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Evaluation of Future Mobile Services Based on the Technology Acceptance Model

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EVALUATION OF FUTURE MOBILE SERVICES BASED ON THE TECHNOLOGY ACCEPTANCE MODEL

Abstract

Mobile telecommunication operators are under great pressure to launch new profitable data services. However, most of the mobile data services have fallen short of the expectation and have failed on the market. One important reason for the failure of mobile data services is the difficulty to assess user needs and requirements in advance. This paper suggests to use the Technology Acceptance Model (TAM) to approximate the user acceptance of non-existing mobile services. The TAM model is applied to assess the potential future acceptance of five mobile broadcasting service scenario. The results show that TAM is a helpful model to evaluate the user acceptance of future services. However, the more innovative the new service is, the less accurate is the model. The results show furthermore that the most influential aspect on the future intention to use is the perceived value of the future product.

1   INTRODUCTION

Mobile telecom operators are under great pressure to launch new data services due to two reasons: On the one hand traditional sources of revenues as voice communication are constantly decreasing. In this context, mobile data and broadcast services are considered to have high future potential to compensate for the losses from voice communication. On the other hand the deployment of wireless infrastructure requires significant investments and determines the business strategy of the network operator for the following years. In many cases, the pressure to capitalize on the infrastructure investments of the past leads to additional investment in developing consumer services (Wohltorf 2004). As a result, the mobile service industry has been characterized by an intrinsic dynamic and the serial launch of various innovative services. Most of these new Mobile Services have fallen short of the expectations and have failed on the market (Carlsson et al. 2006), (Nysveen, Pedersen and Thorbjornsen, 2007).

One important reason for the failure of the services is that it is difficult to assess the needs of the users and their willingness to use the service in advance. Many mobile services are new and potential users can not easily compare them with existing experiences. In addition, many services as for example mobile TV or mobile games are furthermore of an entertaining character and there is no explicit demand for them. Thus, it is difficult to assess specific user requirements for mobile services. As a result, throwing mobile services "on the market in a 'Trial and Error' manner" (Stanoevska-Slabeva and Högg, 2005) has been the typical approach of the mobile service industry for launching new services.

In this paper a new approach for assessing potential adoption of future mobile services is proposed based on the Technology Acceptance Model (TAM). The TAM model has already been applied for analyzing the adoption and acceptance of existing mobile services. Several studies have shown that TAM can explain the influence of different factors on the customers' intention to use mobile services (Cheong and Park, 2005; Hung et al., 2003; Kwon and Chidambaram, 2000; Lu et al., 2003; Nysveen et al. 2005). However, one major problem in the telecom industry is to assess the potential future adoption of mobile services that are not launched on the market yet.

The goal of the research presented in this paper is the exploration of the applicability of the TAM model for evaluation of potential future mobile services. In order to achieve the goal, an exploratory empirical research was conducted based on the example of mobile broadcasting services (Bakhuizen & Horn 2005).

Mobile broadcast services are in general based on the ability to deliver, i.e. to broadcast content to mobile users. Mobile TV has been launched during the years 2006 and 2007 in many European countries as one first generation mobile broadcasting service. Mobile TV is the transmission of traditional and on-demand audiovisual content to a mobile device. It includes live and time-shifted TV on mobile devices.

There are several design options for a potential future second generation of mobile TV: for example one enhancement might be interactive mobile TV, another mobile TV based on user generated content and communities. The goal of the research presented in this paper is the assessment of the future intention to use potential second generation mobile broadcast services based on the TAM.

The research described in this paper started with the design of potential future mobile broadcasting services. The potential intention to use the mobile services described by the scenarios was evaluated based on an adjusted TAM model for mobile services. The analysis revealed that TAM is a suitable approach to evaluate the potential intention to use mobile services. The results also showed that the most influential factor is the perceived value of the future services.

The paper is structured as follows. In the beginning of section 2 the Technology Acceptance Model is discussed and applications of the TAM in the mobile telecommunication industry are presented. In

section three the research approach is described followed by the results in section 4. In section 5, the implications and the demand for future research are discussed.

2 RESEARCH DESIGN

2.1 Technology Acceptance Model

The Technology Acceptance Model (TAM) was introduced by Davis (1989), who showed the influence of the perceived ease of use and the perceived usefulness of a technology on the users' attitudes towards using the technology and subsequently on the actual usage thereof. Legris et al. (2003) describe the main objective of the TAM "to provide a basis for tracing the impact of external variables on internal beliefs, attitudes, and intentions". The TAM is founded on the Theory of Reasoned Action (TRA) described by Fishbein & Ajzen (1975) and the Theory of Planned Behavior (TPB) coined by Ajzen, (1991).

