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Construction and analysis of purchase factor model by using creativity method

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Abstract: This paper describes a purchase factor analysis for best−selling software games. Japanese game industry has grown remarkably since 1983. Developers have to produce best sellers in order to get a profit. However, the concrete factors for a best-selling game have not yet been qualified. Structural equation modeling (SEM) seems to have the beneficial effect on causality analysis. However, the SEM results may lack the reliability because the model is constructed based on the analyzers' subjective assumptions. We need to construct a factor model for solving this problem by extracting the purchase factor from diverse viewpoints. Consequently, we use the KJ method, which is one of the creativity methods, to do just that. There are four steps in the process for analyzing the factor model from the results of KJ method: (1) extract the factors from the KJ method results, (2) refine the model by integrating conceptualistic meanings, (3) assign the collected data to the model, and (4) construct and analyze the model by indentifying the variables. From the result of our analysis of the model, we could qualify the factors of best-selling games by using an objective purchase factor model that was mainly constructed of the "Contents", "Advertisement", and "Brand".

Keywords: creativity method, KJ method, Structural Equation Modeling, marketing, purchase factor analysis**.**

I. INTRODUCTION

The Japanese game industry has grown remarkably since 1983 beginning with the "Family Computer" product released by Nintendo Co. The size of the market in 2007 was twice as large as that in 1987, and now software games play a central role in the industry [1]. However, the running costs of the developers have become compressed, and there is more absorbability between the makers as a result of the ever-increasing appreciation for the development of new and better software games. Therefore, the developers are forced to produce best sellers in order to make a profit. However, the concrete factors surrounding the development of a best seller and the latent factors have yet to be qualified. There are many analysis methods for estimating the consumers' purchase factor, such as Factor Analysis [2~3], Regression [4], and Baysian Modeling [5]. In particular, Structural Equation Modeling (SEM) [6] has a more beneficial effect on a causality analysis because this method can express the complex causal relationship between the observational and latent factors.

We have analyzed the factors by using SEM in order to qualify the factors surrounding best-selling software games. As a result of our analysis, we found that a model constructed by Kitami [7] proved that the consumers' purchasing factor was affected by the basic information about the games and the consumers' expectation. However, this result may not be able to extract substantial paths or latent factors, and thus, the reliability and relevance of this model may be insufficient. The reason for this is derived from the subjective assumptions of the analyzers.

To solve this problem, we propose a process for constructing a SEM model from the results when using the creativity method and that analyzes the consumers' purchasing factor. In this paper, we use a bottom-up type KJ method. We outline the investigative items and apply them to a factor model composed of the factors when using the KJ method.

The rest of this paper is presented as follows. We describe the problem with the approach when using SEM in Chapter 2. Chapter 3 explains the process of constructing a model from the KJ method. Chapter 4 explains a model constructed according to the process and the result of our analysis. The results are the considered and discussed in Chapter 5. Finally, Chapter 6 concludes with a summary of the key points.

II. PROBLEM WITH SEM AND SOLUTION

1. Structural Equation Modeling

SEM is an analysis method that quantitatively evaluates the causality relationship between the more

remarkable variables in statistic data and causality information, and has been used in causality analysis since the 1950's in many domains, such as economics and social science [8]. SEM can visualize and quantify the complex causality relationships between variables. The formula for SEM is as follows.

$$x_i = \sum_{x_k \in pa_i} a_{ik} x_k + u_i, \qquad i = 1,...,n \qquad (1)$$

x_i is a set of variables are considered direct factors. pa_i corresponds to the variables that have coefficients that are not 0 on the right side. Also, u_i shows the error that is not expressed. SEM presents the strength of the correlation and the covariance as the path coefficient. Also, if the path coefficient between variables is large, we assume the relationship between the variables is strong.

2. Problem of approach by SEM

SEM has some advantages as stated above, and is an effective method in causality analysis. However SEM has the following problems.

(1) Experience needed: The analyzer in a targeted analysis when using SEM needs a lot of prior knowledge, because the construction of the model is only exploratory if the analyzer lacks sufficient knowledge, which may lead to bad results and contradictions.

(2) The construction of model is subjective: Even though the analyzer has sufficient knowledge about the target of analysis, there is the possibility that the objectivity of model is lacking.

(3) The accuracy is more weighted than the explanatory power when constructing the model: As previously noted, the accuracy is exploratory when the analysis model is not clarified. Therefore, there is a possibility that the model which has low explanatory power is constructed because the analyzer too achieves the accuracy.

