Online Consumers' Decision-Making Styles Ontology Incorporating Factor Item Weights

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ABSTRACT

Most studies about online consumer behavior have not considered the weight of each item corresponding to its particular decision-making style. As a result, there are not any measures of online consumers' scores for each decision-making style. Research has found that online consumers have different decision-making styles when purchasing product items. Therefore, measuring online consumers' decision-making styles is vital as it can be used to find out suitable product items for these consumers. This paper measures the score of each decision-making style based on the factor score coefficients. Finally, the factor score coefficient ontology is developed and expanded into an online consumers' decision-making style ontology so that it can be utilized by different e-marketing applications that exploit online consumer behavior.

Keywords: Electronic-CSI, Consumers' Decision-Making Styles, Factor Score Coefficient, Inventory Item, Online Consumer

INTRODUCTION

Consumers' decision-making style is defined as mental orientation characterizing a consumer's approach to making choices [11]. One of the ways to characterize consumer styles is consumer characterization, focusing on cognitive and affective orientations related to consumer decision-making [10][12]. Consumer characterization is very promising as it deals with the mental orientation of consumers in making decisions [11]. The origin of the consumer characteristics approach is based on an exploratory study by Sproles [10] that identified 50 items related to mental orientation. Sproles and Kendall [11] reworked this inventory (50 items) to reduce them to 40 items under the title, Consumer Style Inventory (CSI). In the CSI, factor analysis identified eight mental characteristics of consumer decision-making. Since the reliability and validity of the CSI were established [11] using a sample of high school students from the United States only, there was a lot of criticism about whether the CSI and the empirical findings developed with U.S. data could also be valid in other countries. More recently, Durvasula, Lysonski and Andrews [1]

responded to the criticism by comparing the results obtained in New Zealand with those obtained in the U.S.A. [11].

In order to deal with the emergence of e-commerce activities, it is necessary to consider the online consumers' decision-making styles that can affect the willingness of online consumers to purchase products on the web.

Bruskin/Goldberg Research reports that 75% of online shoppers consider credit-card security a primary concern [4]. In addition, Hoffman, Novak and Peralta [3] state that consumers' online information privacy is the primary barrier to online shopping.

Self-service technologies offered by e-businesses can lead to factors that can cause positive or negative reactions to the online shopping service. Meuter et al. [6] found that subjects are most satisfied with technologies that can save time (30%), work reliably (21%), are easy to use (16%), meet a salient need (11%), and offer greater control and access (8%).

Therefore, the CSI model [11] should be modified in order to fit the E-commerce environment. However, there has not yet been significant research on the analysis of consumers' decision-making styles in the E-commerce environment until Sam and Chatwin [9] developed an Electronic-CSI (E-CSI) model which addresses online consumers' decision-making styles.

E-CSI Model

Based on the CSI model [11], the characteristics of consumers' decision-making styles in E-commerce environment should satisfy at least one of the following criteria:

1. Include only those characteristics that can affect the decision of selecting the suitable products or services directly.
2. Include characteristics that are directly related to an online shopping environment.

As a result, a list of 18 items of consumer decision-making styles in E-commerce environment is identified in Table 1.

Table 1: Items in E-CSI Model

Factor 1 – High-Quality, become buying habit Conscious Consumer
1.   Getting very good quality is very important to me.
2.   Once I find a product or brand I like, I stick with it.
Factor 2 – Brand Conscious Consumer
3.   The well-known national brands are best for me.
4.   The higher the price, the better its quality.
5.   I prefer buying the best-selling brands.
Factor 3 – Novelty-Fashion Conscious Consumer
6.   I usually have one or more products of the very newest style.
7.   Fashionable, attractive styling is very important to me.
Factor 4 – Price Conscious Consumer
8.   I buy as much as possible at sale price.
9.   The lower price products are usually my choice.
10. I look carefully to find the best value for the money.
Factor 5 – Product Portability Conscious Consumer
11. When buying products, portability is very important to me.
12. The smaller the product size, the more I prefer.
Factor 6 – Web Site Content Conscious Consumer
13. When I go shopping online, security is very important.
14. It is very important for the web sites to offer communication channels to me for enquiry.
15. It is very important for the web sites to offer product searching service to me.
16. It is perfect if the web sites can offer me richness information about products.
Factor 7 – Web Site Animation Conscious Consumer
17. It will be annoying to get a lot of animated effects on the business web sites.
Factor 8 – Web Site Interface Conscious Consumer
18. Design layout of business web site is one of the important factors to make buying decisions.

