Consumer Mashups: End-User Perspectives and Acceptance Model

Sirsha Bhattarai
Institut Telecom, Telecom SudParis
9 Rue Charles Fourier
91011, Évry Cedex, France
sirsha.bhattarai@it-sudparis.eu

Zhenzhen Zhao
Institut Telecom, Telecom SudParis
9 Rue Charles Fourier
91011, Évry Cedex, France
zhenzhen.zhao@it-sudparis.eu

Noël Crespi
Institut Telecom, Telecom SudParis
9 Rue Charles Fourier
91011, Évry Cedex, France
noel.crespi@it-sudparis.eu

ABSTRACT
The emergence of web mashups has opened interesting possibilities for searching, combining, and reusing information in a simple, lightweight manner. However, actual research on user perceptions and consumer acceptance of mashup technology has received little attention. This paper presents a user acceptance model for consumer mashups, to precisely identify what factors lead to their adoption and to what extent. Our empirical results show that 'performance expectancy' of a mashup platform is the most important attribute in predicting and explaining user's intention to use a consumer mashup platform, this attribute being further explained by the factor 'organization of existing day-to-day activities'. The presented model can serve as a reference for mashup designers to design platforms having better user acceptance.

Categories and Subject Descriptors
H.1.2 [**Models and Principles**]: User/Machine Systems - *Human factors, Software psychology*

General Terms
Human Factors

Keywords
Mashups, User Acceptance, UTAUT, User Research

1. INTRODUCTION
Web Mashups have received considerable attention in recent times, owing to the fact that they provide integration of information and services in an easy, visual manner. Although various tools are available for mashup development, creating a mashup may not be easy from the point of view of end users. In many cases, creating a mashup requires a significant technical and programming knowledge [1, 2, 3]. As such, it becomes important for mashup developers to gather end-users' perspectives about mashups: motivation on doing a mashup, user-requirements, usability aspects and factors for acceptance of mashups.

iiWAS2010, 8-10 November, 2010, Paris, France.

Formal models for user acceptance of mashups, based on user studies are still lacking, or confined solely to enterprise mashups [4], although the importance of consumer mashups in solving situational or routine work by integrating multiple application functionality remains profound. This paper presents a user-acceptance model for consumer mashups, also known as client or service mashups, based on the Unified Theory of Use and Acceptance of Technology (UTAUT) model. At the time of writing, a general user-acceptance model for consumer mashups has not known to be published anywhere.

Our study is conducted with an online survey of 131 users to gather data to verify the model. Users are asked to give feedback about a representative mashup platform called EBSP (Event Based Service Provider), a tool developed by the authors to integrate functionality of iGoogle widgets with the Google Calendar platform. The EBSP platform recommends contextual services as widgets, to be mashed up with the calendar system according to the type of event entered (for e.g., widgets such as travel guides, maps and route planner for the event 'Travelling to Venice'). This simple widget based mashup platform can be regarded as a representative mashup system for various platforms like Intel MashMaker, Microsoft Popfly, Yahoo! Pipes, iGoogle, Netvibes etc., all of which have the notion of modular services referred as modules/widgets/gadgets. The proposed model is suitable for all the above and similar consumer mashup systems.

2. RELATED WORK

2.1 End-User Studies
Not all the current web mashups tools may be easy to use or understand for an averagely-technical end user. However, few studies have been performed in user research. [5] identifies six aspects of mashups, from an end user perspective, to review current tools, viz: Levels of abstraction, Learning support, Community features, Searchability, UI design, and Software Engineering techniques. For less technical users, generally a high level of abstraction, abundant learning support, and community features are desired.

[3] identifies two major factors- "Usefulness" and "Technology initiative" from an end-user survey to have an effect on user's motivation to create mashups. The study has found that people with different levels of technology initiative have interest in creating and using different types of mashups, with low-initiative users preferring mashups related to people, social networks etc. and high-initiative users preferring more complex data mashups. [2] instates that end users do see benefits in mashups for searching, integrating, and sharing information. This and similar studies [6, 7] show that women in general have greater

perceptions about difficulty in using technology as compared to men. The factors other than gender proposed to predict mashup usage were: Computer experience, Technology initiative, Advanced media, Web2.0, and Online Hobbies.

