USER ACCEPTANCE OF VIRTUAL WORLDS

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ABSTRACT

Virtual Worlds enable new ways of communication, collaboration, and cooperation over the Internet by applying 3D environments and voice over IP technologies. This papers aims at assessing user acceptance of Virtual Worlds by applying the Technology Acceptance Model (TAM). Based on literature review, an extended TAM has been constructed. Based on empirical data from an online-survey with 249 participants, hypotheses about user acceptance and adoption of Virtual Worlds are empirically tested. Our results show that community factors such as communication, collaboration, and cooperation play a pivotal role in means of influencing user intention and acceptance of Virtual Worlds. This paper provides meaningful insights for theory building of user acceptance in the context of Virtual Worlds as it shows that traditional models have to take 'community' factors into account. Our findings are also helpful for practitioners to develop new business models in Virtual Worlds.

Keywords: virtual worlds, consumer adoption, technology acceptance model (tam), second life.

1. Introduction

Internet users, especially younger people, spend a lot of time on the Internet to interact with others in order to communicate, collaborate, or cooperate through various channels and applications such as e-mail, online games, or Instant Messaging. Many also use so-called social-networks to interact with others by applying Web 2.0 applications such as MySpace, Blackboard, Facebook, or various Blogs. However, these technologies are limited in their scope to communicate, cooperate, and collaborate [O'Reilly 2005]. By using 3D environment and voice over IP Virtual Worlds set up new channels work together over the Internet. The opportunities for interactivity in Virtual Worlds are richer compared to other web applications which are mainly based on plain text and voice. Users in Virtual Worlds are represented by 3D avatars. These 3D representations can either be an exact replication of the user or any fictional figure, moreover, they can express gestures and emotions such as laugh or giggle, crying, or winking. As 3D technologies become increasingly sophisticated, photo-realistic avatars are just around the corner. People on Virtual Worlds contract friendships, buy and sell virtual properties and assets, and form social networks and organizations. In that perspective Virtual Worlds are in many instances more than just a game. As this is the case with Second Life (SL), where there are no levels, no scores, and there is no "game over". Even more, they promise to become platforms for innovative models for real business. To make efficient use of these new opportunities, the principles of user acceptance, behaviors, and adoptions must be analyzed. In this respect, existing user acceptance models may be adapted to extract recommendations for example for practitioners to build new business models.

According to the Harvard Business Review article "Avatar-Based-Marketing" from Kemp [2006] as well as other reports [Gartner 2007], the number of users is expected to double every year and Virtual Worlds may well eclipse other interactive web applications as a form of entertainment. It might well be that this development is undergoing an evolution comparable to that of the Internet in the mid 1990s. It also might have the potential of profoundly impacting the way people interact and conduct business in the future. There is a wide variety of Virtual Worlds such as Kaneva, HipiHi or beta projects from Google and Microsoft. However, one of the most known and used one so far is SL, despite many critics. Due to the nascent nature of Virtual Worlds, there are still many

technical challenges to overcome in SL such as poor graphics, data transmission problem, server downtime, server failure among others.

In SL residents can not only create their own avatars or 3D representations, but they can also create their own objects and products and retain the property rights of their digital creations. Therefore, they can buy, sell, and trade virtual goods and services with other residents. This virtual commerce is handled with a currency called Linden Dollar (LD). There is a real exchange rate between the LD and the US Dollar. Transactions amount to already more than 1 million US Dollar a day. The number of registered users increased from slightly more than one million in September 2006 to over 14 million users by July 2008. These users can be classified as "innovators" and "early adopters" according to Bass' product diffusion model [Bass 1969]. Following this most recent trend and taking the product diffusion curve as a proxy, it can be assumed that the majority of potential users (early and late majority) is still not using Virtual Worlds and we are only at the beginning. In this context questions arise about user acceptance and adoption of Virtual Worlds. What are the factors driving user acceptance of Virtual Worlds? How important are new opportunities for communication, collaboration, and cooperation for users, and for business models in Virtual Worlds? These and other questions will be addressed in this paper.

Despite the emergence of Virtual Worlds as next generation social-networks and the increasing number of people using them, there is no research so far assessing user acceptance and adoption of Virtual Worlds. In order to detect (new) factors which determine user acceptance and adoption and to derive insights for theory building and to extract key features which make these platforms attractive for users, this contribution applies the Technology Acceptance Model [Davis 1989] as the underlying research framework.

The next section provides a literature review and outlines the most relevant and related studies so far, which have been used for measuring technology acceptance on related applications. Section three presents the proposed research model, hypothesis, the underlying construct and moderating variables as well as the measurement items. Section four outlines the methodology and the data collection process. Various construct variables and items are validated by Cronbach Alpha. The research model is validated by a factor analysis. The final section of this paper provides a conclusion and discussion about Virtual World adoption and their key features.