Factor one. This factor measures high quality and becomes a conscious consumer characteristic. Items loading on this factor measure how important a consumer thinks quality is for the buying decision and it becomes a consumer habit for buying the same high-quality products.

Factor two. This factor identifies a brand conscious consumer characteristic, "brand conscious, price equals quality". It measures consumers' orientation toward buying the more expensive, well-known national brands.

Factor three. This factor measures a novelty-fashion conscious consumer characteristic. High scores on this characteristic indicate that a consumer prefers new product style to those old fashioned styles.

Factor four. This factor measures a price conscious characteristic. A consumer having a high score on this factor is sensitive to product price and prefers buying low price products.

Factor five. This factor measures the product portability conscious characteristic. Those consumers who prefer smaller size products so that

it is flexible for carrying around have a high score on this factor.

Factor six. This factor measures the web site content conscious characteristic. What do consumers think about the facilities, such as security, searching tools, communication tools, product information, offered by online shops? The answer can affect the score on this factor. A high score indicates that consumers care so much about the website facilities that it can affect the consumers' buying decision.

Factor seven. This factor measures the web site animation conscious characteristic. Some consumers don't like the animation effect on the business web site. The reasons include: (1) Confusions about the information displayed on screen, (2) Low data transmission speed on the Internet. Those consumers who don't like web animation effect will get a high score on this factor.

Factor eight. This factor measures the web site interface conscious characteristic. The design of the web site is important to some consumers. Is it better to offer graphics display instead of text display on sensitive information or information that is not easy to understand? The location of the web tools on the web site can also affect some consumers when they want to get some services from the web site. Consumers who have a high score mean that the web interface is sufficiently important that it can affect their buying decisions very much.

Based on the E-CSI model, the factor scores of consumers' decision-making styles are computed to analyze online consumer behavior. In order to allow managers making better decisions, the online consumer behavior should be analyzed accurately.

The remainder of this paper is structured as follows. Section II discusses the computation of factor scores for E-CSI model. Section III describes the factor score coefficients represented in ontology, which is described as machine interpretable definitions of basic concepts in the domain and the relationships between them [7]. Section IV describes online consumers' decision-making styles ontology. Finally, conclusions are presented in Section V.

COMPUTATION OF FACTOR SCORE FOR E-CSI MODEL

The E-CSI model is applied to four industrial sectors to prove that the same inventory items contribute to particular decision-making styles when consumers purchase different types of products. However, the weight of each online consumer characteristic contributing to a particular decision-making style has not been considered. According to Grice and Harris [2], using regression weights, factor score coefficients, is the best strategy for computing factor scores. Tables 2 and 3 present the factor score coefficient matrices of the E-CSI model for apparel and I.T. item industries.

The weights of inventory items for the eight decision-making styles shown in Tables 2 and 3 are used to evaluate the factor scores of the online consumers' decision-making styles.

Table 2: Factor Score coefficient matrix for apparel industry

	Component (Factor)							
	1	2	3	4	5	6	7	8
Prod1_Ans1	.028	-.113	-.162	.222	-.021	.204	-.106	.105
Prod1_ans2	.059	.376	-.013	.057	-.092	-.070	-.167	-.004
Prod1_ans3	.012	.492	-.044	-.294	.053	.108	.183	.106
Prod1_ans4	.049	.390	-.001	.017	.066	-.079	-.107	-.146
Prod1_ans5	-.081	-.094	.158	.543	-.087	-.166	-.086	.061
Prod1_ans6	-.024	-.014	-.082	.409	.126	.072	.124	-.047
Prod1_ans7	-.070	-.019	-.068	.084	.577	.152	.066	-.007
Prod1_ans8	.019	.063	-.010	-.116	.535	-.135	.102	.169
Prod1_ans9	.173	-.043	.162	.074	.177	.022	-.266	-.278
Prod1_ans10	-.048	-.057	-.039	.090	.027	.553	.178	-.121
Prod1_ans11	.016	-.068	.486	.073	.034	-.049	.041	.080
Prod1_ans12	-.071	.004	.474	-.009	-.104	.044	.069	-.012

