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Dennis Castel Hiroshi Tsuji

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Dennis Castel and Hiroshi Tsuji
Research Organization for the 21st Century (RO-21), Osaka Prefecture University, Osaka, Japan

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Abstract

Purpose – The purpose of this paper is to presents an interactive conjoint analysis Web-based system that allows the problems of traditional conjoint analysis to be avoided. In the case of a product with lot of parameters, respondents' tacit preferences may be difficult to understand for marketing analysis. To get a precise analysis, respondents must be allowed to reconsider and correct by themselves their evaluations with an adapted tool.

Design/methodology/approach – This system also helps respondents to easily evaluate complex product profiles and to be involved in the evaluation process, which also leads to the creation of new knowledge for product design. As this system is designed for marketers and for respondents, this paper also presents the case of a product evaluation with attributes selectable by respondents.

Findings – This paper is based on empirical experiment to obtain an efficient design of our system. The authors propose different evaluation scenario to usersto decide the design of our system. The authors want to include users in our evaluation process; however, we found that too much liberty for users can interfere with our objective.

Originality/value – This paper present the design of our original system allowing to perform interactive conjoint analysis.

Keywords Advanced Web applications, Web search and information extraction, Web databases

Paper type Research paper

1. Introduction

For marketing analysis, product designers want to understand and measure the demand of a specific market to design the most attractive product or service. Among a lot of marketing analysis techniques, conjoint analysis is one of the most popular market research tools for designing products or services (Gustafsson *et al.*, 2007). Many companies already use designed questionnaires to collect information about products or services. These days, most of these questionnaires can be answered with a Web-based survey (Tsuji and Takeyasu, 2009). This allows the customer to respond to surveys any time, any place. Moreover, with the help of information technology science, it is a simpler way to collect and analyze all respondents' answers.

In the case of a complex product with a lot of parameters, a respondent's tacit knowledge may be difficult to understand. To get a precise analysis, the respondent must be allowed to correct his or herself and to reconsider his or her evaluation. With a feedback system, marketers can be sure to get more precise information about the product/service of the study. In this paper, we will explain how such a system offers the possibility of getting new information about preferences of consumers.

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In this paper, we will introduce our Server-Side Includes (SSI) Web system named "CASIMIR" (for Conjoint Analysis Spiral Interactive Mining based on Regression analysis). This system has a diagnosis function that allows respondents to receive feedback on all of their evaluations. Moreover, this system gives respondents the possibility of rectifying or validating their answers. We will also discuss about how CASIMIR helps marketers to get more precise data about products and the preference trends of respondents.

This paper is organized as follow. First, we will present the background and the related work. Then, we will briefly define and review the traditional conjoint analysis. The actual diagnosis system with its advantage and limits will also be introduced. Furthermore, we will focus on an alternative evaluation scenario, where respondents can select the attributes of the product they want to evaluate. Based on this scenario, and experimentation will show the limitations of the traditional method. Then, we will propose an interactive conjoint analysis by presenting our Web-questionnaire system CASIMIR. Finally, the presented ideas will be discussed and concluded.

2. Related works

Nowadays, marketers want to easily understand and measure the preference of potential customers for a particular product or service. Among a lot of marketing analysis technique, conjoint analysis is one of the most popular market research tools for design product or services (Orme, 2010). This statistical technique, developed by marketing professor Paul Green, has originated from mathematical psychology (Green and Srinivasan, 1990). This method tries to translate the tacit knowledge of the users into exploitable data. It is now applied for marketing, product management or operational research. Many companies already use designed questionnaires to collect information about products or services (Lohrke *et al.*, 2010).

The traditional conjoint analysis is usually a simple questionnaire given from marketer to respondents. The respondents simply answer and send back the questionnaire. No modification or re-evaluation was possible during the process. No feedback has been sending to the respondent, they could not draw their own conclusion of the evaluation. In addition, marketers have no information about how respondents understood the questionnaire.

One solution is to use a system that can be adapted to the respondents and their behaviors. Last improvement in context awareness recommender system now allowed us to collect a lot of information about respondents. This research wants to include the respondents in the analysis process. In the case of a service analysis, the results could be important not only for the marketers but also for the respondents (Tsuji *et al.*, 2007).

The notion of community, or categorization of consumers, could be major point in the knowledge acquisition. The possibility to see other users' responses can influence our own evaluation. It could be interesting to examine how far a respondent can be influenced by others' results, if he has the possibility to see them before his own evaluation. With all the data about respondents collected, marketers could specify and display the category of results in a social norm comparison (Castel *et al.*, 2012).

With the traditional conjoint analysis, marketer can difficulty control the environment of the survey. With our proposed Web-based system CASIMIR, marketers can let the respondents to correct and improve their evaluation by themselves to get results that are more precise.

To let the respondent select his favorite profile, different questionnaire can be used. The most common are:

- *Conjoint value analysis (Sheng et al., 2009)*: This method is a pairwise comparison system. Marketers show two product profiles to respondents and they must choose their preferred profile. This method is the oldest but has many limitations. Indeed, a large amount of parameters can complicate the choice of respondents and compare two product's profiles at the same time it is also time-consuming.
- *Choice-based Conjoint (CBC) (Johnson and Orme, 2007)*: Respondents are shown a panel of multiple product profiles (and sometime an optional "none" alternative) and are simply asked which one they would choose. With this method, respondents simply pick their favorite profile rather than rating or ranking all the profiles. This method has the advantage to be fast but very limited. If the number of profiles is too large, the respondents can be hesitant, and once they select their favorite profile, marketers have no information about their preferences for the other profiles. A solution would be to show a second time the same panel minus the first favorite profile and ask respondents to select a second favorite one. Repeating this operation until all the profiles are selected will be obviously time-consuming.
- *Menu-based conjoint (Orme, 2013)*: Is the variation of the CBC method or rating-based conjoint. In this case, marketers present all the attributes available of the product and let the respondents choose their own attributes. If this method can be useful for the design of a menu (restaurant, assurance, etc.), this is less useful with other products or services. This is too specific to be used in our researches.
- *Adaptive conjoint analysis (Johnson, 2001)*: This method is a hybrid method which requires a computer. Indeed, it can be separate in two steps. First, respondents must evaluate each parameter with a rating score (fixed by marketers) from "not important" to "extremely important". Then, marketers (helped with software) create two (minimum) profiles based on the preferred attributes. Finally, respondents must decide between the two profiles as a usual CBC method. This method has the advantage to treat profiles with numerous parameters and levels, by letting the respondents pick their favorite attributes. However, there is still no possibility for respondents to verify their responses and be sure that they really make a choice based on their tacit knowledge.

