Determinants of Continued Participation in Web-Based Co-creation Platforms

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Abstract. Co-creation is gaining popularity as a means to collect creativity from the crowd. With web-based co-creation platforms, the general public can participate in the product design process and also gain rewards. In this paper, the demands of users to participate in co-creation was explored through the implementation of a co-creation competition, and the motivations of users were verified through an empirical research using a web-based experiment with a theoretical framework built on the Technology Acceptance Model (TAM). The result of the co-creation competition confirmed the existence of demands to co-create and the analysis of the experiment verified the explanatory power of TAM under the context of co-creation, verifying only a part of the TAM3 constructs.

Keywords: co-creation, creativity, crowdsourcing, TAM, TAM3.

1 Introduction

Co-creation is gradually and effectively changing user involvement in all levels of industry. Most digital content platforms handling image scraps, video clips, or writings are already dependent on user participation as a main source of contents, and even some manufacturers of tangible products ranging from tee shirts to automobiles are already trying to extract unique values by including customers in the process of product design. Especially in manufacturing tangible products, the advancement of 3D printing technology is accelerating the increase of the depth of user participation. Now users hold significance not only as consumers but also as producers of the products. Consequently, there is an increase of needs for manufacturers to understand the motivation of users participating in co-creation in order to promote co-creation. Through the implementation of a co-creation competition and web-based experimentation, this research will explore the demands of users and the determinants of continued participation in co-creation.

In terms of contents co-creation, two important factors made it possible to motivate people to create and share digital contents. The first is the advancement of digital

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imaging technology that led to the development of the digital camera and cameras embedded in mobile phones. Since digital cameras are convenient and did not require additional costs following the purchase of the device, people started to create a tremendous amount of contents. The other factor is the emergence of web 2.0, online platforms such as blog services, YouTube, and social media such as Facebook and Twitter that allow for users' sharing of contents. Moreover, the two factors become all the more interconnected with the emergence of smart phones, allowing for even larger amounts of contents to be created and shared. Some platforms even enable users to create profit by creating contents. Through blogs and YouTube, contents creators are gaining profit by advertisement profit sharing; moreover, in platforms for advanced contents creators such as App Store and Play Store, developers are given more chances to monetize their skills than they were given in the past.

While research on web 2.0 websites such as user-created contents (UCC) based on technology acceptance model or other behavioral models [7], [8], [9] can be regarded as empirical research on co-creation in a broader sense, this paper solely focuses on co-creation platforms for tangible products. Through empirical analysis of motivation in web-based co-creation for tangible products based on Technology Acceptance Model (TAM), this study will suggest how to design the platform and procedure for the creation for increased participation of users. In this paper, TAM is applied as the base theory to analyze the motivation for co-creation.

2 Background

The increased convenience of creation and the marketability of created product are also important factors that enabled co-creation of tangible products. Manufacturers that apply co-creation provide both tools for creation and platforms for actual production and sales. Threadless (http://www.threadless.com/), one popular co-creation platform for tangible products, gathers designs from the community and also receives evaluations of those designs from the community. Then, Threadless introduces top rated designs as actual products every week, and rewards the winner monetarily. As of October 6th, 2013, 4,735 designs among 522,033 designs submitted are printed and sold. Over 1,200 artists are made profit of 8,774,411 as a reward. The total number of the members is over 2.5 million (threadless website, http://www.threadless.com/). Such records of Threadless display the feasibility of the co-creation of tangible products.

Local Motors (http://localmotors.com/), a micro automobile manufacturer introduced by Chris Anderson [5], is another popular example of co-creation. Local Motors produces and sells a vehicle named Rally Fighter. To design Rally Fighter, Local Motors organized a competition for vehicle design to avoid similarities with vehicles manufactured by big companies. The components of the vehicle were also selected by community members, and the entire design of the vehicle was then open sourced under Creative Commons License. Local Motors shows that co-creation can be applied to even in industries of sophisticated products as automobiles.

The advancement of 3D printing technology has opened another dimension of co-creation possibilities. In Shapeways (http://www.shapeways.com/), designers who can create 3D models of products can upload and sell their products immediately.

Shapeways use industrial-grade 3D printers rather than low-cost printers that designers can offer, enabling the production of high quality outputs that are apt for selling [6]. The products are printed after the purchase and designers do not have to worry about actual production, delivery, or inventory. The service offered by Shapeways can make a huge impact to the industries of simple products such as bath supplies and desk utilities because the designers can commercialize their ideas without any support of organizations. As Local Motors' Rally Fighter aims for the niche market of consumers who want unique vehicles [5], Shapeways can trigger the emergence of market of unique and customized home supplies.