Prod1_ans13	-.094	-.033	.027	.025	.065	-.031	-.038	.835
Prod1_ans14	-.012	.066	.092	-.230	.009	.545	-.172	.084
Prod1_ans15	.054	-.045	.075	-.002	.084	.019	.765	-.078
Prod1_ans16	.301	.098	.071	-.094	-.028	-.148	.077	.226
Prod1_ans17	.405	.048	-.073	-.107	.021	.042	-.090	-.081
Prod1_ans18	.403	.008	-.011	.004	-.035	-.019	.109	-.244

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Table 3: Factor Score coefficient matrix for I.T. item industry

	Component (Factor)							
	1	2	3	4	5	6	7	8
Prod2_ans1	.044	-.066	-.066	.556	.148	.013	-.094	.037
Prod2_ans2	-.009	.313	.038	.277	.091	-.104	-.208	-.178
Prod2_ans3	.025	.448	.034	-.196	.033	-.188	.004	.217
Prod2_ans4	.034	.430	-.091	-.066	-.099	.052	-.050	-.152
Prod2_ans5	.011	.022	.510	.050	-.010	-.077	-.056	-.086
Prod2_ans6	-.040	-.070	.570	-.087	-.055	-.020	.020	.041
Prod2_ans7	.052	.071	-.016	-.007	.533	-.152	-.104	.035
Prod2_ans8	.090	.039	-.104	-.367	.306	.070	-.053	-.030
Prod2_ans9	-.073	-.176	.008	.250	.490	.141	.143	.035
Prod2_ans10	-.097	.130	-.067	.222	.072	-.151	.206	.441
Prod2_ans11	-.013	-.106	-.008	-.052	.015	.649	-.028	.031
Prod2_ans12	.003	.106	.009	-.043	-.154	.355	.197	.007
Prod2_ans13	.171	.051	.238	-.193	-.117	-.332	.371	.011
Prod2_ans14	-.087	-.091	-.091	-.036	.010	.117	.700	-.100
Prod2_ans15	.017	-.079	-.021	.003	.029	.097	-.151	.713
Prod2_ans16	.349	.025	-.006	-.008	.103	-.112	-.074	.029
Prod2_ans17	.354	-.017	-.045	-.010	-.006	.022	-.022	-.089
Prod2_ans18	.367	.046	-.057	-.055	-.023	.123	-.177	.016

Based on the coefficient matrices in Tables 2 and 3, the following facts can be deduced:

1. For a particular industry, different decision-making styles have different weights for the same inventory items.

2. For the same online consumers' decision-making style, there are different weights for the inventory items in different industries.

Having considered the two facts above, the factor-scoring formula for factor 1 in the apparel industry is shown in Equation 1.

$$Factor\_Score_{(app,1)} = \sum_{j=1}^{n} Weight_{(app,1,j)} * Item\_Score_{(j)}$$

(1)

where $Weight_{(app,1,j)}$ is the weight of the jth inventory item with respect to factor 1 in the apparel industry and $Item\_Score_{(j)}$ is the score point of the jth inventory item. Similarly, the factor-scoring formula for factor 1 in the I.T. item industry is shown in Equation 2.

$$Factor\_Score_{(IT,1)} = \sum_{j=1}^{n} Weight_{(IT,1,j)} * Item\_Score_{(j)}$$

(2)

FACTOR SCORE COEFFICIENTS REPRESENTED IN ONTOLOGY

The weights of inventory items are very useful since they can be used to determine the factor scores of online consumers' decision-making styles for different industries. In this research, the factor score coefficient ontology of online consumers' decision-making styles is developed using Protégé [8] and then it is expanded into the ontology of the online consumers' decision-making styles.