Each of these questionnaires has its advantages and disadvantages. With interactive conjoint analysis, we propose an alternative to the traditional method.

3. Interactive conjoint analysis

3.1 Term definitions

First, we will describe some key terms of conjoint analysis. Attributes in conjoint analysis means several important product features selected by marketing researchers. Level means a range of possible alternatives for each of these attributes. An attribute is a characteristic of a product, e.g. color, made up of various levels (there must be at least two for each attribute) of that characteristic, e.g. red, yellow or blue (Wierenga, 2010).

To conduct a conjoint analysis, marketing researchers must create profiles with orthogonal planning to describe virtual products or services. *Profiles* are composed of attributes with different levels, which can be considered as a description of a product.

Therefore, defining proper conjoint attributes and levels is arguably the most fundamental and critical aspect of designing a good conjoint analysis for designers. *Total utility* means the score of a profile evaluated by respondents. *Partial utility* means preference scores for each attribute's level.

The traditional conjoint analysis can be thought as a linear regression problem that attempts to model the relationship between two variables by fitting a linear equation to observed data. As input data, total utility is the observations on the dependent variable. As output data, partial utility is the observations on the predictor variable (Aczel and Sounderpandian, 2005). Then, after we calculate the partial utility, we can estimate the total utility of any profile.

Using a linear regression model, we can specify the total utility U_i as the dependent variable partial utility u_k^j and the dummy-variable β_{ik}^j. The mathematical expression of the model can be expressed as:

$$U_i = \sum_j \sum_k \beta_{ik}^j u_k^j + u_0 + \varepsilon \tag{1}$$

where:

i = profile number;
U_i = total utility for profile i;
β_{ik}^j = 0 or 1 decided by orthogonal planning for profile i where j is the level for attribute k; and
u_k^j = partial utility for level j of attribute k.

$$\sum_j u_k^j = 0$$

where:

u_O = base utility (constant); and
ε = error term.

After collecting all the U_i from respondents' answers, we calculate all of the partial utilities u_k^j with regression analysis and constant term u_0 can be evaluated as follow:

$$u_0 = U_i - \sum_j \sum_k \beta_{ik}^j u_k^j \tag{2}$$

Using u_k^j, dummy code β_{ik}^j, and u_0, we can forecast the total utility for each profile base with Formula (1) to measure the amount of attention paid by respondents toward new profiles. Furthermore, for rated profiles, forecasting the total utility can also be done as a standard measure of precision in conjoint analysis.

3.2 Limits of traditional conjoint analysis

In traditional conjoint analysis, data are collected by personal paper-and-pencil and non-computer aided tasks (Castel *et al.*, 2012). A respondent may be asked to list combinations of product attributes and levels of what are known as "profiles". Each profile defines the product with the same attributes, but for each attribute questionnaire, the designer must choose different levels.

Once a respondent has assigned a total utility (score) to all profiles, a computation based on linear regression is used to characterize the relative importance of each attribute and forecast the total utility for profiles. These concepts are schematized in Figure 1.

In traditional conjoint analysis, respondents express their preferences for products (or services) described by various levels of attributes. However, in some case, there are some limitations to this analysis. First, without re-evaluation, it is difficult to control the reliability of conjoint analysis and the consistency of respondent answers. Second, there is no feedback and diagnoses for individual respondents; the results of conjoint analysis are useless for respondents (Sackett *et al.*, 2012). With traditional conjoint analysis, if the number of attributes of a product or the number of levels for one attribute increases, the total number of possible profiles also increases considerably (Sheng *et al.*, 2008). For the respondent, it becomes more complicated to rate precisely all the profiles. If the amount of parameters or the amount of profiles is too high, the respondent has difficulty giving an accurate consistent evaluation (Tiwana and Bush, 2007).

However, this batch-based traditional conjoint analysis is a one-time survey, which means there is no chance for respondents to consider their evaluation and modify their answers (Vella *et al.*, 2012). It is also difficult for marketers to be sure of the consistency of the respondents' evaluations.

For the above-mentioned reasons, to optimize the precision of the results and overcome the limitations, the interactive conjoint analysis is proposed. Next, we will detail our Web-based questionnaire knowledge based system named "CASIMIR".

Table I shows the differences between the traditional and interactive conjoint analysis process.

4. Personal evaluation

4.1 Personal evaluation process

With interactive conjoint analysis, this paper is mainly focused on the presence of feedback for respondents. Depending on the information that marketers decide to display, the reaction of respondents may be different.

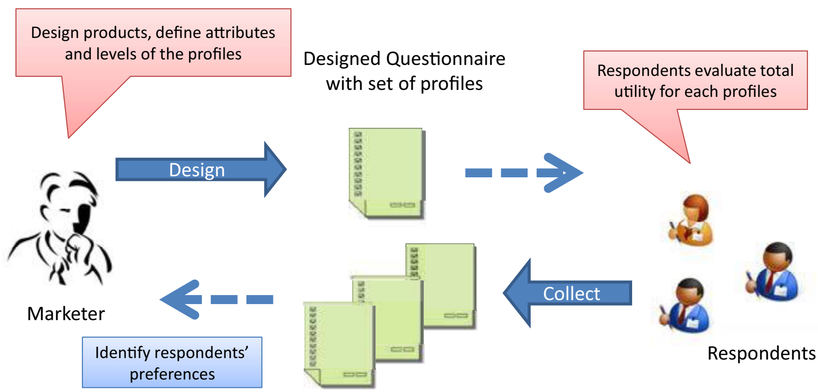


Figure 1. Traditional conjoint analysis process with non-Web-based questionnaire survey

Table I.
Comparison table

Attribute	Traditional conjoint analysis process	Interactive conjoint analysis process
Forecasted total utility	No forecasted total utility for respondents	Presence of forecasted total utility in order to help the respondents
Diagnosis	No diagnosis, or feedback for the user	Presence of diagnosis and feedback for the user
Modification of total utility	No possibility to modify/improve past score	User can modify/improve his past score
Survey	Designed only for marketers only	Designed for marketers but also for users
Inconsistent results	Direct survey with high risk of inconsistent results	Long-term survey so low risk of inconsistent results

Showing the favorite, or not favorite, attribute can enlighten respondents on their evaluation and can influence their next answers. They may realize that they neglected an attribute, or, on the contrary, focused only on one particular attribute. In some cases, like an evaluation of an offshore software outsourcing, the interest for a special attribute could be important (Tsuji *et al.*, 2007; Tiwana *et al.*, 2008).