The proposed TAM model was widely accepted by the information system research community and was further verified and extended by other researchers. Venkatesh et al. (2003) reviewed eight popular models and combined them to the Unified Theory of Acceptance and Use of Technology (UTAUT) to explain the acceptance of information systems. Most of the research in technology acceptance was done on technologies that were introduced into organizations and could therefore only partially describe the completely voluntary usage of technologies such as the mobile phone by independent end users. Only recently the technology acceptance theory was applied to Mobile Services. TAM has been used as research framework for many studies in the field of mobile telecommunication. The following table shows selected studies and the empirically verified factors.

Reference	Object	Intention to Use	Factors (factor loadings)
Cheong & Park (2005)	Mobile Internet	0,678	(1) Perceived usefulness (0,9357) (2) Perceived ease of use (0,9047) (3) Perceived playfulness (0,9022) (4) Perceived price level (0,9362) (5) Perceived contents quality (0,9362) (6) Perceived system quality (0,9194) (7) Internet experience (0,9367)
Hung et al. (2003)	WAP services of user and non -user	0,38	(1) User satisfaction (2) Personal innovativeness (3) Ease of use (4) Usefulness (5) Peer influence (6) External influence (7) Self-efficacy (8) Facilitating condition (9) Attitude (10) Subjective norm (11) Perceived behavioral control (12) Intention
Kwon & Chidambaram (2000)	Cellular phone adoption and use	n/a	(1) individual characteristics; (2) perceived ease of use; (3) perceived usefulness (4) enjoyment/fun (5) social pressure.
Lu et al. (2003)	Meta analysis	n/a	(1) Technology Complexity

Reference	Object	Intention to Use	Factors (factor loadings)
	Mobile Internet		(2) Individual differences (3) Facilitating conditions (4) Social influences (5) Wireless Trust environment
Nysveen et al. (2005)	Mobile Services	0,723	(1) Composite reliability (2) Expressiveness (3) Enjoyment (4) Usefulness (5) Ease of use (6) Normative pressure (7) Behavioural control (8) Attitude (9) Intention
Yang (2005)	Mobile Services	0,703	(1) Perceived usefulness (2) Perceived ease of use

Table 1.   Overview of selected studies

Even though the different versions of the TAM might look very diverse, they have a common nucleus. They all examine a person's individual reaction towards using information technology and mention an additional step called the "intention to using information technology" before turning to the actual use of information technology (c.f. 1).
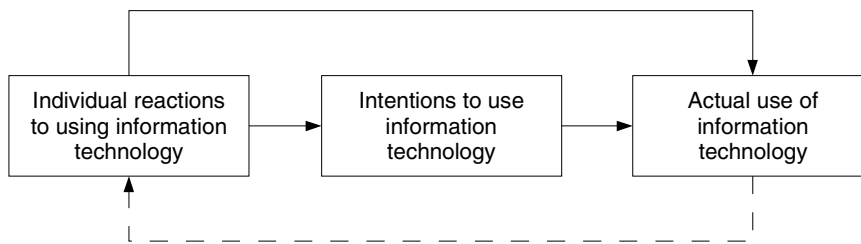

Figure 1.   Basic Concept Underlying User Acceptance Models (Venkatesh et al., 2003)

All models have in common that the intention to use a technology is depending on the person's individual perception of the technology and its value and ease of use. Therefore, it is important to consider not only the technology but also the value perception of the potential customers. The potential user attitude towards the technology determines the intention to use the technology. Therefore, research into people who never used a service is necessary and can provide valuable insights into the success of a service.

The above described studies all referred to existing services. Dependent on the study, non-users or users were interviewed. In this paper the applicability of TAM for future mobile services is assessed.

3   THE RESEARCH APPROACH

The research involved the following activities:

- First the relevant scenarios for future broadcasting services were designed and selected
- Then the specific TAM model was chosen
- Finally the questionnaire was developed based on the chosen TAM.

The results of each steps are presented below.