There are many advantages of co-creation that make it an important trend in industry. For the platforms and companies utilizing co-creation, various ideas or designs can be sourced by user participation. These new concepts are usually closely related to the users' actual needs; thus, it signals the possibility of the demand for them. Creation processes involving other users allow enhanced ideas to be produced and filter insignificant ideas at an early stage. Furthermore, the fact that the creation went through the filtering of the social community further guarantees the interests in the products.

Regarding the participants, co-creation platforms can provide opportunities to actualize the development of self-made designs and ideas. It usually takes much effort to produce tangible products out of a design model or ideas of their own. But with co-creation platforms, designs or even very crude ideas can become seeds for great products. Quirky (http://www.quirky.com/) is a company that sources ideas from the community and convert the ideas to real products. Unlike Shapeways, which requires participants to submit a 3D model of the ideas, Quirky collects crude ideas from community members. The ideas collected then receive feedback and get votes also from community members. In other words, co-creation platforms publicize the means of commercialization and production to ordinary people.

Despite the industry's interest in co-creation platforms and the need for promoting user participation, there is only limited research on the motivation of users' participation in co-creation platforms. Vladimir Zwass suggested taxonomy of co-creation and listed possible motivators of participation in co-creation [4]. Zwass listed further research on those motivators and other factors that affect continued motivation to participate in co-creation platforms.

Furthermore, Zwass divided co-creation into two categories by the co-created values: autonomous co-creation and sponsored co-creation. According to Zwass, autonomous co-creation can be found in the forms of production of procedural content (open source software), production of declarative content, hardware co-creation, development of social capital, reputation system, word-of-mouth promotion, collective sense-making, appropriable collective ranking for importance, collective sentiment expression, and task redistribution. Meanwhile, sponsored co-creation can be found in the forms of ideation, idea evaluation, product co-design, product testing, consumer resource contribution, product promotion, consumer self-revelation, and consumer-side customer service. Among those listed forms of co-creation, sponsored co-creation as a form of product co-design is closest to the web based co-creation platform defined and analyzed in this paper.

3 Research Model and Hypotheses

In this paper, a research model named Co-Creation Participation Model was developed by modifying the TAM3 suggested by Venkatesh and Bala [3] to confirm the validity of TAM and TAM3 as proper models for explaining the motivational factors of co-creation participants.

3.1 TAM and Co-creation

TAM was first developed by Fred D. Davis, who integrated diverse perspectives from expectancy theory, self-efficacy theory, and behavioral decision theory, diffusion of innovations, marketing, and human-computer interactions to explain the two primary factors that affect the behavioral intention to use the information system in organizations [2]. Davis suggested Perceived Usefulness and Perceived Ease of Use as two factors affecting the attitude for usage. Then with series of empirical studies that followed, he confirmed that Perceived Usefulness is significantly related to attitude toward usage and Perceived Ease of Use is indirectly affects attitude toward usage through Perceived Usefulness as mediator [2], [10].

A number of confirmatory researches on TAM is followed and supported by the validity of Perceived Usefulness and Perceived Ease of Use as a determinant of intention to use the new technology [11]. However, despite solid validations of the model and popularity as a base theory of empirical analyses in the field of information systems, TAM has limited explanatory power due to the parsimonious model.

Therefore, as an effort to elaborate TAM, Viswanath Venkatesh and Davis suggested Technology Acceptance Model 2 (TAM2), which includes Computer Self-Efficacy, Perception of External Control, Computer Anxiety, Computer Playfulness, Perceived Enjoyment and Objective Usability as factors affecting Ease of Use in 2000 [12]. In 2008, Venkatesh and Hillol Bala added Subjective Norm, Image, Job Relevance, Output Quality and Result Demonstrability as determinants of Perceived Usefulness and suggested technology acceptance model 3 (TAM3) [3].TAM has already been used in previous research on various information systems including contents co-creation research, even without organizational settings [7], [8], [9]. Since the main mediator of the TAM is Behavioral Intention to Use and Actual System Use is measured with the frequency and continuity of the system usage, technology acceptance can be also defined as development of intention to continued use of the technology. Therefore, TAM is generally applicable to the various contexts regarding introduction of new IT based service including co-creation platforms.

3.2 TAM3 and Co-creation

Among those validated by Venkatesh, the constructs of Experience, Voluntariness, Image, Job Relevance, Computer Anxiety, Objective Usability, and Actual System Use were excluded due to the incompatibility caused by the setting of the experiment.