If respondents give inconsistent evaluations for the first set of profiles, there is now a possibility that the respondent may make the same errors during the evaluation of other sets. With a precise diagnosis, respondents can consider their previous mistakes and improve their responses.

With the traditional conjoint analysis, the marketer chooses the number of attributes and levels of products. To accurately translate the tacit knowledge of respondents, an idea was to let respondents to choose the attributes of the profile they want to evaluate. To illustrate this idea, we can take the example of a laptop shown in Table II.

In this case, a marketer designed a laptop product with seven attributes with three levels, leading to a total of 2,187 possible types of profiles. Obviously, even with simplification with orthogonal planning, this number of profiles is too high. The idea is to let the marketer fix some of the attributes (in our case, the four with an asterisk). The selection of these particular attributes is left to the marketer depending on the importance placed on these attributes in the design of the product. Before the evaluation of the set of profiles, we let the respondent select the attribute in which the respondent has a higher preference among the three remaining. With this respondent, a set of profiles is generated with only five attributes with three levels, and the respondent can evaluate this set as usual.

After finishing his or her first evaluation, we ask the respondent to select the second most important among the other two remaining and then do the second evaluation. Finally, we ask him or her to answer the third evaluation with the last unfixed attribute, as we can see in Figure 2.

Table II.
Example of profile with selectable attributes

	Price*	Weight*	Processor*	Screen size*	Battery life	Hard drive	OS
Level 1	¥50.000	1 kg	Intel i3	11"	4 h	100 GB	Windows
Level 2	¥80.000	1.5 kg	Intel i5	13"	6 h	250 GB	Apple
Level 3	¥11.000	2 kg	Intel i7	15"	8 h	400 GB	Linux

Note: The attributes marked with an asterisk (*), are attributes fixed by the marketers

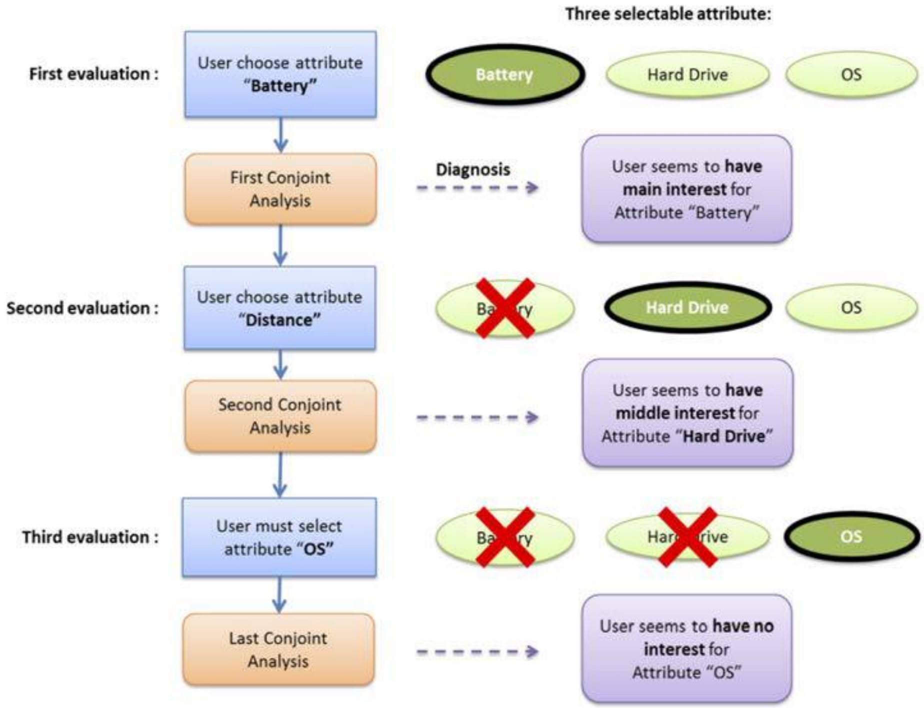


Figure 2.
Scenario for selectable attributes

This solution, inspired by the menu-based conjoint analysis system, seems to lead to two solutions (Orme, 2010). Indeed, it helps to solve the problem of numerous parameters for a product and lets the marketer select a large panel of parameters for his or her product design, but the respondents can still evaluate it easily. In addition, it is very possible to record the order of selected remaining attributes and establish a ranking of the favorite attribute of the respondent. We will study the validity of this personal evaluation process in the experimentation section.

4.2 Experimentation

For the experimentation, 20 respondents to evaluate the laptop profile (as seen in Table II). At the end of the three evaluations, marketers gave a survey to respondents regarding several information like their gender, their age and their degree of knowledge in laptop hardware. At the end of the evaluations, we asked respondents to rank the seven attributes of their preferences.

With the conjoint analysis, we calculated the actual partial utility for every respondent. We also ranked these values, and marketers could observe the difference between the ranked attributes on the survey and the ranked partial utilities calculated after the evaluation.

We noticed that among the 20 respondents, no one has a survey ranking completely similar the calculated one. Only four respondents have more than two matching attributes and six respondents have only one matching attributes. These results show there is a strong difference between what respondents think they like and the preferences found with traditional conjoint analysis. Table III shows the number of respondents with accurate prediction per attribute order. We can notice that the favorite and least favorite attribute (first and seventh attributes) are the mostly well predicted by respondents. It means that with the traditional conjoint analysis method can help to translate the extreme preferences of the respondents but is strongly inaccurate if marketers want details for the others attributes.