3.1   Potential Second Generation Mobile Broadcast Services

First ideas for potential second generation mobile broadcast services were developed based on an extensive literature research, expert interviews, and focus groups. The objective was to identify relevant service scenarios for future mobile broadcast services. In total, 31 service scenarios were identified. Out of these scenarios five were selected to be tested in the online survey based on results of 20 expert interviews and 4 focus groups. The experts and the participants in the focus group prioritized the proposed service scenarios. Two focus groups were conducted in Switzerland, one in Paris / France (1) and one in Bonn, Germany.

The chosen five mobile broadcasting service scenarios are described briefly below:

Visual Radio is the enhanced version of traditional radio. Visual Radio does not only broadcast the regular radio program but also features additional elements. For example: during news programs photos related to the news are shown; while music is played additional information as CD covers and the possibility to download the songs are provided; during sports broadcasts photos and statistics are shown (goals, etc.) and during weather forecasts weather charts are provided.

The **Interactive TV** scenario describes an elaborate form of interactive Mobile TV. Apart from watching the content of the TV stations they know from their regular TV, users have access to an Electronic Program Guide (EPG) which allows them to see the program schedule for the next couple of days in an easy and intuitive manner. The EPG also allows for the recording of a show with a simple click. Other interactive enhancements are: voting during a show and download of ring tones related to a show.

Content Casting is a subscription based service. Users can subscribe to periodically released content such as podcasts, video podcasts or news shows, which are automatically sent to the users' device. Instead of downloading the files on the computer and transferring those to the mobile device the content will always be ready to be consumed on the mobile device.

The **Mobile Community** is a platform that allows for easy interaction between users. It is the extension of online communities into the mobile world. It will allow for the sharing of user created content (like e.g. YouTube or Flickr do it on the internet) but it also allows for live streaming from one mobile phone to many other mobile phones.

The **Real-life Tagging** scenario describes a service that includes the "real world" into the user experience. Users can set tags according to their specific location and/or put a sticker somewhere (2D-Barcode). That way they can enrich the environment with additional information (e.g. culturally interesting places or just meeting points for friends).

Figure 2 (c.f. 2) shows the five scenarios and their degree of innovativeness with respect to the estimated market readiness.
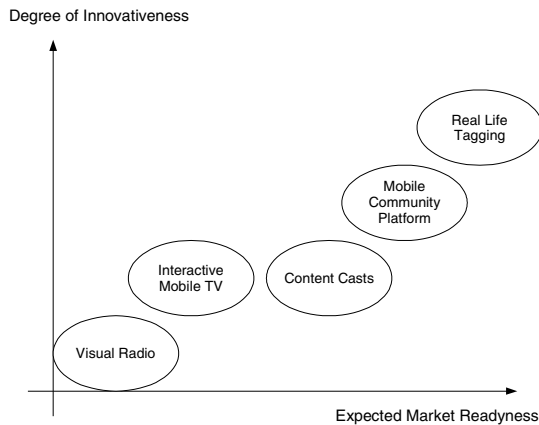
Figure 2.   *Degree of innovativeness and market readiness of the usage scenarios*

3.2   The TAM Research Model

In order to apply the TAM model, it is necessary to operationalize its components in accordance to the specific characteristics of the technology under consideration. The original TAM suggested by Davis focused on the two components perceived usefulness and perceived ease of use. Davis defined perceived usefulness as "*the degree to which a person believes that using a particular system would enhance his or her job performance*" (Davis, 1989). He identified 14 items clustered in three groups: job effectiveness, productivity and time savings, and importance of the system to one's job. The other component, perceived ease if use refers to "*the degree to which a person believes that using a particular system would be free of effort*" (Davis, 1989). Similar to the perceived value, also the ease of use was clustered into three groups. The identified clusters distinguish the ease of use in terms of physical effort, mental effort, and the personal expectation experience of the system's ease of use.

Even though the findings of Davis were considered, it was not possible to apply them to the evaluation of future broadcasting services, because they are oriented towards adoption of technologies in companies. The mobile services considered in this paper are entertainment services. Thus, the "perceived usefulness" and "perceived easy of use" had to be operationalised in a suitable way in order to encounter the specific entertainment characteristics of mobile broadcasting services. The chosen operationalization categories are illustrated in figure 4.

In accordance with Kaasinen (2005) another specific and important factor influencing the acceptance of mobile services is trust. Also, Keat & Mohan (2004) suggested to add a component describing the trust to the TAM. Trust is a combination of level of familiarity, the company reputation, factual signals, and the quality of experience.

