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Using a modified ELECTRE method for an agricultural product recommendation service on a mobile device☆

Jiunn-Woei Lian[1], Chih-Kun Ke*

Department of Information Management, National Taichung University of Science and Technology, 129 Sec. 3, San-min Rd., Taichung 40401, Taiwan

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ABSTRACT

The present study integrates information system engineering and management methodologies to solve a real-life case problem. We develop an agricultural product recommendation service on a mobile platform, and then to understand users' acceptance to confirm that it can be used to solve the problem. For consumers, making the decision to purchase is complex and can be full of contradictions and conflicts. This raises the need to design a product recommendation service that uses multiple criteria to assist consumers. This study employs a modified Elimination Et Choice Translating Reality (ELECTRE) method determine a ranking order which will assist consumers in deciding which agricultural product to buy. Two major findings are proposed. First, we identified five criteria that assist consumers making buying decisions regarding agricultural products. Second, we find that when the system is established on a mobile platform, perceived ease of use does not play a critical role in user acceptance.

1. Introduction

In the era of electronic commerce (EC), disintermediation and the direct selling business model are increasing in popularity. The agricultural product market is no exception. Without brokers serving as middlemen, farmers reap better profits and consumers get higher quality products. Advances in information and communication technology have promoted the development of mobile devices. The recent popularity of these devices has caused smartphones to become one of the major platforms for modern information systems (IS) and EC. The smartphone has become a popular tool with which to purchase products. Therefore, mobile commerce has become the main stream of EC development.

In the context of the direct selling business model, the question of how to assist customers who are looking for suitable products is becoming a critical issue for both academics and practitioners. However, decision-making is a complex behavior, full of contradictions and conflicts. Complex problems rarely have ideal solutions. For example, producers of agricultural products are located in different geographical areas. Agricultural products also vary according to the season, so farmers' promotional programs must reflect this variation. Cost and benefits are major considerations for consumers, but most consumers are not well versed in agriculturally related knowledge. The variety of factors which consumers take into consideration requires a comprehensive evaluation method based on multiple criteria which must be identified by the consumer.

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* Corresponding author. Tel.: +886 4 22196623 (office); fax: +886 4 22196311.
E-mail addresses: jwlian@nutc.edu.tw (J.-W. Lian), ckk@gm.nutc.edu.tw (C.-K. Ke).
[1] Tel.: +886 4 22196600 (office); fax: +886 4 22196311.

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These issues are commonly encountered in general practice; the case used in the present study is a good example. However, previous studies have paid little attention to traditional agriculture, and few studies have provided applicable solutions for problems related to selecting agricultural products. Thus, we find a gap between academia and practice in this area. Motivated by the issues above, and in accordance with the requirements of the real live case, this study aims to develop an agricultural product recommendation service on a mobile platform, and to understand users' experiences and acceptance of this system in order to confirm that it can be used to solve the problems encountered in the real life case. This study integrates the system engineering and information management perspectives to solve a practical problem in the agriculture field. Our study contributes new insights regarding information and communication technology (ICT) applications for agriculture, from a technical and management perspective, and our findings add to those of existing research on this industry.

The rest of the paper is organized as follows. Section 2 reviews related studies on multi-criteria decision analysis and user acceptance of information systems. Section describes the details about the real life case. Section 4 introduces an optimal selection approach for special offers of agricultural products. Section 5 describes the implementation and verification of our system on a mobile device. Finally, Section 6 presents our conclusions.

2. Related work

This review of the related literature covers multi-criteria decision analysis and user acceptance of information systems.

2.1. Multi-criteria decision analysis

The high levels of uncertainty and complexity inherent in complicated multi-dimensional problems typically necessitate the participation of experts in the decision making processes required to solve such problems [1,2]. The purpose of multi-criteria decision making (MCDM) or multi-attribute decision making (MADM) is to support decision makers facing such problems. Several approaches have been proposed for analyzing multi-criteria decisions: Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), VIšekriterijumsko KOmpromisno Rangiranje (VIKOR), Elimination Et Choice Translating Reality (ELECTRE), Decision Making Trial and Evaluation Laboratory (DEMATEL), Analytic Hierarchy Process (AHP), and Data Envelopment Analysis (DEA). Aruldoss et al. [3] did a survey of multi-criteria decision making methods and their applications, reviewing nine MCDM methods and describing the advantages and disadvantages of each. The study showed that MCDM is a powerful decision-making technique.

MCDM applications are used in e-commerce and mobile commerce, among others. Büyüközkan [4] defined possible e-marketplace evaluation criteria and formulated a new multi-criteria evaluation model. The suggested evaluation model deepened our understanding of the generic success factors of an e-marketplace. Chiu et al. [5] proposed a new hybrid multiple attribute decision making model which combined the DEMATEL, DEMATEL-based Analytic Network Process (DANP), and VIKOR methods to resolve e-stores' customer satisfaction issues caused by interdependence and feedback problems among dimensions and criteria. To diagnose e-commerce activity, Denguir-Rekik et al. [6] proposed a "Feedback Based Diagnosis System" (FBDS): a multi-criteria decision making support system designed to help marketers analyze cyber consumers' feedback and/or evaluations gathered via classic recommendation systems. Manouselis et al. [7] identified a set of dimensions that distinguish, describe and categorize multi-criteria recommendation systems, based on existing taxonomies and categorizations. These studies provided a comprehensive overview of how current multi-criteria recommendation systems support the decisions of online users. Some utility-elicitation methods have been developed on the basis of multi-attribute utility theory (MAUT) to fully represent a decision maker's preferences. Huang [8] compared different utility-based recommendation methods (including holistic and decomposed methods) with a traditional content-based method in terms of recommendation accuracy, time expense, and user perceptions. Işıklar and Büyüközkan [9] examined the current mobile phone market in general to determine how to achieve the most accurate decision when purchasing a phone. Two MCDM methods, AHP and TOPSIS, were used in the evaluation procedure, and the authors used a case study to illustrate the effectiveness of the proposed approach. Jan et al. [10] proposed an MDCM methodology to improve the technology selection process, since MDCM allows for multiple actors to express their personal preferences in the selection process of mobile information systems.

ELECTRE is a family of multi-criteria decision analysis methods. ELECTRE methods include two main steps [1]. The first step constructs the ranking relationships for a comprehensive comparison of each pair of actions. The second step elaborates on the recommendations based on the results obtained by an exploitation procedure in the first step. Afshari et al. [11] applied ELECTRE methods to seven criteria for selecting the best personnel. Chi et al. [12] proposed a selection approach which modified ELECTRE methods in order to optimize the composition of web services. Ke and Wu [13] used ELECTRE methods to select a reasonable solution during problem solving. Ke and Chen [14] employed ELECTRE methods for selecting a reasonable solution for optimal message negotiation. Liu et al. [15] also used ELECTRE methods in multi-attribute decision-making under conditions of risk, using interval probability.

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