This evaluation process indeed helped respondent to evaluate easily a complex product with seven attributes. We let the respondents evaluate the profiles depending of their preferences. It also helps the marketers to highlight the attributes that respondents really consider and to sort the attributes, in a way similar to adaptive conjoint analysis (Johnson, 2001). However, the difference between the respondents' preferences (expressed in the survey) and the preferences calculated with conjoint analysis is too important to validate the accuracy of these results. With the absence of feedback, a marketer cannot control the consistency of respondent evaluation. Moreover, with the traditional conjoint analysis method, only one evaluation per set of profile and simple total utilities, respondents do not have the possibility to modify and improve their responses.

With interactive conjoint analysis system, we want to quantify precisely the respondent tacit preference rather than simply sort it. With this, marketers can determine a group of favorite attributes rather than the unique favorite attribute, or least favorite, for the respondents. In the next chapter, we will introduce our CASIMIR system, designed to not only propose a feedback to respondents but also let them modify and improve their scores after each evaluation.

5. CASIMIR system

5.1 Introduction to CASIMIR

Our interactive conjoint analysis was proposed to have the most consistent data possible. Therefore, for this research, respondents are allowed to interact during their evaluation. Indeed, they still evaluate several profiles, and also receive a complete diagnosis. With this diagnosis, they can be aware of their product preferences systematically. In addition, for the next evaluation, they can use this new information to re-evaluate a set of profiles or evaluate new profiles. Translating the preference and tacit knowledge of the respondents allows more precise evaluation responses to be obtained (Kolhe *et al.*, 2011).

After collecting all these responses, the forecasted total utility values and attribute importance are presented to the respondent. With these forecasted values, the respondent can understand his or her tacit choice and detect possible mistakes in past evaluations. If he or she accidentally disregards an attribute during the first evaluation,

Table III. Number of respondent with accurate prediction per ranked attribute

Ranking of attribute (from favorite to least)	No. of respondent with accurate prediction
1st attribute	9
2nd attribute	6
3rd attribute	2
4th attribute	0
5th attribute	4
6th attribute	4
7th attribute	7

after seeing the diagnosis, he or she may attach more importance to this attribute during the second evaluation.

Obviously, the choice of whether to follow this diagnosis or not is given to the respondents. We consider this as a tool that let the respondents think about their evaluation rather than an indication that must be absolutely followed. Respondents can use the diagnosis and forecasted values to re-evaluate and improve their answers. It is important for the product analysis to translate the preference and tacit knowledge of respondents (Cheng, 2000).

The main part of the interactive conjoint analysis has been presented, and now, in this chapter, we will introduce the CASIMIR system. With the help of this Web-based questionnaire, our idea is to forecast the total utility, attribute importance and other personal information in a diagnosis delivered after each evaluation. This application was mainly coded with *PHP* and *JavaScript*, allowing the CASIMIR system to be used on every computer. XAMPP, an open-source Web server solution, was used to develop our system. This solution allows the Apache HTTP server, a MySQL database and an interpreter for PHP scripts to be used. Due to the needs of our project, this solution was the most interesting for us.

To calculate the regression analysis and all the total and partial utilities, the freeware R is used. It is a powerful software for statistical computing (R Project for Statistical Computing, 2014) that uses its own programming language. R software is an implementation of the S programming language combined with lexical scoping semantics.

It allows strong object-oriented programming, and it has an active community that allows users to find a solution for most problems. By connecting the R software to the database, marketers can get access to all registered data. With this, a marketer can calculate the slope of independent variables u_k^j, attribute importance I_k and forecasted total utility $\hat{U}_i$ and base utility u_O, and then all this new data are registered in the database.

5.2 CASIMIR evaluation

In contrast to some conjoint analysis surveys that are anonymous, by using this system, respondents have to log in, allowing the marketer to trace and collect each evaluation. For the collection of data, we have to link all data to respondents in a large database (full representation of the actual database is shown in Figure 3).

First, marketers need to implement a product or service's profile in the database and determine how many attributes and levels are needed for surveys (Rajaraman *et al.*, 2010). Some attributes can be present in different products, such as "screen size" for computers or televisions, so these attributes have to be linked to a particular product. In the same idea, some levels have to be linked to an attribute, like the "blue" and "red" for the attribute "color". With these detailed product and attributes, marketers have to create profiles.

Depending on the number of levels and attributes, the minimum number of required profiles for conjoint analysis may vary. Using the R software helps to realize orthogonal planning and determine this minimum. With a second R script, a set including the minimum number of required profiles can be generated automatically. With this method, a marketer can generate easily some set of profiles and propose them for evaluation. Once the product profiles are created and validated, these profiles are available for evaluation in the database. A same product can have several sets of profiles for different evaluation.