In order to solve these problems, we need to construct a SEM model that is objective and has a broad range of explanatory power. Therefore, we constructed a purchase factor model and clarified the factors for a best seller by using the KJ method, which is one of the creativity methods.

3. Suggestion of model construction by using creativity method

The creativity method is a systematic method that thinks out and arranges many ideas in order to creatively solve a technical problem. In this paper, we systematized the consumers' opinions by using the KJ method. The KJ method is a method used for information integration and can effectively organize innovative ideas by arranging and refining segmentized ideas [9]. This method appropriates a causality analysis because it can express the causal relationship between the factors by using arrows. We expect the following merits from using the KJ method.

(1) A subjective model constructed of diverse opinions.

(2) We can construct a model that has explanation power.

(3) A causal relationship model is expressed.

In this paper, we construct the SEM model based on the completed chart of the KJ method.

However, problems arise when constructing a factor model from the KJ method results. The first problem is the way the factors are decided. If we assume all the groups to be factors, there is a possibility that a massive latent factor will be embedded in the model. So, there are problems with the goodness of fit and the relevance of model. The second problem is the difference of expression. There is a possibility that constructing a model is difficult because the cards are written in a free-form language so that cards with similar meanings are found throughout the model. Therefore, it is necessary to construct a model while solving these problems.

III. MODELING PROCESS FROM KJ METHOD

After experimenting with the KJ method, we construct a SEM model that contains the four following processes (Fig. 1).

(1) Extract factors from the KJ method results.

(2) Refine graph by integrating expressions.

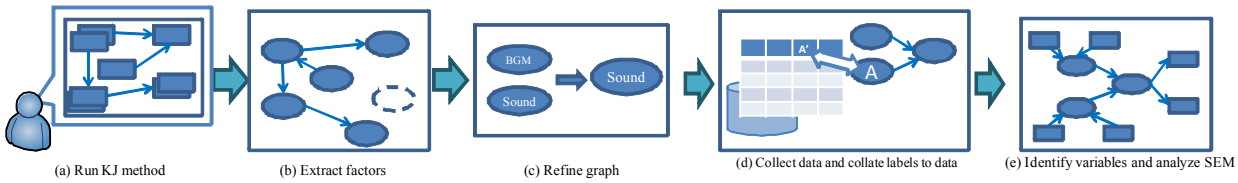

Fig.1 The flow of construction of purchase factor model

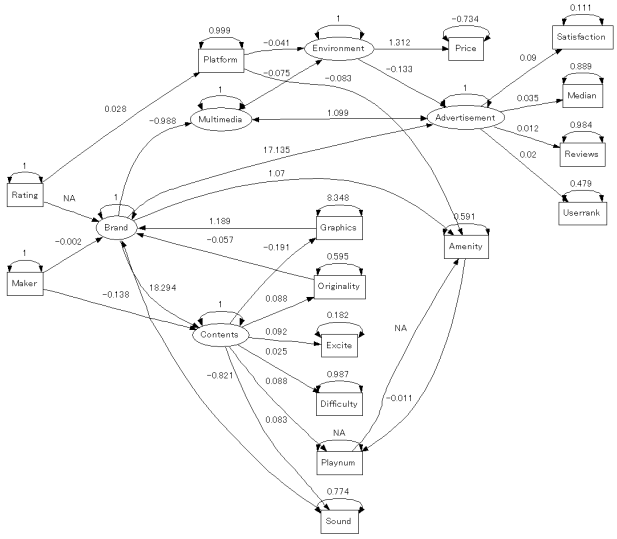

Fig.2 Completed SEM model

Table.1 Fit indices of model

Goodness-of-fit index	0.858
Adjusted goodness-of-fit index	0.784
RMSEA index	0.118
SRMR	0.100
BIC	2061.4

(3) Collate labels to data.

(4) Identify variables and analyze SEM.

The processes for each of the above listed step are as follows.

(1) Extract factors: First, we identify the factor settings for the threshold of the degree and exclude the cards and arrows that adjoin the factors. By using process, we can compress the model excluding the cards and arrows that barely relate to the final factor model.

(2) Refine graph: Second, we refine the model conceptually by integrating the expressions among the cards. In this step, we integrate cards that mutually look alike and exclude cards and arrows that barely relate to the final model.

(3) Collate labels to data: After the above processes, it is necessary to collate the labels to the analysis data. In addition, as much of the data in which the conceptual meanings are approximated with the cards and factors is as collected as possible regardless if its structured or semi-structured data.

(4) Identify variables and analyze SEM: Finally, we identify the variables and analyze the factors for a best seller based on the graph completed by using the above mentioned processes.