2. Literature Review

Information Systems (IS) research has long studied how and why individuals adopt new information technologies, systems, or applications [Venkatesh et al. 2003]. Explaining the reasons and processes of technology usage and adoption is equally of crucial importance for academia, practitioners, and politicians as new technologies are among other key drivers of globalization and provide opportunities for new businesses. IS researchers have relied on several theoretical models to explain user acceptance and adoption of emerging technologies. Based on the Theory of Reasoned Action (TRA) by Fishbein and Ajzen [1975], one of the first and most widely used and accepted models is the Technology Acceptance Model by Davis [1989]. TAM has been used many times to assess user acceptance of traditional web applications such as e-mail, Internet shopping or Internet banking. Augmented and modified versions of TAM have consistently shown that the core drivers of IS usage are the perceived usefulness ([Adams et al.1992], [Davis et al. 1989], [Gefen & Straub 1997], [Igbaria et al. 1997], [Szajna 1996], [Taylor & Todd 1995], [Teo et al. 1999], [Venkatesh et al. 2003]) the perceived ease of use ([Davis et al. 1989], [Igbaria et al. 1997], [Taylor & Todd 1995], [Teo et al. 1999], [Venkatesh et al. 2003]) and the subjective norm favoring and influencing the behavioral intention to use the system ([Hartwik & Barki 1994], [Karahanna et al. 1999], [Taylor & Todd 1995], [Venkatesh et al. 2003]).

Venkatesh et al. [2003] reviewed user acceptance literature in their seminal work about their unified theory of user acceptance, and discussed and compared empirically eight different models to explain user acceptance. They formulated the Unified Theory of Acceptance and Use of Technology (UTAUT) which integrates acceptance determinants across several competing models. According to UTAUT, the intention to use information technology (IT) can be determined by three antecedents: performance expectancy, effort expectancy, and subject norms (social influence). As a consequence, intention to use is to exert influence on actual behavior toward IT adoption with facilitating conditions [Venkatesh et al. 2003].

Virtual Worlds enable new ways and channels to cooperate, collaborate, and communicate. In order to build a research model adapted to Virtual Worlds, existing TAM studies on collaboration, cooperation, and communication technologies, systems, and applications such as e-mail, Instant Messaging, web-based collaboration systems and online games have been taken into account to construct the research model in this contribution. The following table summarizes the most relevant studies about user acceptance according to the Social Citation Index. It provides information about the authors and publication year, the main model used to assess user acceptance, the type of technology assessed, the applied construct variables, and the number of objects used to assess user acceptance and adoption.

Table 1. Related Studies

Author(s)	Model	Research Subject	PEOU	PU	BIU	PE	ATT	SN	ANX	GEN	Other construct variables	Objects
Davis [1989]	TAM	E-Mail, XEDIT,	x	x	x							264 MBA students
Straub, et al. [1995]	TAM	V-Mail	x	x	x							458 Employees
Szajna [1996]	TAM	Email	x	x	x[1]							61 MBA students
Chau [1996]	Modified TAM	MS Word, MS Excel	x	x[2]	x							285 Users
Gefen & Straub [1997]	ExtendedTAM	Email	x	x	x			x		x		392 Workers
Lederer et al. [2000]	TAM	WWW	x	x	x		x					163 Users
Arbaugh [2000]	Extended TAM	Learning Space	x	x	x						Classroom dynamics, Learning	97 MBA students
Brown [2002]	TAM	WebCT	x	x	x				x			78 Students
Chen et al. [2002]	TAM	Virtual stores	x	x	x		x				Compatibility	228 Students
Venkatesh et al. [2003]	UTAUT	Online Meeting Manager	x	x		x[4]		x	x	x	Perceived behavioral control, compatibility, Voluntariness of Use	54 Employees
Lee et al. [2003]	Extended TAM	AIDE [3]	x	x	x	x	x	x			Social presence, Perceived behavioral control, Interface design	31 Students
Hubona & Burton-Jones [2003]	TAM	E-Mail	x	x						x		96 Corporate Staff, 122 Governmental staff
Hsu & Lu [2004]	TAM	Online games	x	x	x		x	x			Flow experience	233 Users
Ong et al. [2004]	TAM	E-learning	x	x							Perceived credibility, Computer Self-efficacy	140 Engineers
Shih [2004]	TAM	Internet	x	x		x	x				Relevance	203 Workers
Van der Heijden [2004]	TAM	Websites	x	x	x		x				Perceived attractiveness, Perceived enjoyment	828 website subscribers
Ngai et al. [2005]	TAM	Web Course Tools	x	x	x		x				Technical Support	836 Students
Wang, et al. [2004]	TAM	Instant Messaging Service	x	x	x						Technology Utility, Perceived Number of User	437 Students

[1] Self report usage, system log usage; [2] Near term, long term;
[3] web-based collaboration technology system, Distance Learning; [4] Performance and Effort Expectations

According to literature, the most common construct variables for technology adoption and acceptance are Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Behavioral Intention to Use (BIU), Attitude towards Technology (ATT), Subject Norms (SN), Performance Expectancy (PE), Socio-Demographical variables such as Gender, Experience, Age (GEN), and Anxiety (ANX). The next section will discuss the various construct and moderating variables and their underlying measurement items.