Kaasinen (2005) furthermore combined the specific components of TAM for mobile services in a new version of TAM dedicated to mobile services. Kaasinen modified the value component (from perceived usefulness) and added the components trust and perceived ease of adoption. Furthermore, she added the additional step of "taking into use" before the actual usage behavior is being observed. This specific version of the TAM is shown in the following figure (c.f. 3) and was taken as basic TAM structure in the evaluation presented in this paper.
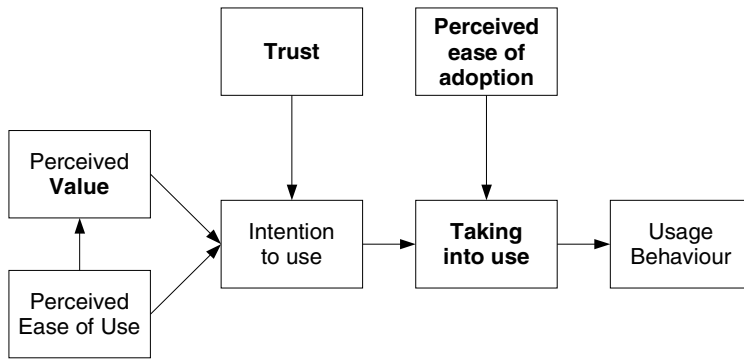
Trust

Perceived ease of adoption

Perceived **Value**

Perceived Ease of Use

Intention to use

Taking into use

Usage Behaviour

Figure 3.   Technology Acceptance Model for Mobile Services (Kaasinen, 2005)

The overall research model, deduced from the TAM proposed by (Kaasinen, 2005) and operationalized to fit the specific characteristics of mobile broadcasting services, and applied in this paper is illustrated by figure 4 below:
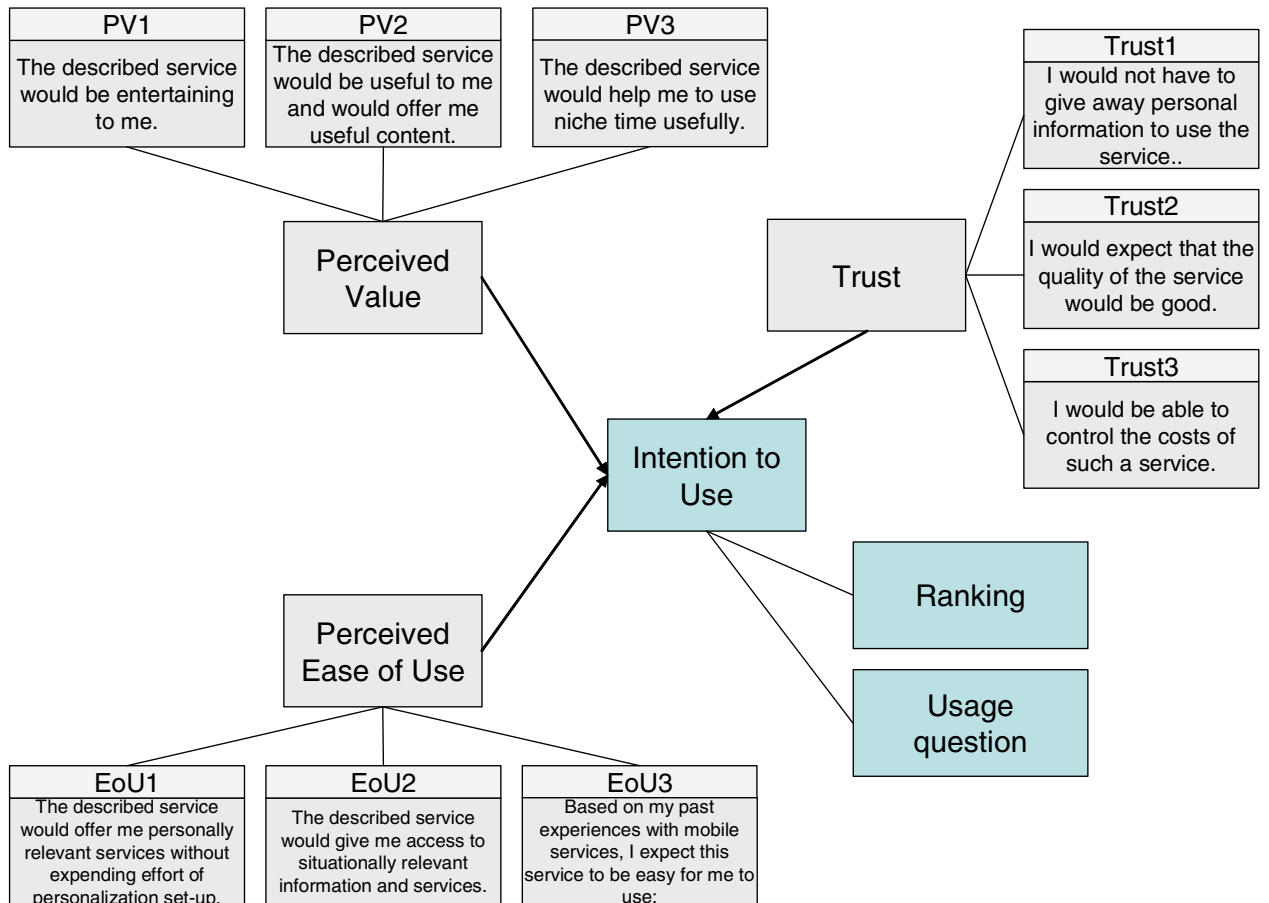
PV1
The described service would be entertaining to me.