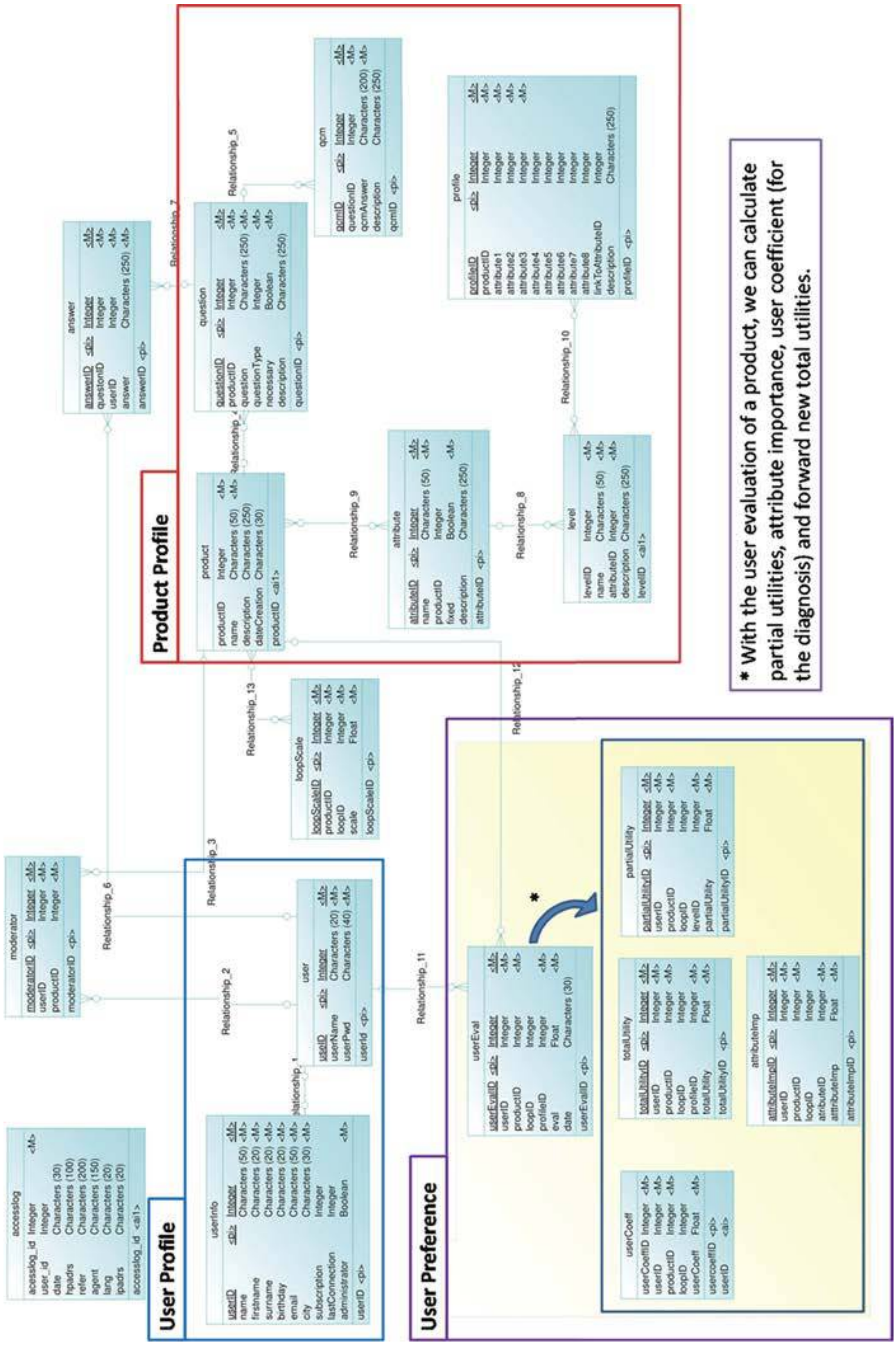


Figure 3.
Full representation of the database

With a provided username and password, respondents have to login to the system and provide some precise basic pieces of information (age, gender, profession, etc.). If there are several profiles created by marketers, a respondent may choose a product to evaluate after having successfully logged in. To get more information for our marketing analysis, the respondent can answer questions related to the product. This will help marketers to more efficiently target customer habits and preferences. After selecting the product, the respondent can start the evaluation of a set of generated profiles (the first evaluation page is shown in Figure 4). Each total utility of the profiles is registered in the database with the respondent. The number of the evaluations of a set is also registered in case the user wants to evaluate again and compare his or her past answers.

Once the user has validated his or her evaluation, on the basis of the total utilities, a temporary comma-separated values (CSV) file is created and sent to the R software. With the sent total utilities, we can calculate the partial utilities, attribute importance, user coefficient and next forecasted utilities. The calculation with R is fast enough to send all these pieces of information to the respondent by way of a diagnosis page just after evaluation. It is important to remark that the diagnosis page is designed for the respondents, not for the marketers. With this page, the respondent can consider and understand his or her previous evaluations, find his or her favorite profile and get feedback on his or her past evaluations (Figure 5).

With this new information, respondents have the possibility of validating or correcting their own evaluations. If they want to reconsider their answers, forecasted utilities based on their previous answers are now displayed to help them to respond more precisely without influencing their tacit preferences (Figure 6).

All processes can be resumed with the architecture shown in Figure 7. For each evaluation, the forecasted total utilities are used to help respondents rate a larger amount of profiles with a more precise score, as explained in the following section.

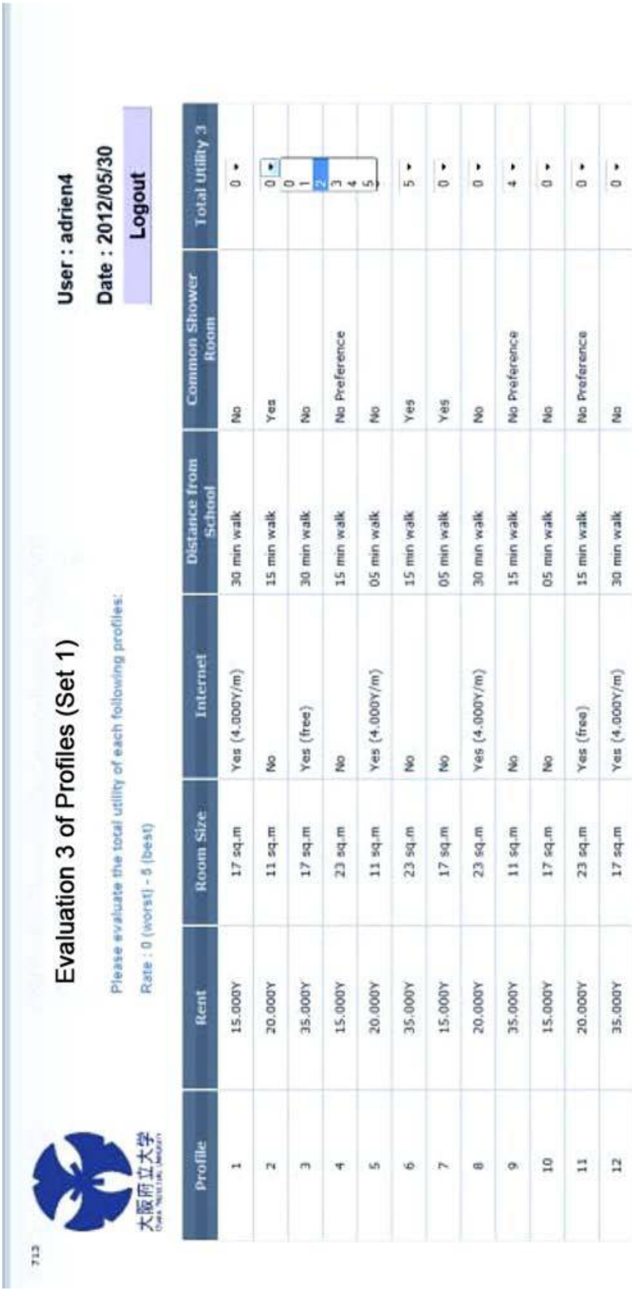
With this software, attribute importance and respondent's evaluation consistency can be calculated (Castel *et al.*, 2013). As mentioned, one important fact is that the CASIMIR system is designed for respondents, not only for marketers. Diagnosis and forecasted values are intended for respondents, allowing them to be involved in the evaluation process and helping them to improve their responses.

