

# Identifying Users' Characteristics Critical to Product Selection Using Rough Set Theory

Ali Ahmady

*Industrial and Manufacturing Engineering Department*

**Abstract.** A consumer's purchase decision making process is very complex. It is obvious that the set of product functional features has a major role in the purchase decision. However, for a same product, users may have different assessments. So it seems that other factors than product functional characteristics play a role in decision making. Frequently, customers are segmented based on characteristics such as age, gender, geographic location, etc. Nevertheless, in many cases it has been seen that the customers in the same segment have different points-of-view for the same product. For example, some customers in a group may consider a product suitable while others don't. Inconsistencies between customers can cause uncertainty for designers in producing the most satisfying product attributes. This paper presents a method to resolve this kind of uncertainty using Rough Set Theory. The input of this method is users' evaluation data for a product with respect to a specific customer subjective feeling. The output is sets of the most influential users' characteristics on their product selection preferences. By using reduced sets of users' characteristics, designers are able to reclassify users and resolve inconsistencies.

## 1. Introduction

The customer purchasing decision process is a crucial part of companies' success, while it is a "black box" for marketers. In fact, no one really knows how the human brain makes decisions. Some attempts have been made to model consumer purchase processes and document characteristics affecting consumer purchase behavior. Among the influential characteristics which marketers agree upon are psychological factors which include attitudes and perceptions [1]. Many factors alter consumers' perceptions and attitudes such as cultural, social, and personal characteristics [2]. Personal characteristics (age, income, lifestyle, etc.) can influence user perception, for instance, to see a particular website as attractive. While consumers themselves don't know exactly what impacts their purchasing process, marketers know that consumers buying decisions are under the influence of their cultural, social, and personal characteristics [1]. Figure 1 shows that consumer purchasing decisions affect user characteristics by manipulating customer attitudes. Knowledge of these factors helps marketers in designing more efficient market strategies, designers producing more satisfactory designs by adjusting product features to customer needs, and manufacturers to enhancing product quality via what the customer wants and ultimately helping society secure its resources more efficiently and effectively.

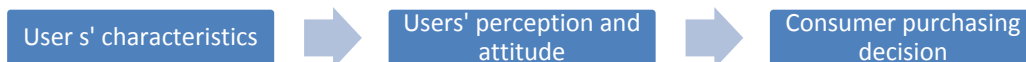


Fig. 1. Linking between customers' characteristics and their purchasing decisions.

This study aims to identify those critical user characteristics that influence user perception using one of the recent developments in databases, Rough Set Theory. Rough Set Theory, a mathematical formalism developed by Z. Pawlak, can be considered a formal model which allows for discovering several sorts of information such as pertinent features or classification rules. Data size reduction (resulting in reduct sets), which is one the main objectives of rough set data analysis [3], will be used in the proposed approach to reduce the sets of users' characteristics by eliminating those which don't impact user perception. The resulting characteristics are critical for product selection.

## 2. Method and Results

In this study, to identify the critical user characteristics affecting customer perception and consequently on the purchasing decision, customer feelings are used as scales to measure user perception. If a product gives a particularly good sense to its user it leads to positive perception respect to that product. It is obvious that different users may have different perceptions of a product. Since the users evaluate the same product, it is assumed that the

source of those inconsistencies comes from user characteristics in which they differ even though product features are the same. If two users evaluate the same product differently and they have the same characteristics, some other discriminating factors may play a role in manipulating perception that have not been considered in the set of user characteristics. In such a case other discriminatory user characteristics should be searched until the users become discernible.

The first step in eliminating irrelevant user attributes is to construct the information system table which is an essential component of Rough Set Model. In this table, which is shown in Table 1, the rows represent the users (objects) and the columns show potential significant user attributes. This table also has one distinguished attribute called the decision attribute which is considered for user evaluations, and descriptors, which the values are denoting the different levels of characteristics of users. Here a very simple example is given to show the outcome of proposed approach. Suppose eight users are asked to evaluate a specific website in term of site attractiveness [4]. The attributes which might be significant in their website evaluation are age, education, internet skill and Centrality of Visual Product Aesthetic (CVPA)[4]. Those characteristics, which if removed them will not affect the decision making results are redundant and can be eliminate from the set of characteristics in Table 1. In order to obtain the reduct sets we need to construct a symmetric matrix called indiscernibility matrix and calculate the discernibility function [5]. The set of all prime implicants of discernibility function determines the set of all reducts of user characteristics [6]. For information system Table 1 three reduct sets  $\{c_2, c_3, c_4\}$ ,  $\{c_1, c_2, c_4\}$ , and  $\{c_1, c_3, c_4\}$  are obtained. Either each of these three sets will influence the users' decision process. If set one is considered as a reduced set of criteria which are  $\{c_2 = \text{Age}, c_3 = \text{skill}, c_4 = \text{CVPA}\}$ , these users' characteristics play a major role in user decision process to perceive and select the website as attractive or not attractive based on the data available.

Table: 1  
Information system table

Criterion Users	c <sub>1</sub> (Age)	c <sub>2</sub> (Education)	c <sub>3</sub> (Skill)	c <sub>4</sub> (CVPA)	Decision
x <sub>1</sub>	4	4	4	3	A
x <sub>4</sub>	5	3	5	3	A
x <sub>5</sub>	4	4	5	1	A
x <sub>7</sub>	4	4	5	2	A
x <sub>8</sub>	4	3	4	2	A
x <sub>2</sub>	3	3	4	3	R
x <sub>3</sub>	3	4	3	3	R
x <sub>6</sub>	3	4	3	1	R

### 3. Conclusions

It is very important for companies to know which factors influence their product's user perception rather than product features to design efficient and effective market strategies and also enhances product quality and customer satisfaction. It is known that the purchasing decision process is under influence of customer perceptions in which customer characteristics play a major role. This study proposed an approach to identify those users' characteristics which are significant in manipulating user perceptions and purchase decision process consequently using reduct sets concept in Rough Set Theory. A very simple example about a website was given to show the input and output of the approach.

### 4. Acknowledgements

I would like to express the deepest appreciation to my committee members, especially Dr D. Malzahn, Dr S.H. Cheraghi, and Dr B. Chaparro that without their support this research would not have been possible.

- [1] P.Kotler and G.Armstrong, Principle of Marketing, Pearson Prentice Hall, New Jersey, 2008.
- [2]N. Hill and J. Alexander, Handbook of Customer Satisfaction and Loyalty Measurement, Gower, 2000.
- [3]M. Magnani, Technical report on R.S.T for Knowledge Discovery in Data Bases, Dept of Computer Science, Uni of Bologna, 2003.
- [4]P. Cristie, The Influence of Aesthetics on Website User Perception, PhD Disserattion, Psychology Departemtn, WSU, 2007.
- [5]A. Ahmady, A Rough Set Based Approach to Resolve Multiple Users' Inconsistencies in Kansei Engineering, IMFGE Dept, WSU, 2009.
- [6]J. Komorowski, L.Polkowski and A. Skowron, Rough sets: A tutorial, the European Union 4th Framework Telematics project Cardi Assist, by the ESPRIT-CRIT 2 project #20288, and by the 8T11C 02417 grant from the National Committee for Scientific research.