3. Research Model and Variables

This section presents each construct and moderating variable and their underlying measurement items. A 5-point Likert scale (strongly disagree to strongly agree) has been used as a measurement scale. The proposed model in this contribution is based on insights from former related studies about user acceptance of technologies and applications for communication, cooperation, and collaboration.

3.1. Construct Variables

Perceived Ease of Use (PEOU) is "the degree to which a person believes that using a particular system would be free of effort" [12, p. 320]. PEOU should be positively related to the use of Virtual Worlds. The following items, based on various studies as outlined in Table 1, are used to define the construct variable PEOU: easiness of use (PEOU1), easiness of becoming skilful (PEOU2), easiness to learn to operate the system (PEOU3), flexibility of interaction (PEOU4), and clearness and understanding of intention of the purpose of Second Life (PEOU5).

Hypothesis 1: The perceived ease of use (PEOU) of Virtual Worlds influences positively and directly the a.) usefulness and b.) behavioral intention to use the system.

Perceived Usefulness (PU) refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" [12, p. 320]. In the context of Virtual Worlds, this means that these platforms enable users to fulfill certain tasks, such as searching for or meeting people, more effectively. As PEOU, the PU is expected to be positively influence Virtual Worlds adoption.

Hypothesis 2: The perceived usefulness (PU) of Virtual Worlds influences positively and directly behavioral intention to use the system.

Research shows that the construct variable perceived usefulness plays a significant role to explain user acceptance and behavior in Virtual Worlds. In comparison to other IT it can be expected that innovative features in Virtual Worlds, such as 3D animations and Voice over IP technologies are of pivotal relevance to understand the diffusion and adoption of Virtual Worlds in the daily private and business usage. Watzlawick et al. [1969] as well as later studies from Turoff and Hiltz [1977] have shown that computer-based communication reduces the transmitted content of information due to content reduction. The reduction of the richness of the transmitted content is the result of a lack of the existence of body language, a lack of para-verbal content (voice level, volume, and tempo) as well as other non-verbal information such as the look, clothing, or behavior which all are not transferred over traditional computer based communication channels. In order to fill this information gap, existing web applications and Web 2.0 communication technologies and applications have used numerous expression forms such as symbols, pictograms, emoticons, or disclaims. But these were still not able to fill the wide information gap.

However, Virtual Worlds have the potential to reduce the information gap by applying 3D animations and by enabling the avatars to show emotions, gestures, and mimics. Based on various studies ([Davis 1989], [Hubona & Burton-Jones 2003], [Lederer et al. 2000], [Ong et al. 2004], [Wang et al. 2004]) and the explanations shown in the previous paragraph, the items are formulated in the proposed model as follows: Second Life improves communication with other people (PU1), Second Life improves cooperation with other people (PU2), Second Life improves collaboration with other people (PU3), Second Life enables me to search for and buy virtual goods faster (PU4), Second Life enables me to search for and meet people faster (PU5), Second Life is effective in searching for and buying virtual goods (PU6), and Second Life is effective in searching for and meeting people (PU7).

Ajzen and Fishbein [1980] demonstrated that attitudes toward an object influence intentions and ultimately influence behavior and use of the object. Hill et al. [1987] and Davis et al. [1989] found that the *Behavioral Intention to Use* (BIU) a system is positively related with usage and is a major determinant of user behavior. In general, TAM theory states that BIU is a direct predictor for the acceptance and adoption of new technologies, which is reasonable as well for Virtual Worlds. The construct variable BIU is assessed through three measurement items. They are adapted from the item scale used by Venkatesh et al. [2003] as well as from other studies ([Brown 2002], [Davis 1989], [Gefen & Straub 1997], [Lee et al. 2003], [Ngai et al. 2005]). The following statements define BIU: I will be on Second Life regularly in the next month (BIU1), I intend to earn money on Second Life (BIU2), and I intend to buy a property on Second Life (BIU3).

Hypothesis 3: The behavioral intention to use (BIU) Virtual Worlds influences positively and directly usage.

The cognitive process which determines an *Attitude Toward Technology* (ATT) influences the technology adoption process of users ([Chen et al. 2002], [Hsu & Lu 2004], [Lederer et al. 2000], [Lee et al. 2003], [Ngai et al. 2005], [Shih 2004]). It can be assessed by the following measurement items: Using Second Life as a learning environment would be a good idea (ATT1), Second Life makes learning and working more interesting (ATT2), Second Life motivates learning and working (ATT3), and working with Second Life is fun (ATT4).

Hypothesis 4: The attitude toward technology (ATT) influences positively and directly the perceived usefulness.