The factor score coefficient ontology of online consumers' decision-making styles should be designed in such a way that can satisfy the two facts deduced in Section II. First of all, the Factor_Weight class, which stores the item weights of a general decision-making style for different industries, is created and it is the superclass of the eight classes [7] indicating the item weights of the eight specific decision-making styles as shown in Figure 1, which illustrates the concept that the weights of inventory items are different for different online consumers' decision-making styles.

Figure 1: Eight classes representing the item weights of different decision-making styles

In order to consider item weights in different industries, there is an Items_Weight class, which stores the eighteen item weights in the E-CSI model as slots. Since Items_Weight class is also the superclass of the four industry weight classes as shown in Figure 2, the four industry weight classes inherit from Items_Weight class, indicating the weights of all 18 items for the four industrial sectors.

Figure 2: Four industry item weight sub-classes

In the Factor_Weight class, four slots can be created, each of which indicates the weights of all 18 items in a particular industry as shown in Figure 3 and Figure 4. Since the four slots are object instances of the four industry weight classes, as shown in Figure 3, the Factor_Weight class is a composite class. As indicated by filled diamond shapes in Figure 3, there is exactly one instance for each of the four slots in Factor_Weight class. It illustrates that there is exactly one set of item weights for each industry. Based on Figure 1, the eight factor weight classes inherit from Factor_Weight class to illustrate that individual factor weights are different for the four industries.
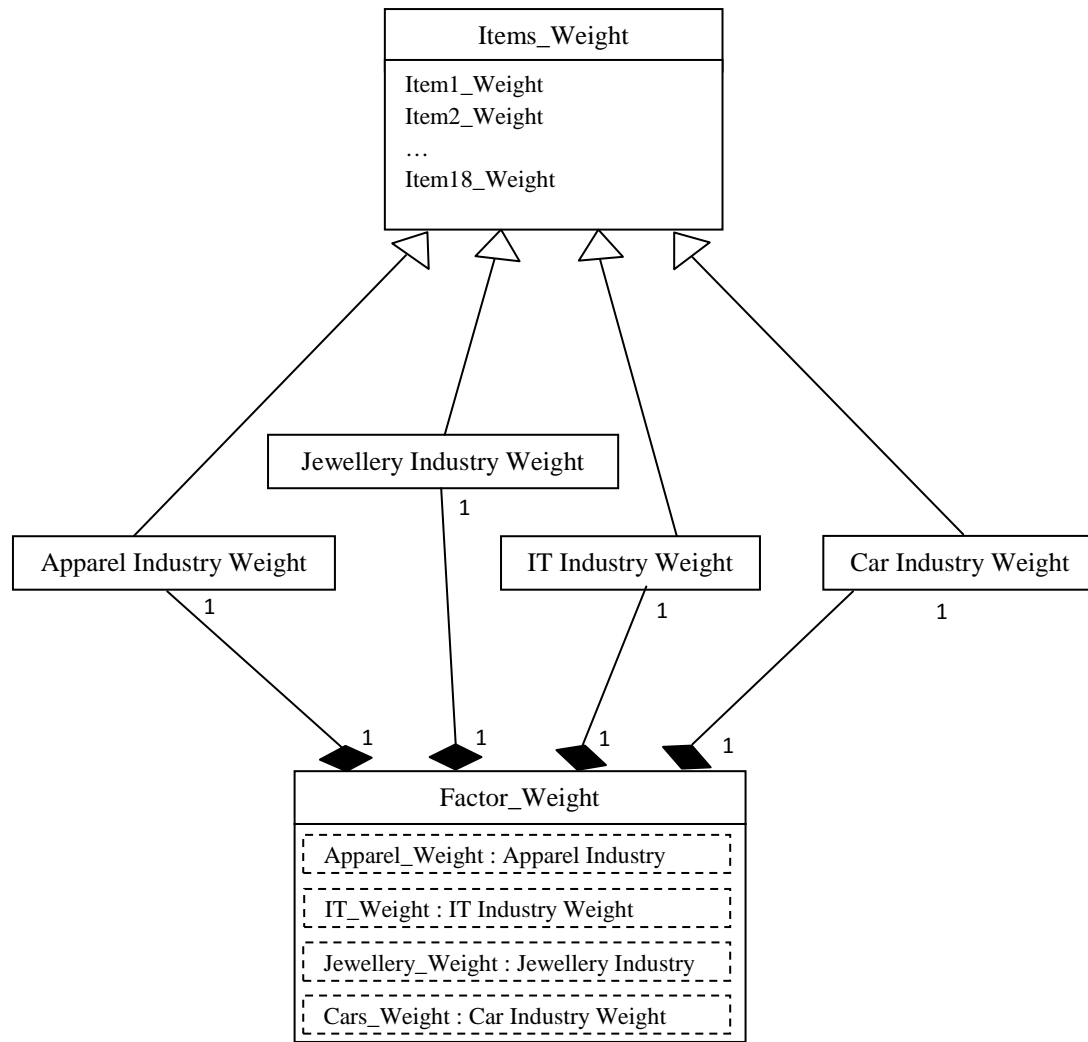
Figure 3: Class diagram showing Generalization between Items_Weight class and industry weight classes (at top) and Composition between Factor_Weight class and industry weight classes (at bottom)
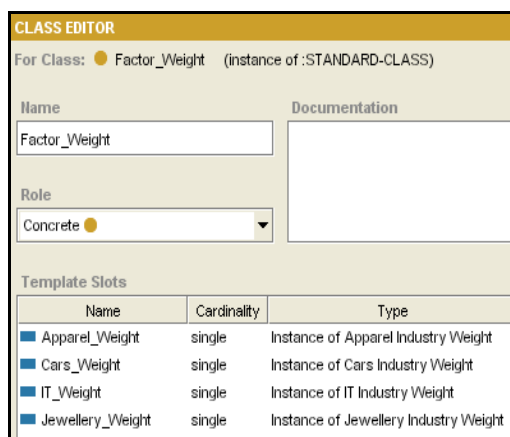