PV2
The described service would be useful to me and would offer me useful content.

PV3
The described service would help me to use niche time usefully.

Trust1
I would not have to give away personal information to use the service..

Trust2
I would expect that the quality of the service would be good.

Trust3
I would be able to control the costs of such a service.

Perceived Value

Trust

Intention to Use

Ranking

Usage question

Perceived Ease of Use

EoU1
The described service would offer me personally relevant services without expending effort of personalization set-up.

EoU2
The described service would give me access to situationally relevant information and services.

EoU3
Based on my past experiences with mobile services, I expect this service to be easy for me to use:

Figure 4.   Applied TAM Research Model

3.3   Development of the online questionnaire

The online questionnaire consisted of two parts. The first part comprised an extensive description of the five scenarios followed by the questions of the TAM for each scenario. The description included a picture of the service or the service context, and the most important service components describing the value proposition of the service. For all questions a 5-point Likert scale with anchors ranging from "strongly agree" to "strongly disagree" was applied. In order to cross-validate the results, in the second part of the questionnaire the users were asked to rank the five different scenarios.

The questionnaire and the measures were pre-tested by selected consumers of the target group and selected experts in the field of mobile telecommunication.

4   DATA COLLECTION AND ANALYSIS

4.1   Data Collection and Descriptive Statistics

The respondents were recruited across Europe. Several mailing-lists and personal letters were sent to address consumers from different countries and with different background. In total, 2.147 people accessed the survey and 703 respondents completed the survey (30.74 %). The remaining respondents that accessed the survey, did not fill in the complete questionnaire.

The size of the sample is fairly large compared to other TAM studies. Legris, Ingham and Collerette (2003) identified TAM studies from 25 up to 2.500 respondents. The average sample size for one scenario was 290 respondents.

First the descriptive statistics of the respondents are presented. The following figure 5 shows the distribution of respondents according to the country of the origin and the age of the survey respondents.
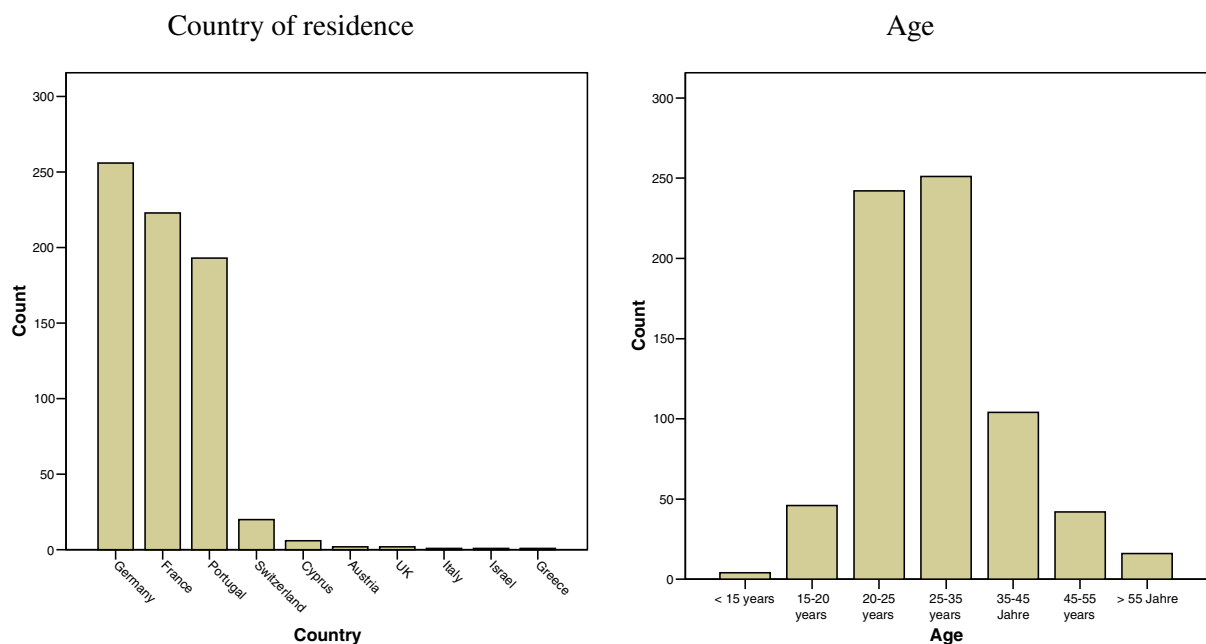