Subject norms (SN) are defined in terms of social influence. According to Fishbein and Ajzen [1975] subjective norm or social influence is the person's perception that most people who are important to him or her think s/he should or should not perform the behavior in question. Normative pressure favoring the use of Virtual Worlds should be positively related to the actual use. The four measurement items used and adapted from Venkatesh and Davis [2000] and other studies ([Gefen & Straub 1997], [Hsu & Lu 2004]], [Lee et al. 2003]) are: My supervisors/teachers think I should use Second Life (SN1), my friends think I should use Second Life (SN2), my supervisors /teachers /friends have been helpful in the use of Second Life (SN3), my employer/college should support the use of Second Life (SN4).

Hypothesis 5: Subject norms (SN) influence positively and directly the perceived usefulness.

Compeau and Higgins [1995] applied the Social Cognitive Theory based on Bandura [1986] to the context of computer usage. *Performance Expectancy* (PE) in the context of technology usage is defined as the performance-related result of using a technology. PE deals with job-related outcomes or with individual esteem and sense of accomplishment (personal expectancy). Based on previous studies ([Lee et al. 2003], [Ong et al. 2004], [Venkatesh et al. 2003]) two measurement items are taken into account in our research model to reflect performance expectancy of using Virtual Worlds: I find Second Life useful to further my career (PE1), using Second Life enables me to enhance my computer literacy (PE2).

Hypothesis 6: Performance expectancy (PE) influences positively and directly the perceived usefulness.

The seventh construct variable used in the proposed research model is *Anxiety* (ANX) of using a new technology. This variable encompasses evoking anxious and emotional reactions when it comes to using a technology according to Brown [2002]. In the case of Virtual Worlds, four measurement items were applied: I feel apprehensive about using Second Life (ANX1), it scares me to think that Second Life could make me lose a lot of resources (money, information etc.) by hitting the wrong key (ANX2), I hesitate to use Second Life for fear of making mistakes (ANX3), and Second Life is somewhat intimidating to me (ANX4).

Hypothesis 7: Anxiety (ANX) influences negatively and directly the perceived usefulness.

3.2. Moderating Variables

Various studies like the seminal work from Venkatesh et al. [2003] as well as those from Gefen and Staub [1997] or Hubona and Burton-Jones [2003] outline that socio-demographical variables influence the consumer adoption and usage behavior ([Gefen & Straub 1997], [Hubona & Burton-Jones 2003]). They found that attitudes were more salient for younger people as subjective norms are more salient for older women. Additionally, Venkatesh et al. [2003] showed that attitudes are less salient for women than for men. However, subjective norms are more salient for women in early stages of experience. To reflect these findings, the following individual moderating variables are taken into account in our research model. Five measurement items are defined: gender (GEN1), age (GEN2), and experience (GEN3). There were also questions about the location (GEN4) and technology infrastructure (GEN5) to access Virtual Worlds.

Hypothesis 8: Socio-Demographical variables moderate the perceived usefulness of Virtual Worlds.

Figure 1 illustrates the proposed research model, the construct and the moderating variables applied in this contribution.

Table2 summarizes the various construct and moderating variables used in the proposed research model as well as the number of measurement items used.

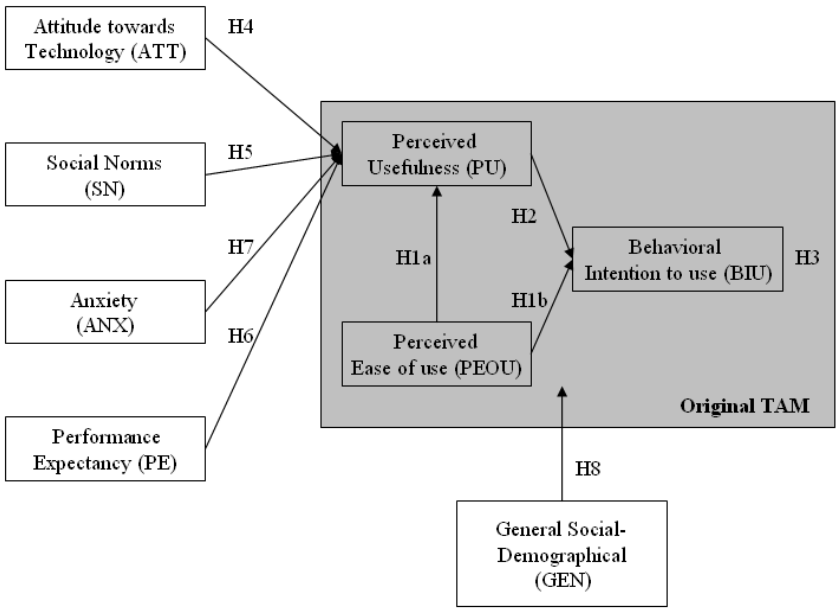

Figure 1. Research Model

Table 2. Construct Variables and Items

Construct Variable	Acronym	Description	Items
Perceived Ease of Use	PEOU	Includes variables related to ease of use	5 items
Perceived Usefulness	PU	Includes variables related to usefulness	7 items
Behavioral Intention to Use	BIU	Includes variables related to intended use of the system	3 items
Attitude Towards Technology	ATT	Includes variables related to the attitude towards the system	4 items
Subject Norm (social influence)	SN	Includes variables related to social influence using the system	4 items
Performance Expectancy	PE	Performance of users of the system	2 items
Anxiety	ANX	Includes variables related to anxiety using the system	4 items
Moderating Variable			
Socio-Demographic Variables	GEN	Includes socio-demographical variables	5 items