Figure 4: Slots in Factor_Weight class

ONLINE CONSUMERS' DECISION-MAKING STYLES ONTOLOGY

Since a person has different decision-making styles, all instances of the person class have different decision-making styles, such as price factor, etc. The Price Conscious factor class contains slots such as Price_Q1, Price_Q2, Price_Q3 (corresponding to three questions in price conscious factor), and Factor_Average (industry average score of the corresponding factor), as shown in Figure 5. The solid rectangles in Figure 5 represent classes and the dotted rectangles indicate instances. Arrows represent slots and instance of (io). Dotted lines indicate instances of other decision-making styles and their corresponding questions, not shown in the figure.
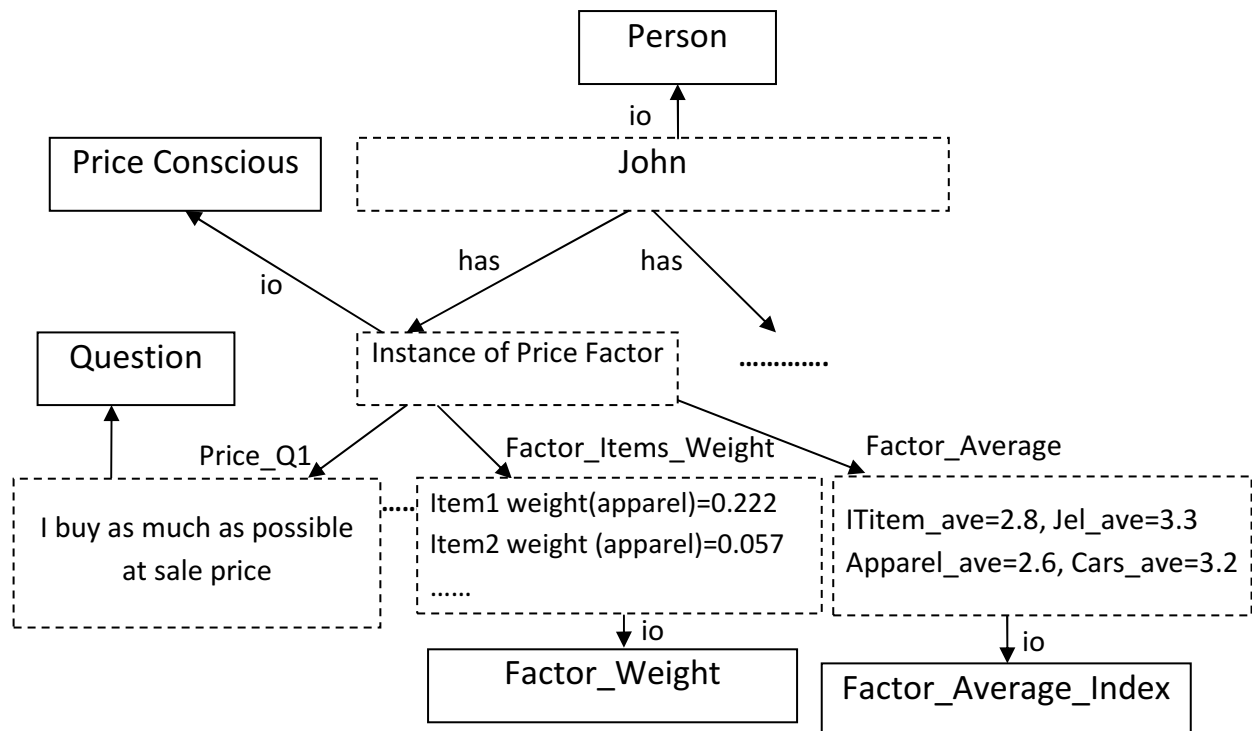
Figure 5: Relationship among classes in the domain of consumers' decision-making styles