6. Conclusion

First, this paper has introduced and showed the principle and limits of traditional conjoint analysis. With a simple experience, we show that it may difficult to translate correctly the respondents' preferences and it leads to inconsistent analysis for marketers. With our SSI Web-questionnaire system named "CASIMIR", we want to design a flexible solution, accessible anywhere and anytime for respondents.

We also have shown the importance of feedback in the CASIMIR system. Showing attribute importance and personal consistency may helps respondents to consider their evaluation and preferences. To translate the tacit reasoning of a respondent is a complicated task. This system allows the respondent to react to their own feedback. If they do not validate the diagnosis, we noticed they have chance to correct and improve their past evaluations.

In addition, to have a precise rating from respondents without increasing the time of the evaluation, respondents can count on the forecasted values based on the previous evaluation. This allows the CASIMIR system to help the respondents make decisions more easily



Profile	Rent	Room Size	Internet	Distance from School	Common Shower Room	Total Utility 3
1	15.000Y	17 sq.m	Yes (4.000Y/m)	30 min walk	No	0
2	20.000Y	11 sq.m	No	15 min walk	Yes	0
3	35.000Y	17 sq.m	Yes (free)	30 min walk	No	
4	15.000Y	23 sq.m	No	15 min walk	No Preference	
5	20.000Y	11 sq.m	Yes (4.000Y/m)	05 min walk	No	
6	35.000Y	23 sq.m	No	15 min walk	Yes	5
7	15.000Y	17 sq.m	No	05 min walk	Yes	0
8	20.000Y	23 sq.m	Yes (4.000Y/m)	30 min walk	No	0
9	35.000Y	11 sq.m	No	15 min walk	No Preference	4
10	15.000Y	17 sq.m	No	05 min walk	No	0
11	20.000Y	23 sq.m	Yes (free)	15 min walk	No Preference	0
12	35.000Y	17 sq.m	Yes (4.000Y/m)	30 min walk	No	0