Figure 5.   Respondents' profiles

Although the questionnaire was sent throughout Europe most (95,3 %) of the valid answers were from Germany, France and Portugal, where the English version of the questionnaire was used. 34,3 % of the respondents were between 20 and 35 years, 35,6 % between 25 and 35 years, and 14,8 % between 35 and 45 years old.

In contrary to the expectations, the respondents between 20 and 35 had the least intention to use (e.g. 50,8 % vs. 61,4 % intention to use compared to all respondents for Interactive Mobile TV).

Another relevant characteristic of the sample was the gender distribution. 78,6 % of the respondents were male and the other 21,4 % were female. The low percentage of female respondents is similar to previous studies (Hung, Ku and Chang, 2003, Cheong and Park 2005). Over all scenarios male respondents reported a higher intention to use then female.

4.2   Discussion of Results

4.2.1   Evaluation of the scenarios

The intention to use was assessed as a binary question (no=1/yes=2), which means the higher the value the more appreciated was the scenario by the respondent. In addition, these results were cross-checked by a ranking question. The respondent ordered the scenarios according to her or his personal preferences. As a result each scenario was assigned a rank between 1 and 5. The highest rank received the value 1 and the lowest the value 5. Thus, the lower the mean the better was the rank of a scenario.

A correlation analysis of the scenarios showed a high correlation between the direct question of the intention to use and the rankings. The results based on the achieved means are provided in table 2 below.

		Interactive TV	Visual Radio	Content Casts	Mobile Community Platform	Real-Life Tagging
Intention to use	Total	1.62 (3)	1.59 (4)	1.63 (2)	*1.48 (5)*	**1.67 (1)**
Ranking	Total	**2.74 (1)**	2.85 (2)	3.08 (4)	*3.31 (5)*	2.98 (3)

Table 2: Comparison of the total results regarding the intention to use and the ranking

The table shows that the two surveys did not result in the same ranking of the scenarios. Based on the mean calculated from the answers of all respondents, a consensus regarding the ranking was achieved for the scenario "Mobile Community Platform". This scenario was considered as the least attractive one from the perspective of use and the ranking. The highest difference resulted regarding the scenarios "Interactive TV" and "Real-life Tagging". The scenario "Interactive TV" was considered most attractive in the ranking while the highest value regarding the "intention to use" was achieved by "Real Life Tagging".

A more detailed analysis that considered also the language used by the respondents to answer the survey revealed that a better fir of the two answers is given for more homogeneous user groups (see table 3). A higher consensus was achieved within the groups of users that used the same language.

		Interactive TV	Visual Radio	Content Casts	Mobile Community Platform	Real-Life Tagging
Intention to use	English	1.67	1.59	1.70	1.58	**1.77**
	French	**1.78**	1.72	1.76	1.47	1.74
	German	1.42	1.47	1.44	1.39	**1.51**
Ranking	English	2.89	3.28	2.98	3.08	**2.74**
	French	**2.26**	2.71	3.10	3.68	3.21
	German	3.03	**2.64**	3.13	3.17	2.97

Table 3:. Scenario-Ranking based on intention to use and a direct ranking

For three scenarios there is consensus regarding the intention to use and the explicit ranking of the scenarios. This shows that the perception of mobile services is influenced by cultural background. For example respondents using the French questionnaire had a clear preference for the scenario "Interactive TV", while respondents using the English questionnaire had a clear preference for "Real Life Tagging". These results explained the difference of the priorities when considering the total numbers.