The online consumers' decision-making styles ontology contains different classes for different decision-making styles. In Figure 6, there is a class for each decision-making style, which is important in describing the concepts of this model so that it is easier to access each decision-making style. Dec_Making_Style is an abstract class of the individual decision-making styles subclasses which indicates that a decision-making style is divided into eight categories. Each decision-making style class contains the following information:

i.   The related inventory items

ii. The factor industry average values in different product industries obtained from the group means, each of which is calculated by averaging the raw scores on the highest loading item of each factor in a particular product industry [9].

iii. The weights of inventory items

iv. The factor score of the decision-making style
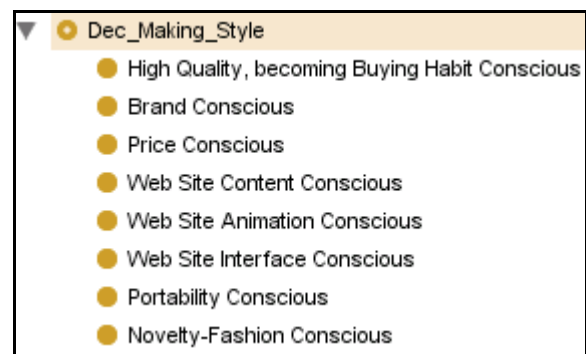
Figure 6: Hierarchical Structure of Decision-Making Style class