2.2 Technology Acceptance Models

The Technology Acceptance Model (TAM) [8] and UTAUT [7] are well accepted models explaining individual's use of information and technology. The latter is a consolidated model derived from eight different models, and reported to outperform the performance of each one in explaining user acceptance for an IT system or product. Four internal constructs in UTAUT viz. performance expectancy, effort expectancy, social influence and facilitating conditions are determined to have an effect on the behavioral intention, and actual usage, moderated by factors like age, gender, experience, and voluntariness.

Several researchers have applied the UTAUT model to explain acceptance of technologies like 3G mobile services [9], Blackboard® (a web-based tool) [10] and enterprise mashups [3] etc. [9] has found that performance expectancy, effort expectancy, social influence, and facilitating conditions uplifted not just the behavioral intention, but usage behavior as well. [10], in particular is not seen to find a strong support for the hypothesized relationships in the UTAUT model. [3] has proposed an assimilation model (adoption and routinization) for enterprise mashups with system-specific variables.

3. METHODOLOGICAL APPROACH

3.1 User Acceptance Model

Based on the general functionalities offered by mashups and end-users perceptions about mashups from related studies, we propose a converged user-acceptance model (Figure 1) for consumer or service mashups as follows.

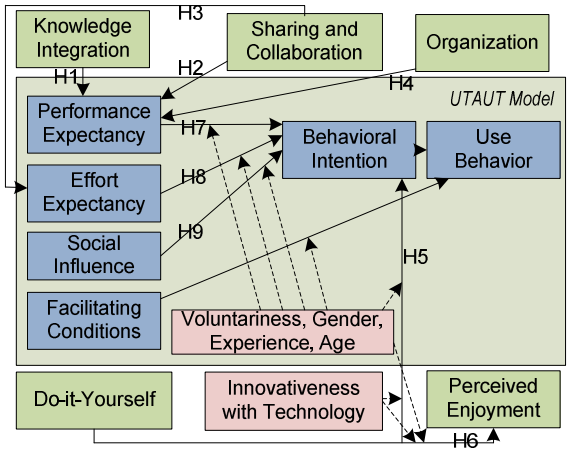

Figure 1. The proposed user-acceptance model

In addition to the internal constructs of UTAUT [7], the proposed research model uses several external constructs specific for consumer mashup systems: *Knowledge Integration* refers to the combination of information or application functionality from multiple sources to a single platform. *Sharing and collaboration* indicates sharing of mashups between users and collaborative building. The variable *Organization* refers to organizing existing daily life activities of end users through mashups. *Do-it-yourself* is a characteristic attribute of mashups as it allows users to combine user-desired information and services, with great flexibility and personalization opportunities to produce a valuable output. *Perceived enjoyment* [11] is one characteristic feature, referring to the 'fun' element in doing a mashup. We also introduce an external moderator, *Innovativeness with Technology*, which is expected to have a varying degree of effect on individual's intention to use a technology.

The following hypotheses are formulated:

Hypothesis1: Knowledge integration (Information/ application functionality) in consumer mashups has a positive effect on performance expectancy.
Hypothesis2: Sharing and collaboration in consumer mashups development has a positive effect on performance expectancy.
Hypothesis3: Sharing and collaboration in consumer mashups development has a positive effect on effort expectancy.
Hypothesis4: Organization of daily life/study/work related activities has a positive effect on performance expectancy.
Hypothesis5: Do-it-Yourself (DiY) attribute of consumer mashups has a positive effect on behavioral intention, moderated by age, innovativeness with technology, and gender.
Hypothesis6: Do-it-Yourself (DiY) attribute of consumer mashups has a positive effect on perceived enjoyment, moderated by age and innovativeness with technology.
Hypothesis7: Performance expectancy of consumer mashups has a positive effect on behavioral intention, moderated by gender and age.
Hypothesis8: Effort expectancy in consumer mashups has a positive effect on behavioral intention, moderated by gender and age.
Hypothesis9: Social influence on consumer mashups has a positive effect on behavioral intention, moderated by gender and age.