4.3   Reliability of results

The remainder of the analysis focused on the intention to use. The reliability of the results was measured using Cronbach's alpha. The results for the tested scenarios are shown in the following table.
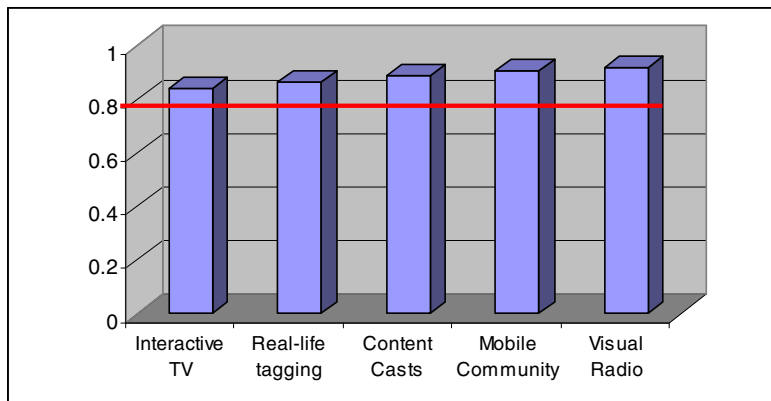

Figure 6 Reliability of the results

The observed values for Cronbach's alpha suggest that the measures are a reliable measure for the respective constructs – the minimum value of 0,80 according to Straub (1989) is in all cases excelled. This means that TAM can be considered as a suitable approach to access the intention to use future mobile services. However, compared to other TAM studies the value for Cronbach's alpha are slightly lower. This was probably due to the future nature and therefore unknown nature of the considered services.

4.4   Factor analysis

Factor analysis was applied to analyze the convergent validity of the used model. The high factors loadings of most of the model show significant level of convergent validity. Nunnally & Bernstein (1978) advised to rely on a minimum factor loading of 0.6. The following Table shows the results of the factor analysis.

	Item	Interactive TV	Real-Life Tagging	Content Cast	Mobile Community	Visual Radio
Perceived Value	PV1	0,793	0,796	0,861	0,824	0,901
	PV2	0,801	0,716	0,849	0,745	0,850
	PV3	0,718	0,713	0,756	0,758	0,760
Ease of Use	EOU1	0,791	0,824	0,841	0,902	0,861
	EOU2	0,806	0,829	0,748	0,842	0,788
	EOU3	0,654	0,624	0,617	0,679	0,653
Trust	TRUST1	0,774	0,772	0,794	0,776	0,763
	TRUST2	0,820	0,766	0,769	0,793	0,759
	TRUST3	0,811	0,801	0,799	0,784	0,755

Table 1 Factor loadings for each scenario

All factor loadings excelled the suggested minimum value of 0.6. There are no systematic differences between the observed values.

4.5   Results of the regression analysis

To test the hypotheses multiple linear regression analysis was used. The factors perceived value, ease of use and trust as independent variables were regressed on intention to use (dependent variable) in order to examine the causal links of the TAM. The following figure shows the comparison of the adjusted R^2 of the different scenarios in descending order. The adjusted R^2 explains the variance of the observed data by the statistical model and can be used as an indicator for the goodness-of-fit of the model.
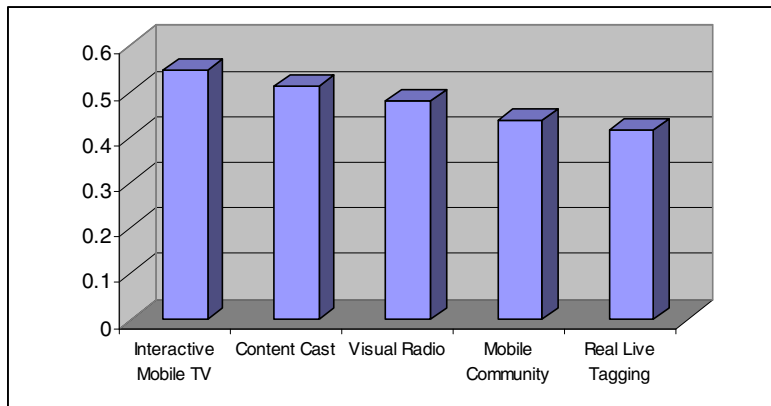

Figure 7 Adjusted R^2 for the different scenarios

The results of this analysis show strong support for the TAM. But the explanatory power of the TAM is decreasing with an increasing level of innovativeness of the considered service. This finding is in line with prior research on innovation and perception of new products. Robertson & Yu (2001) stated that "The degree of difficulty of introducing new ideas depends on the nature of the newness in the product as customers assess the bundle of attributes they perceive." (p. 188).