4. Methodology

4.1. Sample, Data Collection, and Quality

Pre-tests were conducted prior to the data collection with a small sample of respondents in order to assess the survey's reliability and to modify any questions that may create confusion. Because of the explorative character of the survey, the study bases on a convenience sample as it could not be expected to receive a totally random sample of Virtual Worlds users. The data for this study is unique because behavioral data is collected at the individual level and consist of a sample of 249 respondents. Data were collected through means of an online survey conducted over the Internet in early summer 2007. SL users were contacted through mailing lists, postings, blogs, and "in-word" announcement of this study. Each survey participant received 300 Linden Dollar (about 1.5 USD) for a complete and accurate survey sheet. Due to the fact that on SL each person has to have an avatar name, which is a different name than the real life name, anonymity was guaranteed. Moreover, by providing the avatar's name, we were not only able to count the respondents but also to check whether every participant filled out the survey only once by cross-checking IP addresses.

Unfortunately, SL provides no data about the social-economic structure of their users. However, if expected that SL users have similar characteristics like Internet users, this convenience sample seems to represent the Internet population quite well. Of all respondents, 53% are female compared to 47% male. Hence, no significant gender gap

can be detected in data set as it is the same in Internet usage [Chin et al. 2008]. The age structure of our sample is well balanced as the youngest person is 18 and the oldest person is 77 years old. This is consistent with the fact that the minimum age of using SL is 18 years. The respondents come from 37 different nations. Most of them are US citizens (56%) followed by members from the UK (8%) and Canadians (8%). Members from Europe in total amount to 12% of all respondents. These figures are probably representative for SL as this is a platform hosted and promoted mostly in the US.

4.2. Measurement Scale Validation

In order to validate the proposed research model, the validity and reliability of the construct variables and underlying measurement items have to be examined at first. In order to assess the construct validity and reliability, a test on Cronbach Alpha was conducted for each construct variable and the underlying measurement items. Passing this test is a prerequisite for further analysis ([DeVellis 1991], [Nunnally 1987]). The overall Cronbach Alpha for all items is 0.87. It varies for the corresponding construct variables between 0.67 and 0.89. Therefore, no individual measurement item and construct variable significantly deflated Cronbach Alpha which has a threshold value of 0.60 [Hair et al. 1998]. Hence, no item was discarded. The following table outlines the construct variables and number of underlying measurement items, Cronbach Alpha and the mean value and variance.

Table 3. Survey Items

Construct Variable	Number of Measurement Items	Cronbach Alpha	Mean	Variance
PEOU	5 items	0.82	3.51	0.05
PU	7 items	0.84	3.71	0.08
BIU	3 items	0.74	3.73	0.18
ATT	4 items	0.89	4.37	0.00
SN	4 items	0.67	3.94	0.15
PE	2 items	0.70	3.81	0.01
GEN	5 items	N/A	N/A	N/A
ANX	4 items	0.83	2.09	0.04

As the reliability coefficients are all within generally accepted thresholds [Hair et al. 1989], the results suggest a high level of reliability of the construct variables and underlying measurement items.

4.3. Model Validation

The validity of the construct of the proposed research model was assessed using a factor analysis. The principal components method was used to extract the main factors needed to test the proposed research model. A factor loading greater than 0.50 with the theoretically correct sign was required for the assignment of an item to a factor [Backhaus et al. 2003]. The varimax rotation method was used to ease the interpretation of the extracted factors.

First, the number of factors in the model was assessed. We use the Kaiser rule [Kaiser & Derflinger 1984] in order to determine the number of factors. This rule suggests dropping all components with Eigenvalues under 1.0. Our performed analysis suggests a total of 12 factors to take into account for our further analysis.

Second, we calculate the factor loadings. Table 4 below provides the component matrix which shows the factor loadings as the result of the factor analysis. The factor loadings, also called component loadings, are the correlation coefficients between the variables (rows) and factors (columns). The coefficients of correlation express the degree of a linear relationship between the row and column variables of the matrix. The relationship is tighter, as the coefficient is closer to one et v.v.. A negative sign indicates that the variables are inversely related. Loadings above a value of 0.6 are usually considered ’high‘ and those below 0.4 are ’low‘ [Manly 1994]. Overall, our proposed research model shows a good construct fit as in most cases each construct variable corresponds to a factor. Factor loadings above 0.60 are marked with a gray background in the following table.