The weights of inventory items are indicated by the factor score coefficients which are incorporated into the online consumers' decision-making style ontology so that the factor scores of each online consumer's decision-making style can be easily evaluated based on the ontology. It can be achieved by including the weights of the inventory items for different industries in each decision-making style class as shown in Figure 7.
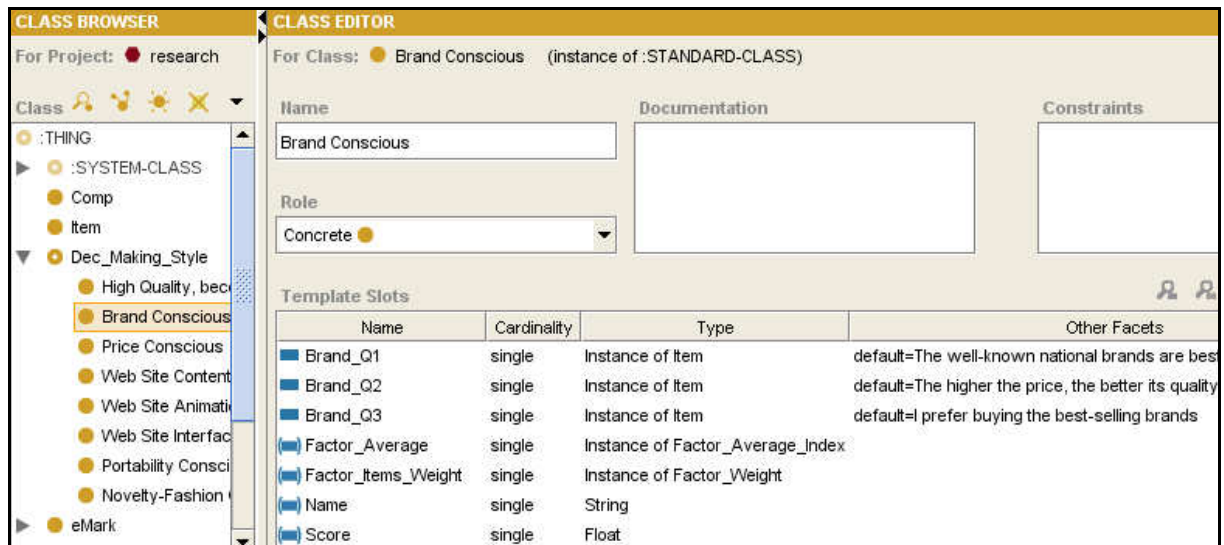
Figure 7: Slots in Brand Conscious factor of online consumers

The class Factor_Average_Index, shown in Figure 8, contains average indexes for different product industries as slots – Apparel, IT Item, Cars and Jewellery. Figure 9 shows the Person class which describes a person with his/her own decision-making styles.
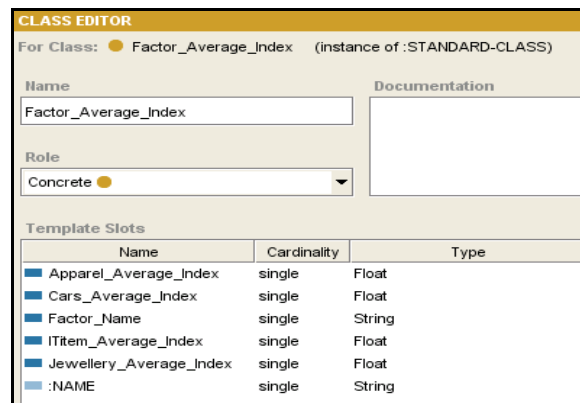

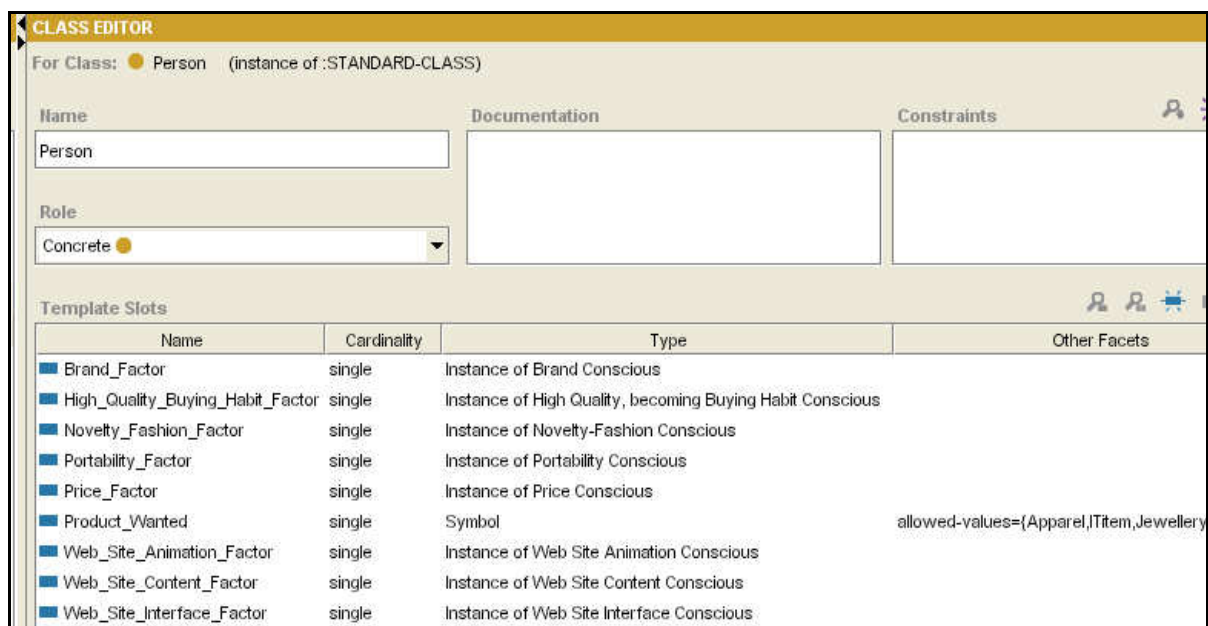
Figure 8: Attributes for factor average index class

