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A novel hybrid decision-making model for determining product position under consideration of dependence and feedback

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ABSTRACT

With the development of information and communications technology, people are gradually replacing paper maps with vehicle telematics systems (VTS). VTS provides customers with navigation services, as well as other functions and system services. This study discusses the development trend of VTS products/services and customers' needs for navigation and location services, audio–video and entertainment services, communications and information services and safety and security services. Automobile manufacturers and VTS product/service providers should determine new product development strategies based on their customers' needs, as these needs will directly influence future sales. To assist in determining customers' VTS needs and intentions, this study evaluated customers' important VTS product/service criteria. A novel MCDM (Multiple Criteria Decision-making) model was applied that integrated four MCDM techniques: decision-making trial and evaluation laboratory (DEMATEL); principal component analysis (PCA); analytical network procedures (ANP); and Vlse Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR). These four techniques were applied to determine the product's position and improve the four VTS service systems for obtaining the best win–win service solution. This paper proposed the key driving aspect of the four VTS service systems and determined their product's position based on the proposed model. The conclusions are also suggestions for service providers to improve upon existing service functions and plan further utilities for the next generation of VTS service systems. This study also aids VTS service system providers in determining their product's position and proposing their new value position.

1. Introduction

With rapid advances in information and communications technology (ICT), suppliers of consumers' electronic devices and the automobile industry have already begun to modify their development strategies. New generation automobiles emphasize mechanical efficiency and VTS system functions. In order to satisfy the service needs of the mobile environment for different customer groups, the VTS service system needs to be integrated and offer diverse service functions. Consequently, some integrated functions have appeared, such as the information and communications service and the vehicle monitoring service. Today's car has become an open mobile service system from a closed transportation tool. The automobile has increased the added value of navigation, safety, security, information, communications, and entertainment functions. The VTS service system can aid drivers and passengers in contacting call centres and accessing navigation information. The VTS service system can not only improve driving convenience but also ensure the safety of vehicles under

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appropriate monitoring. The innovation of ICT technologies can be attributed to the diverse system service, with devices becoming thinner and lighter. Even though the VTS service system is continually increasing its service functions, VTS service devices are generally similar among customers. This trend is attributed to the VTS service system/device becoming more and more popular over the past year and going from a luxury good to a necessity good. Navigation technology and the electronic service functions of VTS service systems have continually made rapid progress in achieving the satisfaction levels of the customers' needs. In the highly competitive market of VTS, customers have been pleased with improvements in the devices hardware and electronic mapping software services. Therefore, it is important for VTS service operators to identify what consumers need to develop a new generation of VTS service systems to satisfy customers' needs. This will not only influence the sales volume of automobile operators, it will also impact the service market of end users in the automobile market.

The GPS (Global Positioning System) was developed by Bradford Parkinson, Roger L. Easton, and Ivan A. Getting of the United States of America's (USA) Department of Defense in 1973. The service system includes space satellites, ground control stations and user receivers. The GPS application is quite extensive. Navigation devices can be classified as vehicle, aviation and marine navigation. Vehicle navigation devices are widely applied to END (Embedded Navigation Device), PND (Portable Navigation Device), PDA (Personal Digital Assistants) smart phones and a diversity of other mobile devices [1,2]. The original purpose of the GPS technology was for the military. However, it was gradually released to private enterprises. The related map information systems were built thoroughly. The application service of GPS technology has begun to move toward diversification [3–5]. The END is proposed to be equipped in high class cars, as a luxury good, by automobile producers. END is a highly system-integrated device and controls the air conditioner, vehicle body, telematics, vehicle safety, and communications and entertainment utilities. It is primarily promoted as a value-added device by automobile producers and, therefore, its price is higher than that of other devices. PND is equipped with a car cradle attached to the windscreen or placed upon the dashboard. Navigation is the primary utility of a PND, but the entertainment utility has also been integrated inside it in recent years. PND can easily be demounted and installed into different cars. Therefore, consumers can use it in unequipped cars, such as the automobile. PND is positioned into the consumer market and is developed by GPS, or telematics enterprises. Vehicle Navigation Systems (VNS) integrate the GPS, map information system and GIS (Geographical Information System), and display the navigation information in the screen of the VTS system. The drivers can input their present position and destination into the VTS service before departure and the VTS service system will guide drivers with the best route, including avoiding traffic congestion conditions and providing journey time assessments. VTS helps drivers to adjust their driving route based on real-time traffic information.

This study discusses customer service needs, defines the VTS service system functions/utilities, and analyzes different customers' needs. To accomplish the study goals, the evaluation system of the VTS is defined by: (1) five primary value evaluation aspects (e.g. Location and navigation services, LN; Safety and security services, SS; Communications and system services, CS; Multimedia and entertainment services, ME; Image and customer relationships, IR), (2) four price evaluation aspects (Service fee rate, SF; Package pricing, PP; Flexible payment methods, PM; Convenience payment channels, PC). The DEMATEL (Decision-making Trial and Evaluation Laboratory) technique will be used to construct the Network Relationship Map (NRM). Principal component analysis (PCA) technique is applied to categorize criteria based on their properties. The Analytic Network Process (ANP) technique is used to determine the weights of the components, while the VIKOR (Vlse Kriterijumska Optimizacija I Kompromisno Resenje) technique is adopted to determine the product's position. This study proposes an integrated evaluation model to analyze the current service gap of VTS service systems/devices and illustrate four real commercial types of VTS services/devices to test the proposed model. This proposed model can aid VTS system service operators in determining the product position of VTS service systems/devices by the service value position map and determining the service improvement paths using the NRM (Network relationship map). It can also provide the product/service development strategy of VTS systems/devices for the VTS service providers and automobile operators in the future. In the VTS service systems/devices, the system service providers need to play an integrated role in providing the users with a variety of vehicle navigation and mobile services applications.

This study uses the VSI (value satisfaction index) and PSI (price satisfaction index) to describe the PPM. It also defines the four product position conditions: (1), common and luxurious, (2) low price to catching market, (3) no or limited choice and (4) high price and gorgeous. The common and luxurious (H,H) position is located in the first quadrant, the low price to catching market (L,H) position is located in the second quadrant, the no or limited choice (L,L) position is located in the third quadrant, and the high price and gorgeous (H,L) position is located in the fourth quadrant. For the four product position conditions, one of the four commercial VTS services systems/devices is located in (H,H), one is located in (L,H), and two are located in (L,L). This research result illustrates important information in that the development trend of VTS service systems/devices has generally moved from (L,L) to (L,H) by improving the PSI move to (H,H) through improving the VSI. Thus, the VTS service systems/device operators need to think about how to change their product position from (L,H) to (H,H) through improving the VSI and PSI of the VTS service systems/device. This study also proposes that the NRM determine the service improvement path. The aspect of the SS is the primary dominating aspect, the aspect of CS is the most important influential aspect in the NRM of the VSI. The aspect of the PC is the primary dominating aspect and the aspect of the PM is the most important influencing aspect of the PSI. This study can aid VTS services systems/devices operators and automobile manufacturers to determine their product position of VTS services systems/devices based on the PPM technique, to determine the improvement direction and to plan new generation service systems/devices using the NRM technique. VTS services systems/devices can also understand the competitive condition of the VTS services market and determine their competitive strategy and plan their best solution.