In case of Experience, because there is no popular co-creation platform with tangible output in Korea, no participants had significant experience in platforms of interest. Moreover, because participants were not recruited within organizational context,

Voluntariness, Image, and Job Relevance were not able to be measured. And since the experiment was carried out with a dummy web platform with one time visit, Objective Usability and Actual System Use were also unable to be measured properly.

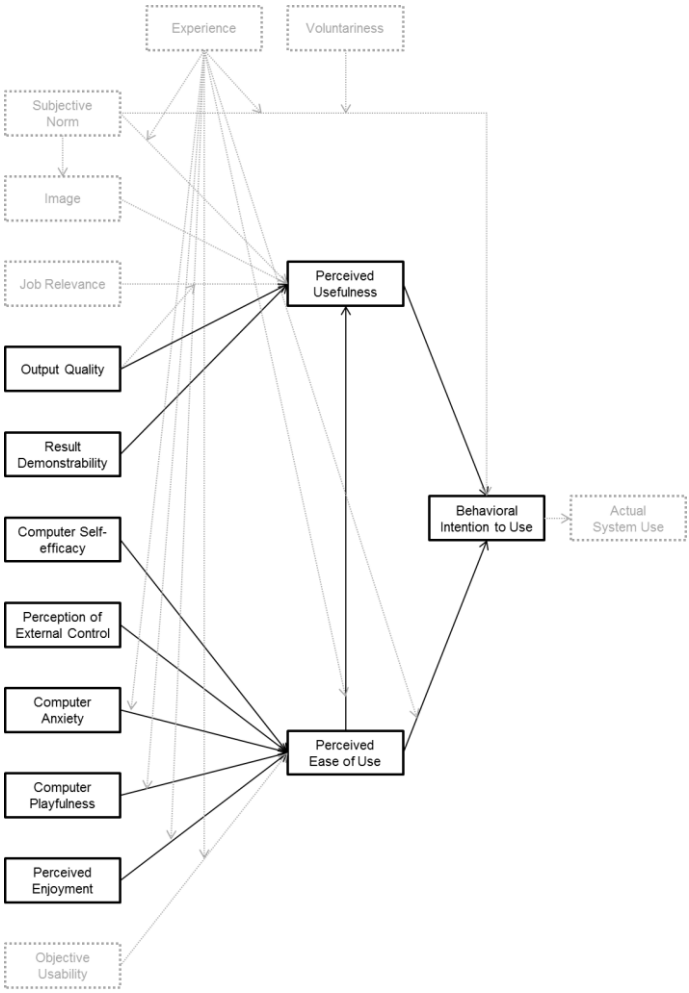

Fig. 1. Co-Creation Participation Model Derived from Technology Acceptance Model 3

4 Experimental Procedure

4.1 Measures

Survey questionnaires to measure the constructs were prepared by translating the questionnaires provided by Venkatesh and Bala [3] into Korean.

4.2 Stimulus Preparation

The stimulus was designed based on the structure of threadless, one popular co-creation platform. Threadless was chosen as the service model because although uploading an illustration of tee shirt design is relatively easy, the illustration is one of the main features that define the characteristic of the product.

The stimulus was developed using Ruby on Rails (Rails), a popular web development framework based on Ruby programming language. Rails was chosen because it is suitable for fast prototyping by supporting scaffolding functionality which provides basic structure for create, update, delete, show, and list the records. A big number of plug-ins called Gems are also available as an open source, which make it easy to add functionalities including authentication, image upload and image handling.

After development of web application, the application at first was hosted using heroku (Sic.). Heroku (https://www.heroku.com/) is a PaaS (Platform as a Service) that provides a package of virtual machine, web server, and PostgreSQL database.

4.3 Data Collection Method

The stimulus was composed of a fully functional web platform for uploading and rating tee shirt designs and task guides floating on the bottom right corner of the website. Tasks were designed to guide participants to use all the basic functionalities including signing up, editing profile, uploading, and rating designs. Since evaluating other designs is as important as uploading designs for the community to operate, the task required participants to rate more than 5 designs to proceed.

After conducting the tasks requested, participants were redirected to an online survey composed of measures from TAM3. The questionnaires were translated into Korean and the answers were measured using 7 point likert scale as in Davis research in 1986 [2].

4.4 Pilot Interview

Before actual data collection, a pilot interview was conducted to check the existence of bugs or errors and to confirm that participants could fully understand and perform tasks as guided. The interviewee was a college student majoring in visual design to assure the interest in co-creation services on designs.

