance of this mobile service significantly.

5 Summary and outlook

We introduced the CAM as an instrument for the analysis and evaluation of the user acceptance for mobile services. The CAM is characterised by a structure that helps to identify systematically a balanced set of important, individually measurable and independent acceptance criteria. The application of the CAM supports both the product development cycle as well as the product lifecycle. As the CAM can be adapted to the mobile services, it is possible to monitor the acceptance in early phases (where requirements and general conditions can rarely be described in detail) as well as in late phases (where prototypes and experiences of the mobile services already exist). When the CAM is used iteratively it helps to improve mobile services permanently. Furthermore, it is applicable for business and private users.

The application of the CAM is guided by a process model that supports all phases from the development of acceptance criteria over the measurement of relevant indicators to the evaluation and visualisation of the derived results. These results are visualised by a spreadsheet for detailed analysis and by a spider chart similar to a DART target for a summarised representation.

Using the CAM reveals several insights:

- *User types and user behaviour patterns.* Analysing the different types of users provides deeper insight into user acceptance. Social-demographically diverse users generally differ in lifestyle and the structure of the social network, which lead to characteristic user behaviour. Different user groups can also be retrieved statistically *ex post* by a cluster analysis. However, cluster analyses are only feasible if the parent population is large enough. It is important when analysing the different types of users that the users had the opportunity to gather enough experiences to develop differentiated usage behaviours.
- *User acceptance trends.* The continuous use of the DART-valuation is helpful to monitor how meaningful indicators change over a period of time. Evaluation results depend on social and cultural influences (What is currently en vogue?). An iterative application of the CAM is recommended. A detailed and reliable comparison is possible if the indicators are used in a constant and unchanged way. The quality of the results generally depends on the characteristics of the service that is analysed and the time when the service is evaluated. Existing mobile services are easier to evaluate than abstract ideas about future products. Earlier development stages with no existing prototypes make it hard to analyse the user acceptance. Generally, the service provider has to decide how often and when to apply the CAM for evaluating a specific mobile service.
- *Verification of strengths and weaknesses.* Target values for every single indicator have to be determined before the actual start of the survey, in order to compare these to the actual values of the user acceptance indicators. The comparison is useful to derive actions and measures to improve the user acceptance. However, a general statement is not possible. Some results might even require not only one action for a single indicator but also a combination of several actions and measure to increase the user acceptance. Examples for actions are a more thorough evaluation of the customers' needs, the improvement of ergonomics, the matching of the different business models and strategic alliances, etc.

- *Perceived importance.* Weighting factors allow a flexible consideration of acceptance criteria according to the requirements and valuation of the user. Generally, weighting factors for every single indicator have to be determined before the start of the survey. But weighting factors can also be retrieved empirically according to the user's perceived importance of different acceptance indicators. The comparison of nominal and empirical weighting indicators is useful to derive actions and measures to improve the user acceptance. Additionally, it has to be considered, that the importance of acceptance criteria can change during the different development phases (cf. trend analysis above).

The application of the CAM leads to a more comprehensive understanding of factors that are responsible for user acceptance of mobile services of the third and fourth generations.

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