We performed an Exploratory Factor Analysis (EFA) with the objective to assess the basic structure of our proposed research model. The following conclusion can be drawn from the table above.

Table 4. Validity Analysis (Component Matrix)

Code	Item Variable	1	2	3	4	5	6	7	8	9	10	11	12
PEOU 5	Clear and understandable	0.21	0.18	-0.31	0.13	0.53	0.07	0.21	0.03	-0.12	0.08	-0.06	-0.10
PEOU 4	Flexible to interact	0.34	0.17	-0.10	0.33	0.41	-0.06	0.02	0.13	-0.20	-0.17	-0.09	-0.26

PEOU 3	Learning to operate	0.04	0.08	-0.16	0.04	0.85	0.00	0.00	0.08	0.00	-0.08	0.08	-0.01
PEOU 2	Become skilful	0.04	0.03	-0.04	0.12	0.78	0.16	0.01	-0.02	-0.03	0.06	-0.06	0.01
PEOU 1	Easy to use	0.07	0.02	-0.03	-0.02	0.86	0.01	0.03	-0.06	0.06	0.02	-0.03	0.03
PU 7	Effective to search/meet people	0.27	0.29	0.01	0.67	0.12	0.00	-0.01	0.11	0.05	-0.04	0.06	0.07
PU 6	Effective to search/buy virtual goods	0.07	0.04	0.06	0.88	0.04	0.03	0.01	0.00	0.00	0.02	-0.03	-0.08
PU 5	Search and meet faster people	0.12	0.37	0.09	0.66	0.04	0.03	-0.02	0.11	0.02	-0.01	0.04	0.15
PU 4	Search and buy faster virtual goods	0.02	0.06	-0.01	0.84	0.05	0.04	0.08	0.00	0.02	0.00	-0.07	-0.06
PU 3	Improves collaboration	0.20	0.85	-0.02	0.17	0.09	0.13	0.09	0.04	0.02	-0.01	0.01	0.07
PU 2	Improves cooperation	0.17	0.85	-0.03	0.23	0.06	0.15	0.08	-0.04	0.00	0.00	0.00	0.06
PU 1	Improves communication	0.21	0.76	-0.01	0.14	0.09	0.16	0.07	0.10	-0.02	0.03	-0.04	-0.03
BIU 3	Intend to buy property	0.26	0.25	0.00	-0.05	0.08	0.73	-0.06	0.02	0.05	0.00	-0.08	-0.01
BIU 2	Intend to earn money	0.16	0.06	-0.08	-0.08	0.04	0.70	0.01	0.14	-0.06	-0.06	-0.14	-0.17
BIU 1	Use next few months	0.30	0.09	-0.16	0.04	-0.01	0.53	-0.02	0.09	0.06	0.09	-0.31	-0.23
ATT 4	Working with it is fun	0.62	0.14	-0.20	0.06	0.22	0.27	0.09	0.25	0.16	-0.12	-0.12	-0.06
ATT 3	SL motives learn/work	0.81	0.19	-0.17	0.07	0.05	0.11	0.07	0.01	0.06	-0.07	-0.11	-0.10
ATT 2	SL makes learn/work interesting	0.82	0.21	-0.17	0.03	0.14	0.11	0.00	0.07	0.06	-0.09	-0.15	-0.01
ATT 1	SL use as learning environment	0.68	0.24	-0.07	0.17	0.16	0.06	-0.01	0.05	0.34	-0.01	-0.01	-0.01
SN 4	College should support usage	0.27	0.31	0.06	0.00	0.04	0.20	0.24	0.13	0.38	0.04	0.17	-0.08
SN 3	Teacher/Friend helpful using SL	0.07	0.05	0.02	-0.08	0.21	-0.08	0.76	0.12	-0.06	-0.08	0.01	0.11
SN 2	Friends think I should use SL	0.11	0.17	-0.16	0.05	0.05	0.07	0.77	-0.07	0.05	0.00	-0.16	-0.13
SN 1	Supervisor/Teacher think I should use SL	-0.05	0.01	-0.03	0.10	-0.12	0.00	0.81	0.08	0.02	0.11	0.09	-0.01
PE 2	SL enables to enhance computer literacy	0.65	-0.05	0.03	0.11	-0.10	0.14	0.11	0.18	-0.13	0.00	0.17	0.30
PE 1	Useful for future career	0.62	0.12	-0.13	0.03	-0.04	0.33	0.05	-0.02	0.01	0.18	0.15	0.13
	Gender	0.15	0.09	0.11	-0.02	-0.03	0.00	-0.03	-0.05	-0.11	-0.04	-0.21	0.77
	How long been on SL	0.06	0.18	-0.24	-0.08	-0.05	0.03	0.01	0.22	0.11	0.69	-0.01	0.12
	Educational level	0.11	-0.03	-0.09	-0.01	-0.01	-0.01	0.01	-0.05	0.81	0.07	-0.04	-0.05
	Age	0.27	-0.08	-0.23	0.08	-0.10	0.11	-0.04	-0.02	0.62	-0.16	-0.19	-0.04
	Access with	0.03	0.00	0.05	-0.04	-0.06	-0.03	-0.04	0.05	-0.11	0.00	0.82	-0.18
	Access from	-0.04	-0.11	0.09	0.04	0.06	-0.10	0.05	-0.26	-0.09	0.75	0.00	-0.16
ANX 4	SL intimidating	-0.03	-0.05	0.80	0.01	-0.23	-0.06	-0.02	-0.01	0.01	-0.03	0.11	0.15
ANX 3	Hesitate using SL	-0.12	0.03	0.81	0.10	-0.03	-0.04	-0.12	0.14	-0.01	-0.01	-0.06	0.06
ANX 2	Scares me using SL	-0.10	0.00	0.78	0.11	-0.05	-0.08	-0.07	0.05	-0.11	0.00	-0.08	-0.08
ANX 1	Feel apprehended using SL	-0.17	-0.02	0.67	-0.12	-0.09	-0.18	0.09	-0.06	-0.18	-0.08	0.16	0.02