Figure 4.
First evaluation page of the CASIMIR system

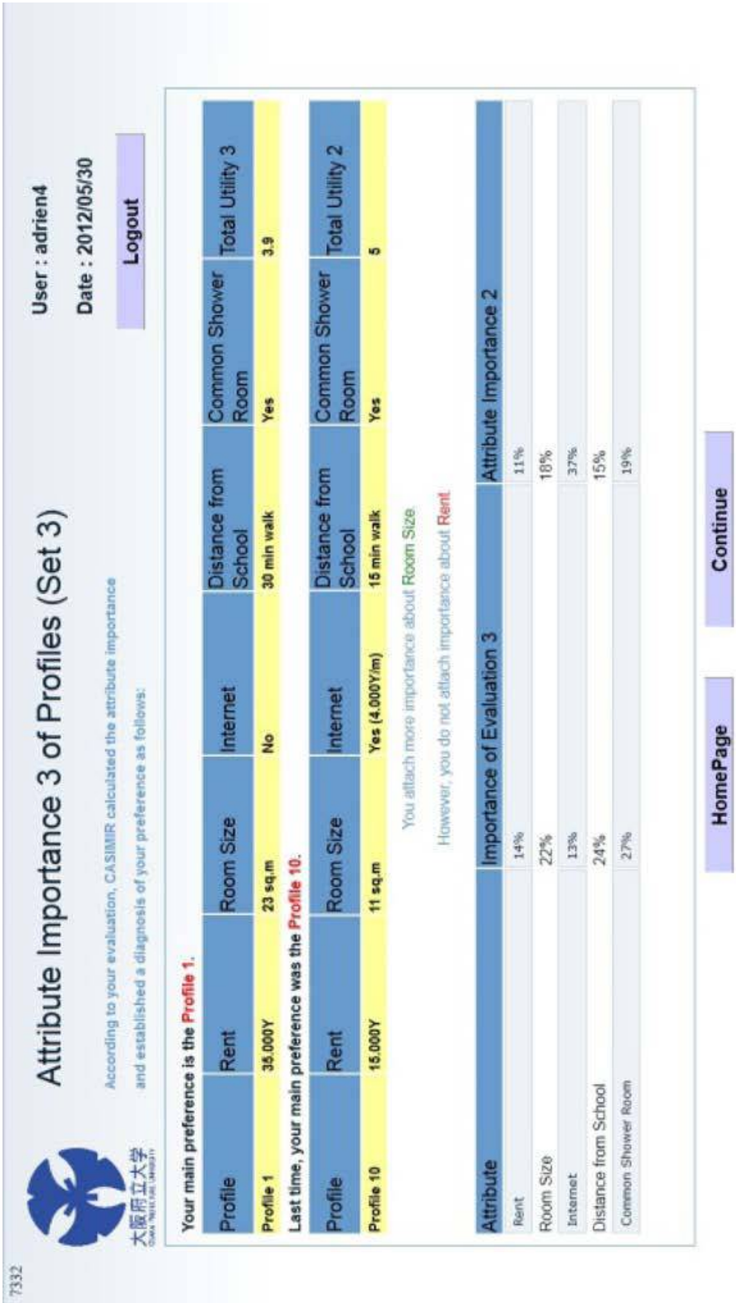
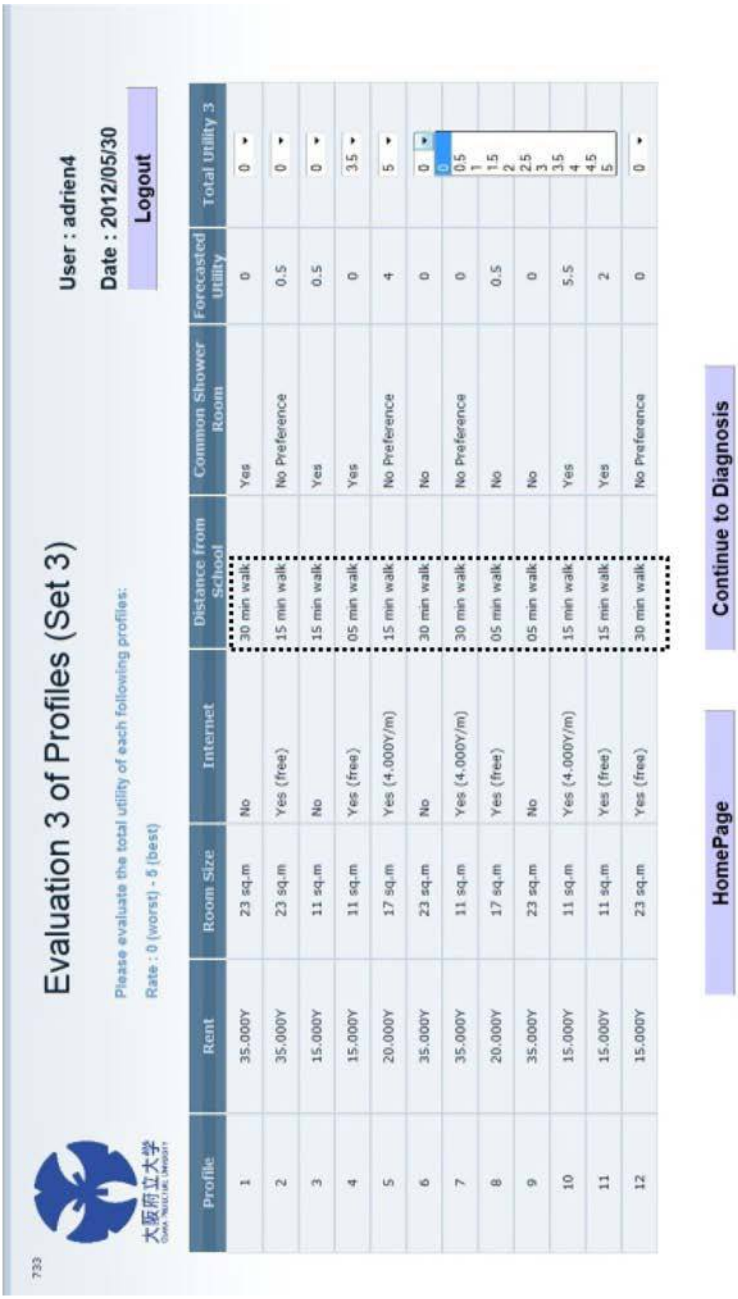


Figure 5.
Diagnosis page of the CASIMIR system



Profile	Rent	Room Size	Internet	Distance from School	Common Shower Room	Forecasted Utility	Total Utility 3
1	35.000Y	23 sq.m	No	30 min walk	Yes	0	0
2	35.000Y	23 sq.m	Yes (free)	15 min walk	No Preference	0.5	0
3	15.000Y	11 sq.m	No	15 min walk	Yes	0.5	0
4	15.000Y	11 sq.m	Yes (free)	05 min walk	Yes	0	3.5
5	20.000Y	17 sq.m	Yes (4.000Y/m)	15 min walk	No Preference	4	5
6	35.000Y	23 sq.m	No	30 min walk	No	0	0
7	35.000Y	11 sq.m	Yes (4.000Y/m)	30 min walk	No Preference	0	
8	20.000Y	17 sq.m	Yes (free)	05 min walk	No	0.5	
9	35.000Y	23 sq.m	No	05 min walk	No	0	
10	15.000Y	11 sq.m	Yes (4.000Y/m)	15 min walk	Yes	5.5	
11	15.000Y	11 sq.m	Yes (free)	15 min walk	Yes	2	
12	15.000Y	23 sq.m	Yes (free)	30 min walk	No Preference	0	0

Figure 6.
Second evaluation page of the CASIMIR system with the appearance of new column "forecasted utility"

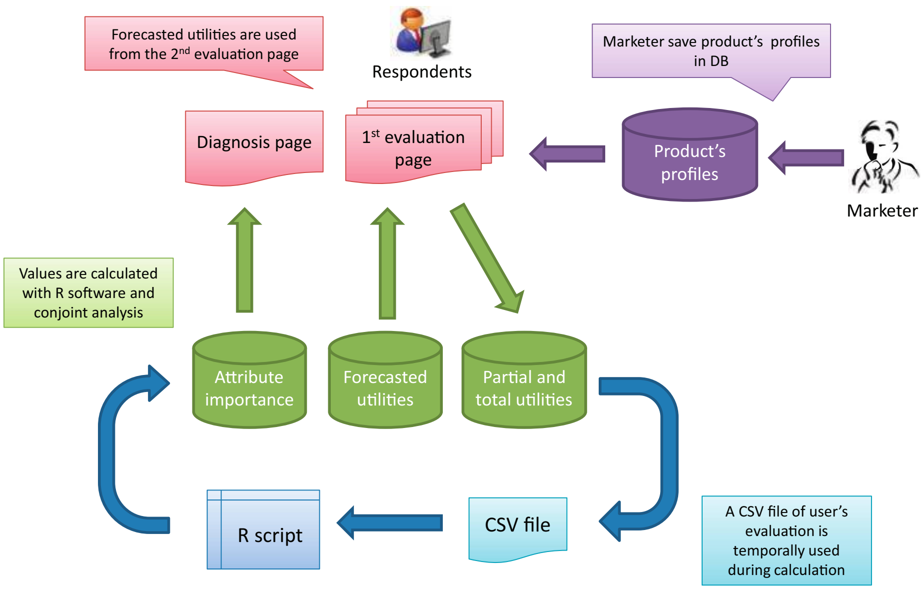


Figure 7.
Interactive process of the CASIMIR system

without compromising their tacit knowledge. Our first experiment showed the limitations of the traditional method, another experiment could validate our proposed system.