3.2 End-User Survey

An online survey was developed based on the research model in Figure 1, using the software QuestionPro [12]. Particularly, we were interested to find out what does it take for users to express their willingness in using mashup technology, which is a relatively novel technology in the web2.0 arena as yet. Hence, we asked users to give their experiences in using a novel mashup platform, the Event Based Service Provider (EBSP), a mashup platform developed by the authors to bring value to people's daily lives and existing activities. Specifically, our approach is to model behavioral intention rather than use behavior, since we assume end users are new to usage of the mashup system.

Before letting the users experience with our system, we provided a brief video tutorial about commercial mashup tools (iGoogle, Yahoo! Pipes, Popfly and Intel Mashmaker) to make them familiar with mashup technology. Then we provided a brief video tutorial on the EBSP system, with various examples. A total of 423 requests were sent out online, of which we received 233 partial responses. Only 131 were complete and valid for our study, yielding a useful response rate of 30.97%. The questionnaire used a five-point Likert scale (Strongly disagree =1, disagree=2, Undecided=3, Agree=4 and Strongly agree=5). The survey was conducted in a period of one month, due to limited available time among students of Asian institute of Technology, colleagues in Institut Telecom and other personal contacts.

3.3 Data Analysis

The average age of the 131 respondents in the survey was 26.6 years, among which 101 (77.1%) were male and 30 (22.9%) were female. 75.6% were students and 22.9% employed. 57.3% of the respondents were Masters students. 26% of them defined their functional area as Information Science, and 26% as Telecommunications. 43.5% reported to have 'high' innovativeness with technology, and 39.7% average. Interestingly, 61.1% reported to have previously heard of the term 'mashups' or mashup technologies in the internet. Data obtained from the survey has been statistically analyzed using SPSS13.

3.3.1 Cronbach's Alpha Test

Cronbach's alpha test (Table 1) is done to measure the internal consistency or reliability of the individual items of a construct, and of the overall items in questionnaire.

Table 1. Cronbach's Alpha Test

Variables [No. of items]	Mean	Std. Deviation	Cron-bach's α
Knowledge Integration: KI [4]	3.83	0.51	0.729
Organization: ORG [3]	3.64	0.57	0.712
Performance Expectancy: PEx [4]	3.61	0.53	0.716
Sharing and collaboration: SC [3]	3.66	0.45	0.634
Effort Expectancy: EEx [4]	3.82	0.63	0.837
Do-It-Yourself: DiY [4]	3.75	0.57	0.8
Facilitating conditions: FC [3]	3.80	0.62	0.768
Perceived Enjoyment: PE [2]	3.72	0.54	0.524
Social Influence: SI [3]	3.72	1.50	0.942
Behavioral Intention: BI [3]	3.50	0.59	0.781
Entire instrument [33 items]			**0.904**

An overall Cronbach's α value of 0.904 (out of '1') is above the recommended value of 0.7 showing high reliability. On observing individual variables, besides Perceived enjoyment (0.524) and Sharing and Collaboration (0.634), all other variables (8 out of 10) were able to achieve reliability above 0.7. This implies that the most of the items were able to explain the particular variable well and consistently for which they were selected.

3.3.2 Correlation Analysis

The hypotheses were tested using Pearson's correlation analysis in SPSS13, the summary being shown in Table 2.

Table 2. Pearson's Correlation

Hypo-thesis	Variable 1	Variable 2	Pearson Correlation	Sig (2-tailed)
1	KI	PEx	0.563**	0.000
2	SC	PEx	0.518**	0.000
3	SC	EEx	0.262**	0.003
4	ORG	PEx	0.594**	0.002
5	DiY	BI	0.435**	0.000
6	DiY	PE	0.388**	0.000
7	PEx	BI	0.574**	0.000
8	EEx	BI	0.392**	0.000
9	SI	BI	0.102	0.247

***p< 0.01 level; *p<0.05 (2 –tailed)*

3.3.2.1 Effect of Moderators

To analyze the effect of moderators like age, gender, and innovativeness with technology (Hypotheses 5-9), responses were categorized into several classes as shown in Table 3.