A Rotation converged in 10 iterations.

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

The construct variable *Perceived Ease of Use is* strongly associated with factor 5, in which three out of the five measurement items have a significant factor loading over 0.60. The construct variable *Perceived Usefulness* shows that it is strongly associated with factor 2 and 4. Factor 2 includes measurement items related to the perceived improvements of Virtual Worlds for collaboration, cooperation, and communication. The items about collaboration, cooperation, and communication play an important role in the Virtual World adoption, as expected. The result of the factor analysis suggests grouping them into a new construct variable, which requires the definition of an additional hypothesis. (Hypothesis 9: *The perceived community functions (COM) which enable new ways and channels to communicate, cooperate, and collaborate in Virtual Worlds influence positively and directly the BIU of Virtual Worlds*). This new construct variable is called *Community* (COM) as it deals with community behavior (collaborate, communicate, and cooperate). All of the remaining four items had a significant factor loading of 0.60 or higher, indicating that they all are strongly associated with the construct variable *Perceived Usefulness*. The construct variable *Behavioral Intention to Use* is strongly associated with factor 6. Two of three measurement items are highly significant with a value over 0.60, the third measurement has still a value of 0.53. The construct variable *Subject Norm* was strongly associated with factor 7, in which three out of the four measurement items are highly significant. One measurement item has a factor loading of only 0.24, which means that it will be dropped as a measurement item. The construct variables *Performance Expectancy* and *Attitude Toward Technology* are both strongly associated with factor 1. These results suggest that these two construct variables should be combined into one single construct variable. As both deal with the attitude toward technology or performance, we kept the label of the construct variables ATT for *Attitude Toward Technology*. The construct variable *Anxiety* is strongly associated with factor 3. All measurement items are strongly significant with a value of over 0.60 each. Finally, the *moderating variables* gender, experience, education, and age are loaded on factor 9, 10 and 12 where age and educational level are loaded to the same factor. These results are similar to the finding of Venkatesh et al. [2003].

The factor analysis above suggests some serious adaptations of the initial proposed research model outlined in Figure 1. In order to test the various hypotheses we conducted a Confirmatory Factor Analysis (CFA) through a structural equation modeling. The results of the multivariate test of the structural model are provided in the following Figure 3 which outlines the regression coefficient for each factor as well as the significant level expressed as the significant path. Our results support all hypotheses except one which was the *Anxiety* which was positive but not significant.