The actual version of the CASIMIR system is designed to be precise and useful for marketers as well as for respondents. A respondent who feels involved in the evaluation process will provide consistent responses to marketers. This system is designed to offer a solution adaptable to different cases of marketing problems.

References

Aczel, A.D. and Sounderpandian, J. (2005), *Complete Business Statistics*, Chapter 10 and 11 (Regression Analysis), McGraw-Hill/Irwin.

Castel, D., Vella, A., Wei, F., Saga, R. and Tsuji, H. (2012), "Diagnosis for interactive conjoint analysis", *International Conference on New Trends in Information Science, Service Science and Data Mining*, pp. 371-376.

Castel, D., Saga, R. and Tsuji, H. (2013), "Design of personal spiral conjoint analysis", *Journal of Industrial Engineering & Management Systems (IEMS)*, Vol. 12 No. 3, pp. 234-243.

Cheng, H.A. (2000), *Knowledgescapes: A Probabilistic Model for Mining Tacit Knowledge for Information Retrieval*, Berkeley Digital Library.

Green, P. and Srinivasan, V. (1990), "Conjoint analysis in marketing research: new developments and directions", *Journal of Marketing*, Vol. 54, pp. 3-19.

Gustafsson, A., Herrman, A. and Huber, F. (2007), *Conjoint Measurement*, 4th ed., Springer.

Johnson, R.M. (2001), *History of ACA*, Sawtooth Software.

Johnson, R.M. and Orme, B.K. (2007), *A New Approach to Adaptive CBC*, Sawtooth Software.

Kolhe, S., Kamal, R., Saini, H.S. and Gupta, G.K. (2011), "A web-based intelligent disease-diagnosis system using a new fuzzy-logic based approach for drawing the inferences in crops", *Computers and Electronics in Agriculture*, Vol. 76 No. 1, pp. 16-27.

Lohrke, F.T., Holloway, B.B. and Woolley, T.W. (2010), "Conjoint analysis in entrepreneurship research: a review and research agenda", *Organizational Research Methods*, Vol. 13 No. 1, pp. 16-30.

Orme, B.K. (2010), *Getting Started with Conjoint Analysis*, Research Publishers LLC.

Orme, B.K. (2013), *Menu-Based Choice (MBC) for Multi Check Choice Experiments*, Sawtooth Software.

R Project for Statistical Computing (2014), available at: www.r-project.org (accessed July 2012).

Rajaraman, A., Leskovec, J. and Ullman, J.D. (2010), *Mining of Massive Datasets*, Stanford University.

Sackett, H., Shupp, R. and Tonsor, G. (2012), *Discrete Choice Modeling of Consumer Preferences for Sustainably Produced Steak and Apples*, Agricultural and Applied Econsomics Association.

Sheng, Z., Nakano, M., Kubo, S. and Tsuji, H. (2008), *Risk Bias Externalization for Offshore Software Outsourcing by Conjoint Analysis*, Osaka Municipal Universities Press.

Sheng, Z., Sano, M., Hayashi, Y., Tsuji, H. and Saga, R. (2009), "Visualization study of the relationships between responses in choice-type questionnaire", *International Conference on Information Management, Innovation Management and Industrial Engineering*, Vol. 2, pp. 249-253.

Tiwana, A. and Bush, A.A. (2007), "A comparison of transaction cost, agency, and knowledge-based predictors of IT outsourcing decisions: a cross-cultural field study", *Journal of Management Information Systems*, Vol. 24 No. 1, pp. 259-300.

Tiwana, A., Bush, A.A., Tsuji, H., Sakurai, A. and Yoshida, K. (2008), "Myths and paradoxes in Japanese IT outsourcing", *Communications of the ACM*, Vol. 51 No. 10, pp. 142-445.

Tsuji, H. and Takeyasu, K. (2009), "Interactive decision support web tool based on conjoint analysis", *Management Information System and Its Applications*, Osaka Municipal Universities Press, pp. 38-57.

Tsuji, H., Sakurai, A., Yoshida, K., Tiwana, A. and Bush, A. (2007), "Questionnaire-based risk assessment scheme for Japanese offshore software outsourcing", in Meryer, B. and Joseph, M. (Eds), *Lecture Notes on Computer Science 4716, B*, Sprinter-Verlag, pp. 114-127.

Vella, A., Castel, D., Saga, R. and Tsuji, H. (2012), "Finding heterogeneity for diagnosis in conjoint analysis", *Proceeding of Technical Meeting on Information Systems, IEE Japan*, pp. 3-8.

Wierenga, B. (2010), *Handbook of Marketing Decision Models*, Springer.

About the authors

Dennis Castel received a Master's degree in Computer Science at EISTI (Ecole Internationale des Sciences du Traitement de l'Information) in France in 2010. In October 2014, he received a Doctoral degree in Management Information System at Osaka Prefecture University, Japan. He studied marketing analysis, knowledge mining and especially conjoint analysis. Dennis Castel is the corresponding author and can be contacted at: castel.dennis@gmail.com

Hiroshi Tsuji is an Executive Director and Vice President of Osaka Prefecture University, Japan. He received BD, MD and PhD from Kyoto University in 1976, 1978 and 1993, respectively. He was a researcher of Hitachi between 1978 and 2002. He was a visiting researcher of Carnegie-Mellon University in 1987 and 1988. His research interest includes management information systems and knowledge management systems. He is a member of IEEE, ACM, IPSJ, IEEJ, and so on.