The interviewee was asked questions while following predefined tasks and changes on-screen. The conversation was recorded. After finishing all the tasks defined, the interviewee was requested to provide additional feedbacks.

After the pilot interview, the acquired feedbacks were applied to the stimulus website, modifying the design for better understandability and correcting vague expressions in the questionnaire.

4.5 Participant Recruiting

The roles of users in co-creation platforms can be classified into three categories: creators, evaluators, and consumers. However, the users of co-creation platforms tend to not to choose a single role. Both creators and consumers actively participate in

evaluating creations and according to Vladimir Zwass, the roles of users become fluid that even formerly consumers easily become creators. [4] Nonetheless, users initially can be divided into two big groups of creator-evaluators and consumer-evaluators.

In this paper, creator-evaluators were targeted participants of research, since consumer-evaluators are not recruitable until the platform has enough of creations to offer, and the primary interest of the research was to promote the creation rather than purchase in co-creation platforms.

Participants of the experiment were recruited from acquaintances and members of another web-based co-creation platform called byillust (http://www.byillust.com/) by email, without any reward being provided. Surveys by 30 participants composed of 15 male and 15 female were collected. The range of participants' age was from 19 to 31.

5 Results and Discussion

Data collected by the survey were coded and analyzed using the structural equation model to check the reliability and validity of measurement models and to verify the relationship suggested by TAM and TAM3 in the co-creation context. Statistical analysis was processed using Partial Least Square (PLS). PLS is a widely used method for factor analysis and regression analysis in the field of information systems, where TAM is developed and mostly used [20]. SmartPLS (http://smartpls.de/) software was used for PLS analysis.

5.1 Reliability and Validity of Variables

Reliability Analysis. For verification of reliability, Cronbach Alpha and Composite Reliability were used. Cronbach Alpha above 0.5 and Composite Reliability above 0.7 verify the reliability of the construct. According to the Table 1, for all of constructs, Cronbach Alpha is bigger than 0.5 and Composite Reliability is bigger than 0.7, verifying that the measures of the constructs are reliable.

Table 1. Composite Reliability and Cronbachs Alpha

	Composite Reliability	Cronbachs Alpha
BI	0.875094	0.781075
CANX	0.822352	0.763494
CPLAY	0.765451	0.664613
CSE	0.862399	0.792430
ENJ	0.938365	0.902142
OUT	0.947172	0.915867
PEC	0.827082	0.687272
PEOU	0.916040	0.878002
PU	0.960404	0.944989
RES	0.819293	0.617145

Construct Validity Analysis. For verification of construct validity, convergent validity and discriminant validity were examined. For convergent validity, loading between constructs and corresponding measures, and cross loading between constructs and unrelated measures were used. According to the analysis, loading between constructs and corresponding measures are bigger than 0.5 except measure CANX1 and RES4, verifying convergent validity. Measure CANX1 and RES4 were excluded in the research model verification.

In the case of discriminant validity, square root of AVE (average variance extracted) should be above 0.5 and bigger than latent variable correlation with other constructs to confirm discriminant validity [21]. However, according to the Table 2, correlation between Perceived Enjoyment and Behavioral Intention to Use is bigger than square root of AVE of Behavioral Intention to Use. Since Behavioral Intention to Use is more important than Perceived Enjoyment, Perceived Enjoyment was also excluded in the research model verification.

Table 2. Square root of AVE (average variance extracted) and Latent Variable Correlations

	$\sqrt{AVE}$	BI	CANX	CPLAY	CSE	ENJ	OUT	PEC	PEOU	PU
$\sqrt{AVE}$		0.845	0.767	0.672	0.784	0.914	0.926	0.784	0.856	0.927
BI	0.845									
CANX	0.767	0.212								
CPLAY	0.672	0.160	0.099							
CSE	0.784	0.322	0.113	0.369						
ENJ	0.914	0.856	0.176	0.444	0.488					
OUT	0.926	0.542	0.097	0.460	0.254	0.553				
PEC	0.784	0.385	−0.064	0.404	0.635	0.404	0.627			
PEOU	0.856	0.718	0.256	0.165	0.331	0.565	0.548	0.609		
PU	0.927	0.825	0.252	0.084	0.278	0.692	0.406	0.242	0.729	
RES	0.769	0.638	0.101	0.545	0.527	0.685	0.692	0.647	0.616	0.520

5.2 Research Model Verification

Verification of the research model was processed through bootstrapping and the result is depicted in Figure 2 and Table 3. Generally, t-value bigger than 1.96 accepts the relation with significance level of 0.05 and t-value bigger than 2.58 accepts relation with significance level of 0.01.