Table 3: Moderators and their classes

Moderator Category	Classes	N
Age	20-30 years	107
	Above 30 years	20
Gender	Male	101
	Female	30
Innovativeness with Technology	Average	52
	High	57
	Extremely High	20

Pearson's correlation was performed between each class of moderator and the relationship of two variables stated in the hypothesis to show changes in the strength of the relationships over different classes.

3.3.3 Multiple Regression

In order to predict the magnitude by which the Behavioral intention is explained by the constructs Performance Expectancy, Effort Expectancy, Social Influence and Do-it-Yourself, multiple regression was performed. This determines the predictive power of the model in explaining variance in behavioral intention, which is a measure of user acceptance.

4. RESULTS AND DISCUSSION

In order to explain factors for acceptance of consumer mashups, a user-acceptance model, based on reported end-user studies is proposed.

Data collected from the survey was statistically analyzed to investigate relationships between the variables in the research model. The results of correlation analysis show that among the nine hypotheses, except Hypothesis9, all are proved.

Table 4: Results of Hypotheses

Hypothesis	Result	Hypothesis	Result
1	Proved	6	Proved
2	Proved	7	Proved
3	Proved	8	Proved
4	Proved	9	Not Proved
5	Proved		

Knowledge integration, sharing and collaboration, and Organization of daily life activities and processes are seen to have a positive effect on the performance expectancy, with the latter having the most significant positive effect (0.594**). This is an important finding which indicates that users perceive a mashup system to be most useful when it brings value in organizing their day-to day activities and processes.

Interestingly, sharing and collaboration among users in a mashup platform is not particularly seen to a have a strong effect (0.262**) on the expected effort to create and use a mashup (effort expectancy). This can be interpreted as- the surveyors regard collaborative work not particularly advantageous to reducing the complexity of doing a mashup, as compared to the greater advantage their individual efforts bring in.

The aspect of Do-it-yourself (DiY) in a mashup provides enormous flexibility to users in choosing what to build, and opportunities to render personalized features over the mashup.

This feature was however, observed to have only a moderately positive effect (0.435**) on the intention to use, the relationship being affected by the moderator 'innovativeness with technology'. The strength of correlation is observed to increase from average (0.415**), high (0.460**) to extremely high innovativeness (0.463**) in people as expected. Also, males were seen to have a greater effect (0.459**) in the relation as compared to females (0.374**). These results are in accordance with related studies in innovativeness and gender [2, 6, 7]. Also, the age group 'Above 30' was found to have a significant greater impact (0.821**) on this relation as compared to '20-30 years' group (0.345**). This can be due to greater knowledge and experience about mashups technology in the adult group compared to the younger group.

The relationship of DiY and perceived enjoyment was found to have a weak positive correlation for the sample. However, the relationship is most strong for the extremely-high innovativeness group (0.496**) as compared to high (0.360**). This indicates that people with greater technological innovativeness perceive more fun and enjoyment in working with mashups compared to the less technologically innovative people. Also, there is a greater effect on the relationship for the adult group (0.704**), compared to the younger group (0.394**), for reasons similar to above.

An important result from the study is the relation of performance expectancy to behavioral intention. Performance expectancy is found to outperform all other constructs in explaining behavioral intention, with the most strong relation to it (0.574**). This means that users give a great value to usefulness of the mashup platform compared to other factors like expected effort (0.392**), DiY (0.435**) or social influence (not significant), when they decide to use the platform. Such relationships are also found to be affected by moderators like gender, innovativeness and age. For example, the correlation between performance expectancy and behavioral intention is strong for males (0.642**) while found non-significant for females at $p<0.05$, and strongly significant for the adult group (0.901**) as compared to the younger group (0.565**). The relationship of social influence and behavioral intention was found insignificant for $p<0.01$. However on analyzing the effect of moderators, the relationship was found strong for females (0.561**) and non-significant for males in the sample. Stronger impact of social influence on females in using a new technology as compared to males is in accordance with previous gender-based studies on social influence [6, 7].