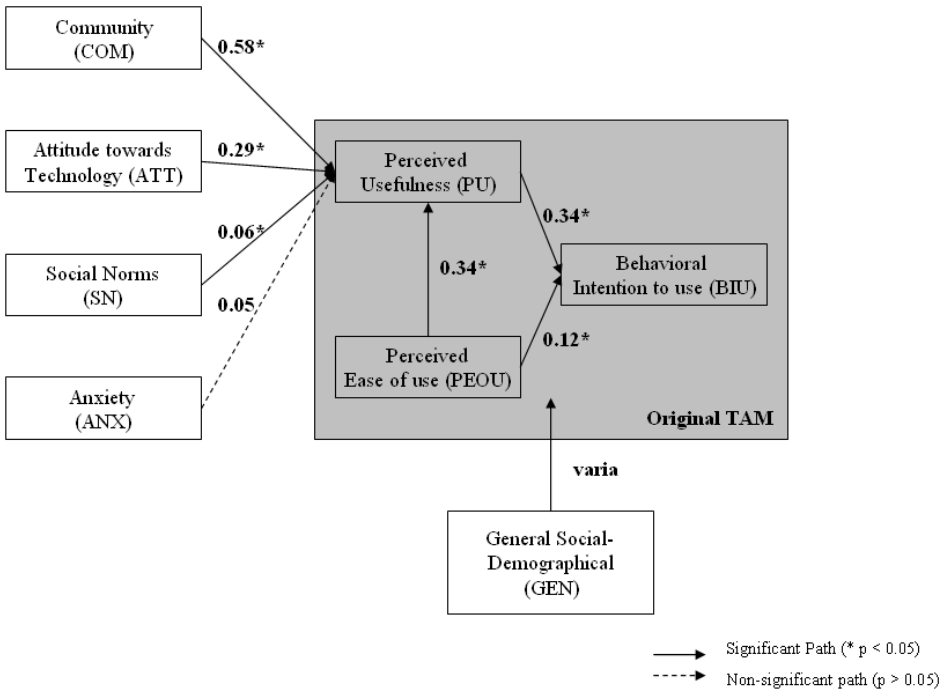

Figure 3. Re-defined Research Model

Each of the hypotheses outlined above is represented in Figure 3 by an arrow. Therefore, by calculating the standardized beta coefficient in the above model each hypothesis is tested automatically. Our results shows that the

perceived functionalities of Virtual Worlds to communicate, cooperate, and collaborate (COM) are the most important ones for the user adoption and acceptance of Virtual Worlds. It has the highest value and therefore strongly influences the perceived usefulness of Virtual Worlds. Moreover, as many other studies have found, another important factor influencing the perceived usefulness and ultimately behavioral intention to use the system was perceived ease of use. Finally, it should be noted that the moderating variables are important, too, in most cases which is in line with former studies. For a discussion of the results, see Gefen and Straub [1997], Hubona and Burton-Jones 2003, and Venkatesh et al. [2003].

We further assess the overall 'model-fit' of the proposed model by calculating the Root Mean Square Error of Approximation (RMSEA) according to Browne and Cudeck [1994] as well as Steiger and Lind [1980]. The idea behind this value is the comparison between the variance-covariance matrix with the empirical variance-covariance matrix. It measures whether the proposed model adequately represents reality [Backhaus et al. 2003]. The RMSEA can get a value between 0 and 1. The smaller the value (i.e. difference between the two matrixes) the better the model fit. Often a value of 0.08 is used as a threshold [Backhaus et al. 2003] meaning that the proposed model is acceptable and reflects adequately reality. We get a value of 0.073 which suggests that the proposed model reflects reality and if we would take another sample from the same population we would get the same results. We got similar results with other model fit measurements such as the Comparative Fit Index (CFI) with 0.85 and the Tucker-Lewis Index (TLI) with 0.96, both indicating a good overall structure of the model.

5. Conclusion and Discussion

Virtual Worlds have already attracted millions of internet users to collaborate, cooperate, and communicate with each other. This paper is one of the first attempts to identify the key factors which influence user acceptance and adoption of Virtual Worlds. Based on previous studies specifically the Technology Acceptance Model (TAM), this paper presented a research model to assess user acceptance of Virtual Worlds. By means of survey data with 249 users from Second Life, the proposed model and underlying hypotheses on user acceptance and adoption of Virtual Worlds were tested. The model is statistically significant and well constructed. However, the conducted analysis has several limitations. The survey based on a convenience sample of user of Second Life, which is only one of various existing Virtual World. Hence the generalizability of the study is limited.

The research results show in particular that the possibility to interact in a 3D environment in combination with Voice over IP plays a pivotal role in user acceptance and technology adoption of virtual worlds. Of all the factors tested, the most important determinant of Virtual World adoption seems the perceived value of communication, cooperation, and communication channels on Virtual Worlds. The effects of these COM components were significantly larger than that of the next most important determinant, perceived usefulness of the Virtual Worlds. Moreover, other influencing factors proposed by Technology Acceptance Model are also relevant to determine user acceptance, such as social norms (SN), attitude toward technology (ATT), and socio-demographical factors (GEN).

The findings have important implications for academia and practitioners. In terms of research the analyses have demonstrated that communication, collaboration, and communication and hence, the community is of crucial importance for the development and assessment of Virtual Worlds. They have to be taken into account in further research on Virtual Worlds adoption and diffusion.

Our results are also important for practitioners and especially companies entering Virtual Worlds to either attract, retain, or interact with existing or new customers as well as promote or sell existing or new products or services. Business models for Virtual Worlds need to provide clear and attractive value proposition to users. In particular they have to address the need for community building elements such as communication, collaboration, and cooperation functionalities in order to fully take advantage of Virtual Worlds as a new channel to interact with customers.

Nevertheless, due to the nature of this emerging technology and application, further research is needed to further understand user behavior in Virtual Worlds. It also suggests that Virtual Worlds, other than Second Life, should be taken into account to fully understand user behavior and intention to use such applications. Finally, more research should test the proposed model with wider and diverse populations across various cultures.

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