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Understanding m-commerce payment systems through the analytic hierarchy process

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Abstract

Money is always a tempting subject; however, few works are done to address the payment issue over online commerce. This paper analyzes currently available e-payment systems and finds the stored-value card to be the best overall payment scheme for online commerce.

The paper employs the analytic hierarchy process (AHP), a quantitative method of decision-making, to evaluate the performance of four e-payment systems: the credit card, the stored-value card, the smart card, and the telecommunication bill. The results show that the stored-value card has the highest performance among the four options considered. Our findings also suggest that a payment alternative, such as the credit card, can be flawed technologically but can still become the de facto e-payment scheme due to the advantage of an established customer base. This leads us to suggest that multiple usages be added to e-payment systems with higher economic/social merits so that they can gain a critical customer base. Users will benefit as technologically more capable e-payments are widely adopted for online commerce.

Keywords: M-commerce; Micropayment; The smart card; Analytical hierarchy process (AHP); Transaction costs

1. Introduction

Electronic cash (or digital cash) was invented early on in the development of e-commerce. However, the reality of e-cash business has proved less than exciting. Within the first few years, the issuers of e-cash went bankrupt (DigiCash), dropped the product (CyberCash), or moved into another business (First Virtual).

Observing the failure of the above e-cash mechanisms and the extensive adoption of the credit card on the Internet (95% of online payments are made by credit cards in the US; Singh, 1999, p. 762), we probe the question of what payment schemes are adequate for the e-business environment. We hypothesize that, in addition to technological considerations, economic and social factors play an important role in the popularity of online payments. This paper begins by describing four e-payment systems and defining the technological, economic, and social factors that characterize these systems. It then delineates the presumptions and procedures to conduct the analytic hierarchy process (AHP). To test our hypothesis, AHP is used to obtain the relative weights among the subfactors and the total values of each payment system based on these weights. An ordinal ranking based on the total value gained by each payment scheme determines their relative performance. Based on our analysis of the results, we suggest policy alternatives.

2. Payment systems

This paper focuses on e-payment schemes that are either currently available or have been previously put into practice for a period of time, that is, the credit card, the stored-value card, and the smart card. In addition to these schemes, the telecommunication bill is a promising method for m-commerce payment because of the surge in mobile subscription rates across countries and the installation of intelligence systems in telecommunication networks.

2.1. The credit card

The credit card is the most popular payment method for online shopping today, despite its vulnerability to security breaches when used online (Turban et al., 2000, p. 277). The secure sockets layer (SSL) protocol was invented in 1994 to deter false uses. The credit card is a postpaid method.

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2.2. The stored-value card

The stored-value card is often viewed as a prepaid method. Indeed, credit cards, stored-value cards, and smart cards all function like magnetic strip cards, but with different payment times. When the stored-value card is used in online commerce, customers must key-in certain identification numbers that match the information stored on the magnetic strip. The amount of the product or service is then deducted by the card reader and the reader rewrites information back to the card. Many stores desiring micropayment mechanisms adopt the stored-value card payment system. In Taiwan, Software International issued Web Gold Services (WGS) for its online game players to make payments.

The stored-value card can be either anonymous or identifiable. Anonymous cards have the advantage to be transferred from one person to another, whereas identifiable cards are nontransferable (Greenstein and Feinman, 2000, p. 305–306).

2.3. The smart card

The smart card exemplifies the real-time payment method and is the only payment scheme capable of converting stored value back to real currency. With its superior encryption technology, the smart card is less vulnerable to security breaches than the credit card. Another merit of the smart card lies in its capabilities to include peer-to-peer payment.

2.4. The telecommunication bill

The telecommunication billing system can be thought of as a charge card for which all balances must be paid at the end of every billing cycle. In this sense, it is a postpaid payment method. This system is unable to make peer-to-peer payments.

In countries where telecommunications services are popular, telecommunication bills can easily substitute for other payment systems for two reasons. First, telecommunication service providers possess the sole access to the online shopping activities of their customers. Second, the telecommunication billing system is able to handle micropayment, as evidenced by its over 99% billing accuracy and reliability (Standage, 2001, p. 10).

3. Evaluation criteria

Most discussions about e-payment emphasize only technological advancement. However, we suggest that economic and social factors are also critical to people's decisions regarding the use of e-payment schemes. We therefore propose that three major factors affect the performance of e-payment systems: technological, economic, and social factors. We break each of these categories into subfactors that are most instructive and mutually exclusive, leading to a total of 13 subfactors that influence the performance of a payment system.

3.1. Technological factors

3.1.1. Security

Because e-commerce is operated on an open network, encryption technologies must be developed to deter hacker attacks. In particular, security failures reduce people's trust in electronic payment systems and hinder the emergence of these systems.

3.1.2. Reliability

The e-payments must be available online 24 h a day. That is, the operation system of e-payment should not present failures at anytime (Neuman and Medvinsky, 1995, p. 2).

3.1.3. Nonrepudiation

Acknowledging payment and producing receipts are the basic properties required for any payment system. Such proof of payment can deter the alteration or destruction of transaction information during transmission (Neuman and Medvinsky, 1995, p. 2).

3.1.4. Latency (clearing time and frequency)

Even during peak load periods, payments should be transmitted at a steady pace. Customers and merchants should be able to use the e-payment mechanisms without noticeable delays in authorization and clearing (Schmidt and Muller, 1997, p. 4).

3.1.5. Transaction completeness

Payments must be completed; otherwise, transaction inconsistencies will result. A simultaneous and instant clearing and settlement instrument should be installed in e-payment systems to avoid transaction incompleteness.

3.2. Economic factors

3.2.1. Costs

There are two kinds of costs in adopting e-payment systems: fixed and transaction costs. Fixed costs refer to those of installing payment equipment such as card readers and payment software. Transaction costs are those incurred by merchants and customers every time they undertake a business exchange. As many online transactions involve micropayment, low fixed and transaction costs are essential to the popularity of e-payment systems.

3.2.2. Monetary convertibility

Provided an e-payment system allows the (monetary) value in a digital format to be converted back to real currencies, the utility of the system increases for end-users, and it is more easily accepted (Schmidt and Muller, 1997, p. 4).