When multiple regression was performed to predict behavioral intention, it was seen that the four predictors-Performance expectancy, Effort expectancy, Social influence and Do-it-yourself were able to predict only upto 36.6% (adjusted R^2) of the total variance in behavioral intention, with performance expectancy (Beta =0.455) being the major predictive factor of behavioral intention, which is in consistence with the results of correlation analysis.

The results of the hypotheses set in the study have shown support to the UTAUT model. The fact that only 36.6% of the variance in behavioral intention has been explained suggests the need to further refine the model by incorporating unmeasured variables. Nonetheless, this study can provide useful directions for user-acceptance of mashups. Through the results of the study, we recommend mashup developers to pay particular focus in bringing value to organizing better existing day-to-day activities of average end- users rather than focusing on complex feature extensibility in the platform.

This study has been conducted as a part of a Masters research work in the domain of User Generated Services (UGS), in which the authors have introduced and developed a calendar-mashup system (EBSP), and proposed a general user-acceptance model for consumer mashups, based on the UTAUT.

5. FUTURE WORK

In future, our work shall investigate on UTAUT's response to variable sample sizes, with particular focus on small sample size, to find out whether its reportedly high ability of explaining upto 70% of variance in use behavior is well suited only for large longitudinal studies, or are its results equally applicable to smaller studies. In parallel, the EBSP platform will be developed for increased personalization and usability features.

6. ACKNOWLEDGMENTS

Our sincere thanks to Mr. Hui Wang, Mr. Honguang Zhang , Mr. Shashank Pandey and Mr. Asish Singh for their contributions made for this study.

7. REFERENCES

[1] Yu, J., Benatallah, B., Casati, F., and Daniel, F. 2008. Understanding Mashup Development. *IEEE Internet Computing*, 12(5), 44-52.

[2] Zang, N., and Rosson, M.B. 2008. What's in a mashup? And why? Studying the perceptions of web-active end users. In *Proceedings of IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC)*, 31-38.

[3] Zang, N. 2008. Mashups on the Web: End User Programming Opportunities and Challenges. In *Proceedings of PLATEAU'09 Workshop at Onward (Oct. 2009)*.

[4] Pahlke I., and Beck, R. 2009. Assimilation of Enterprise Mashup Systems − The Impact on Changes in Work Processes. In *Proceedings of the Special Interest Group on Adoption and Diffusion of Information Technology (DIGIT) Pre-ICIS Workshop; Phoenix, USA.*

[5] Grammel, L., and Storey, M. 2008. An End User Perspective on Mashup Makers. *University of Victoria Technical Report DCS-324-IR.* lars.grammel.googlepages.com/paper_mashup_makers.pdf

[6] Miller, J. B. 1976. Toward a New Psychology of Women. Beacon Press, Boston.

[7] Venkatesh, V., Morris, M., Davis, G. B., and Davis, F. 2003. User Acceptance of Information Technology: Toward a unified view. *MIS Quarterly*, 27, 425-478

[8] Davis, F. 1989. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information. *MIS Quarterly.* 13, 319–340

[9] Wu, Y., Tao, Y., and Yang, P. 2007. Using UTAUT to explore the behavior of 3G mobile communication users. In *Proceedings of The International Conference on Industrial Engineering and Engineering Management (IEEM).*

[10] Marchewka, J. T., Liu, C., and Kostiwa, K. 2007. An Application of the UTAUT Model for Understanding Student Perceptions Using Course Management Software. In *Communications of the IIMA*, 7(2), 93-104.

[11] Teo, T. S. H., Lim, V. K. G., and Lai, R. Y. C. 1999. Intrinsic and extrinsic motivation in Internet usage. In *Omega Int. J. Mgmt. Sci*. 27, 25-37.

[12] Questionpro. www.questionpro.com