When constructing the model, we have to identify the latent and observational variables. In this paper, we assume the factors that cannot collate with the observational data to be latently variable. In addition, we assume the factors and the cards that can collate with the observational data to be observational variables, and we construct the model excluding cards that cannot collate with the observational data.

IV. CASE STUDY

1. Target of experiment

We constructed a purchase factor model from the consumers' opinions by using the process proposed in Chapter 3. In this paper, we ran the KJ method targeting five university students as our case study. In this experiment, the theme was set to "the factors for best-selling software games".

The target data for software games included 2381 products that were evaluated by consumers in PlayStation mk2 [10]. There were 17 data attributes (maker name, platform, genre, price, rating of target age, publish date, the number of players, game rank, the game criterion (difficulty, originality, graphic, sound, excitement and amenity), the number of reviews, the degree of satisfaction, and comprehensive evaluation). We also used R 2.10 [11] when analyzing the factors in SEM.

2. Experiment results

The KJ method results showed that the model consisted of 63 cards and 73 arrows. According to the process proposed in Chapter 3, we set threshold to four and constructed a SEM model consisting of five latent and 15 observational variables using this process.

The results from analyzing the completed model are shown in Fig. 2. The fit indices of the model are listed in Table. 1. The Goodness-of-fit index (GFI) of this model was calculated to be 0.858 and was unable to achieve a rough standard of 0.9. However, we could express part of the consumers' purchase factor [12].

This factor model was assumed to consist of the contents of the games, the maker brand, and advertisement because their degrees were the largest. Next, in the calculated path coefficients, the contents more relatively strongly influenced the "Sound", "Excite", and "Originality" than "Graphics", "Difficulty", and "Playnum" (the number of players). "Brand" had the high influence on the "Advertisement" (17.135) and "Contents" (18.294). In addition, "Brand"

was strongly affected by the "Graphics" (1.189). "Advertisement" showed a strong relationship with Multimedia (1.099).

V. CONSIDERATION

We understood that the consumers' purchase factor mainly depends on the contents of games, maker brand and advertisement from the results of our analysis. "Contents" positively influenced "Sound", "Graphics", and "Originality". The reason for this is that the consumers want novel games that can be played for longer periods of time, and they want an aural allurement that is yielded by next-generation hardware. Next, "Brand" highly influenced "Advertisement" and "Contents". Therefore, the maker brand for consumers consists of the degree of advertisement and quality of the contents. We also found that "Advertisement" was affected by "Environment" and has a strong relationship with "Multimedia". So, we learned that the amount and quality of current information greatly influences the consumers' purchase factor.

Five male university students ran the KJ method for this research paper. They had a lot of experience playing games, so the KJ method results highly relevant and the "Brand" and "Advertisement" were taken into consideration. However, the KJ method has a problem in that the level of objectivity may be lacking due to the age-bracket of the test subjects, their gender, and the degree of knowledge for the set theme. Therefore, it would be more effective for us to run multiple KJ methods targeting different test subjects and combine these results to construct a more objective factor model that contained broader view points.

Next, we look into consideration the model construction process. First, for the extraction method of the factors, we set threshold for the degree and assumed the cards that were over the threshold to be a factor. In addition, we excluded 14 cards and 14 arrows that did not adjoin the factor. If we extract too many factors, there is a possibility that a model identification problem may occur because a lot of latent factors are set in the model. Therefore, when we set the threshold, it is important to have the cogitate attributes of the data and the extracted factors. In integrating the expressions between cards, we integrated the cards by confirming their meanings one by one in order to avoid wrongly classifying them during the automated process.

VI. CONCLUSION

We propose a construction process of a consumers' purchase factor model using a creativity method, and clarified the factors surrounding the best seller of software games. We constructed a model by using the KJ method, which is one of the creativity methods, to solve the problems with SEM concerning the objectivity of the model and the construal difficulty cased by individual differences.

The results from constructing a model and analyzing the factors concerning the best seller when using the KJ method when the theme was set to "the factor of the best-selling software games" showed a consumers' purchase factor that mainly consisted of the contents of the games and the brands of the makers.

However, the KJ method has some problems in that a difference in the height of an interest for a theme and the degree of knowledge bias are caused by individual differences. Therefore, some issues with the overall reliability and adequacy of the factor model may remain if we construct a factor model based on only one experiment. Therefore, we will construct a factor model by integrating multiple results from our experiments. We can construct a factor model that has a higher level of objectivity by improving this process.

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