According to Table 3, path from Perceived Usefulness to Behavioral Intention and Perceived path from Perceived Ease of Use to Perceived Usefulness were accepted, confirming that TAM is verified under the context of web-based co-creation platform. Furthermore, among constructs listed in TAM3, only Computer Anxiety and Perception of External Control are confirmed to affect Perceived Ease of Use.

In conclusion, it is more proper to extend basic TAM with confirmed constructs from TAM3 and other contextual constructs that can be derived from possible motivators in co-creation rather than to use TAM3 fully as the base model for co-creation platform research.

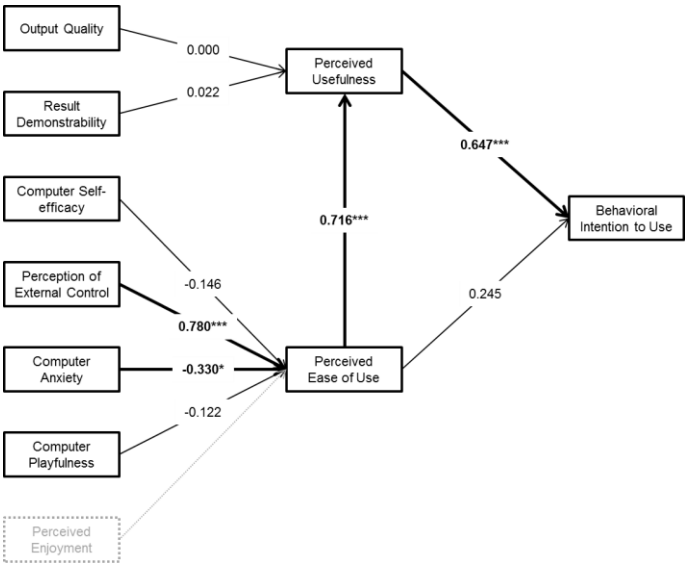

Fig. 2. Final Model

Table 3. Composite Reliability and Cronbachs Alpha

Path	T Statistics	Verification
CANX ->PEOU	2.093593	Accepted
CPLAY ->PEOU	0.57136	Rejected
CSE ->PEOU	0.746272	Rejected
ENJ ->PEOU	-	Excluded
OUT ->PU	0.000975	Rejected
PEC ->PEOU	4.315112	Accepted
PEOU ->BI	1.340673	Rejected
PEOU ->PU	3.257242	Accepted
PU ->BI	3.806427	Accepted
RES ->PU	0.127541	Rejected

6 Conclusion

6.1 Research Summary

The existence of demand to participate in co-creation was verified through co-creation competition. The co-creation participation model based on TAM and TAM3 was suggested and analyzed through the experiment with web-based co-creation platform.

As a result of the analysis, TAM turned out to be applicable to the acceptance of co-creation platforms, while constructs in TAM3 are not verified except Perception of External Control. In TAM3, Perception of External Control is defined as “the degree to which an individual believes that organizational and technical resources exist to support

the use of the system"[18], [3] which means that providing technical support and giving high level of freedom while using the co-creation platform can positively affect the perceived ease of use, eventually promoting continued participation in co-creation. In addition, Computer Anxiety is defined as "The degree of 'an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers'"[18, 3] in TAM3 which suggests setting target users with people who are comfortable with using computers may decrease negative effect on continued participation.

6.2 Limitations and Further Research

Although confirming the existence of needs for co-creation platforms and validating TAM as the base of co-creation research were successful, providing the direction to promote the participation of co-creation was unsuccessful due to the limited confirmation of constructs.

The inconsistency of the research model can be explained by the difference of context between TAM, TAM3, and the experimentation in this paper. TAM was originally developed for explanations of technology acceptance in organizational setting, and TAM3 was for the expansion of TAM under the same context. Even though TAM was applicable in context other than organization due to its parsimoniousness, TAM3 is too context-specific to be used under non-organizational context. Therefore, it is more proper to expand TAM under the context of co-creation than to apply TAM3 as a research model.

Besides the suitability of the research model, another limitation results from the short duration of service usage. For example, the assessment of Output Quality and Result Demonstrability can be affected over persistent use of the service. The Output Quality can especially be dependent on the score rated by community members but participants were not able to receive proper social feedback because they visited the website only once before answering survey questions. Regarding the specificity of the context, different methodology such as field research surveying the actual users of existing service or longitudinal research with development and execution of real service is suggested for future research.

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