Figure 9: A Person class: Each consumer has its own decision-making styles

Knowledge Base

The weights of inventory items for different decision-making styles and the each decision-making style's industry average values are important for Internet consumer behavior applications so that they should be stored in the ontology. Figure 10 shows the weights of some inventory items for the Brand Consciousness factor in the apparel industry while Figure 11 shows the factor industry average values of Brand Consciousness factor.

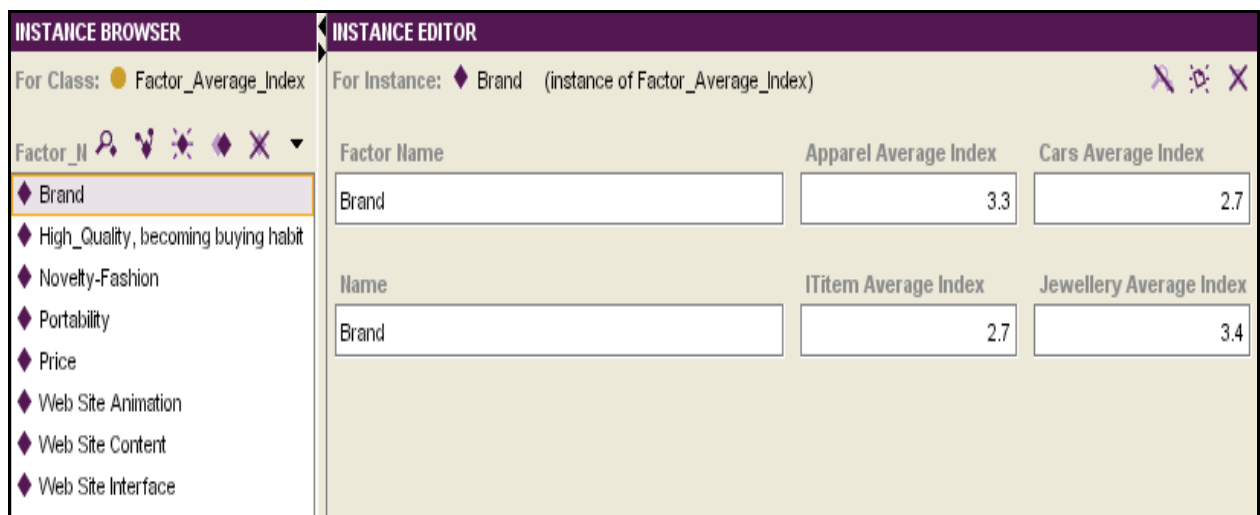Figure 10: Instance of Brand Conscious Weight in apparel industry

Figure 11: Instance of factor industry average values of Brand Consciousness factor

CONCLUSION

In this paper, based on the factor score coefficient matrices, the weights of inventory items corresponding to their decision-making styles for the E-CSI model have been determined across the four non-consumable product industries; namely: apparel, IT item, jewellery and car items. The weights of inventory items play a very important role in the factor scores of the online consumers' decision-making styles, which are very important for e-marketing applications development related to Internet consumer behavior. Therefore, the weights of inventory items are incorporated into the online consumers' decision-making styles ontology. A sizeable and still-growing fraction of all software has been deployed on intranets or the Internet [5]. The ontology can be adopted by different intranet-based or Internet-based e-marketing applications to analyze online consumer behavior accurately.

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