The analysis of the standardized beta-coefficients of the regression model for each scenario are shown in figure 8 below.
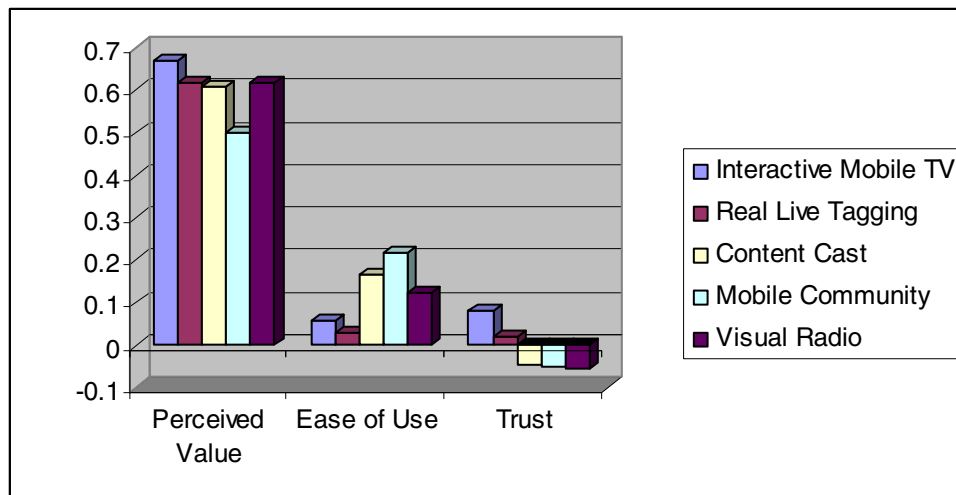
Figure 8: Standardized Beta-coefficient for the components

The coefficient for the perceived value shows by far the highest impact on the intention to use. Hence, this factor should be carefully considered. Combined with factor loadings of the different items describing one factor shows that there is not a great difference between the relevance of the usefulness and entertainment component of a service. Surprisingly, not even in the case of specified entertainment service, a stronger relevance of the entertainment item could be observed. The other factors, ease of use and trust, had a less significant impact on the intention to use. However, the factor trust seemed to have an undetermined impact on the intention to use.

5   CONCLUSION

The aim of the paper was to explore the applicability of the TAM model for assessing the intention to use for future mobile services that are not available on the market yet. The research was conducted for five scenarios of future mobile broadcast services. The TAM model included measures for perceived value, perceived easy of use and trust. The questionnaire included a description of the scenarios and was send throughout Europe. 703 participants filled in the questionnaire.

The following results were achieved:

- The analysis showed that the TAM is an appropriate research method to evaluate the user acceptance of future services. However, the more pioneering and thus little implicit knowledge is present about the service, the less accurate is the model.

- Surprisingly the lowest value for the intention to use was achieved for the scenario ""Mobile Community", even though there are numerous examples of successful communities.

- The adoption of mobile broadcast services might be considerably influenced by cultural differences. Thus, mobile operators that are active internationally need to design services in a manner, that they can be easily adjusted to different cultural needs.

- The analysis of the data showed that the most influential aspect on the intention to use is the perceived value of the future product. The potential value proposition of the service has to be defined in a manner that it meats the specific features of the mobile medium and the specific needs of target customer groups.

The results achieved provide a basis for future research:

Firstly, to improve the overall goodness-of-fit of the model additional factors could be included. Certainly, the social influence is an important factor. Malhotra & Galletta (1999) suggested to enhance

the TAM by including the social influence. This proposal was inspired by the works of Kelman (1958) who analyzed the extensively the characteristics in terms of compliance, identification and internalization.

Secondly, the presentation of the perceived value for non-existing services is a critical issue. In this research, it was fully relied on a verbal description of the assumed value elements of a service. In conjunction with the type of questions regarding the perceived value, the respondent is strongly affected by the study design. Especially, the entertainment value of a future service is difficult to communicate without having the actual service at hand.

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