A Decision Support System Approach for Choosing Delivery Services in Smart E-Commerce Environments

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Abstract
One of vital characteristics of smart e-commerce is the ability of providing real-time multicriteria decision making for the best possible delivery service. Success in the e-commerce sector is partly determined by delivery service qualities, including price, safety, speed, traceability and friendliness that contribute to the satisfaction of customers. This paper discusses the provision of a multicriteria decision making tool that enables customers to examine and choose, with certitude, the best possible delivery service. The proposed DSS is based on an AHP method comprising three structured muti-criteria and sub-criteria for selecting the best possible choice from a set of alternatives. The DSS has been tested for three famous providers of delivery services in Indonesia, including JNE, TIKI and Pos Indonesia.

Introduction
A high degree of customers' satisfaction results in the increasing customers' loyalty in the long run. E-commerce systems are fastly growing and aggresively competing to win the competition in interconnected markets nowadays. In the past, product selection and price variations were adequate to satisty customers, but now in order to develop a successful business, companies need to provide the facilities, services, and processes that meet the needs of demand (Dimitriou, 2017). Service is a critical differentiating factor, and within the scope of service, the delivery of delivery services is probably the most important (Starkey, 2010). The research done by Interactive Media in Retail Group (IMRG) found that 40% of respondents who had a bad experience with a shipping service stopped shopping for certain retailers. Royal Mail research showed that 90% of consumers would return to an online diluent if they are satisfied with the delivery service (Starkey, 2010). This shows how important the delivery service to e-commerce users loyalty.

One of the current efforts is to incorporate intelligence in e-commerce systems, and thus introducing what so-called Smart E-commerce Systems (Song et al, 2017). One of vital characteristics of smart e-commerce is the ability of providing real-time multicriteria decision making for the best possible delivery service. According to Vogel et al (2017), success in the e-commerce sector is partly determined by delivery service qualities, including price, safety, speed, traceability and friendliness that contribute to the satisfaction of customers. In e-commerce environments, more and more recommendation systems are utilized to enhance the selection of available services (Buettner, 2017). Lin et al (2017) proposed an intelligent system to analyse consumer demands through electronic word-of-mouth (eWOM).

Continuing competition in e-commerce has resulted in an increasing number of e-commerce service providers offering logistics services (Jiao, 2014). The increasing number of shipping companies will make it difficult for customers to choose which service companies should be used to deliver the products they buy online to the destination address. Due to the constraints of cognitive ability, time and online shopping experience, customers' ability to gather and analyze relevant information is limited when they shop online (Li, 2011). Therefore decision-making is a real challenge for online shoppers (He, 2014). Jie Yu (2015) and Al-nawayseh (2013) created a model to assist e-retailers in choosing the best shipping service providers for their customers. There is not much research on the use of DSS in helping customers choose the best service delivery providers when they want to shop online. Mentzer, Flint, & Hult (2001) in his research stated that the relative parameters of logistics services vary depending on customer segmentation. This indicates that different commodities, will also have different criteria in the selection of delivery services. This paper discusses the provision of a multicriteria decision making tool that enables customers to examine and choose, with certitude, the best possible delivery service.

Delivery as a Sub-system of Logistics

According to Gleissner and Femerling (2014), freight services from sellers to buyers is a sub-section of logistics. The definition of logistics according to the European Standards Committee is the process of planning, implementation and control over the movement and placement of persons or goods and of supporting activities associated with such activities, in an organized system to achieve specific objectives. Logistics activities based on their functions can be divided into procurement logistics, production logistics, and distribution logistics. Delivery is included in the distribution logistics. In e-commerce systems delivery service providers include carriers, forwarders, general cargo, and small goods transport which includes courier service, express service, parcel service (CEP), and postal services (Gleissner and Femerling, 2014). In smart e-commerce systems (SESs) logistics and delivery service firms should provide comprehensive logistic solutions including warehousing, packing, distribution and returns processing to achieve improved margins, efficiency, transport capacity and customer satisfactions.

DSS Architectural Model

The architectural model of the devloped DSS for selection of delivery services is based on web and cloud computing environments as presented in Figure 1. The heart of the knowledge base system is the AHP model (Ligar & Banowosari, 2017). The DSS consist of four modules: (1) Web Graphical User Interface (WGUI), (2) Database System, (3) Knowledge Base System, and (4) Web Data Extraction System. Customers who are searching for delivery service firms and finding the best possible one can interact with the DSS through Web Graphical User Interface (WGUI). The customer pereferences can be also entered to the DSS prior to the selection of the best delivery service. These preferences can the be stored the database system module and embedded in the knowlede base system module. The AHP model can be reconfigured based on the current update customer preferences so that the AHP decision tree can be restructured based new added criteria or sub-criteria. The customers can also specify a list of alternatif delivery services to be included as objects of selection for AHP. Data about customers and delivery service firms can be entried by the customers and firms themselves via WGUI or can be extracted by the DSS from the web using Web Data Extraction System module, assumming the data are available in the web.

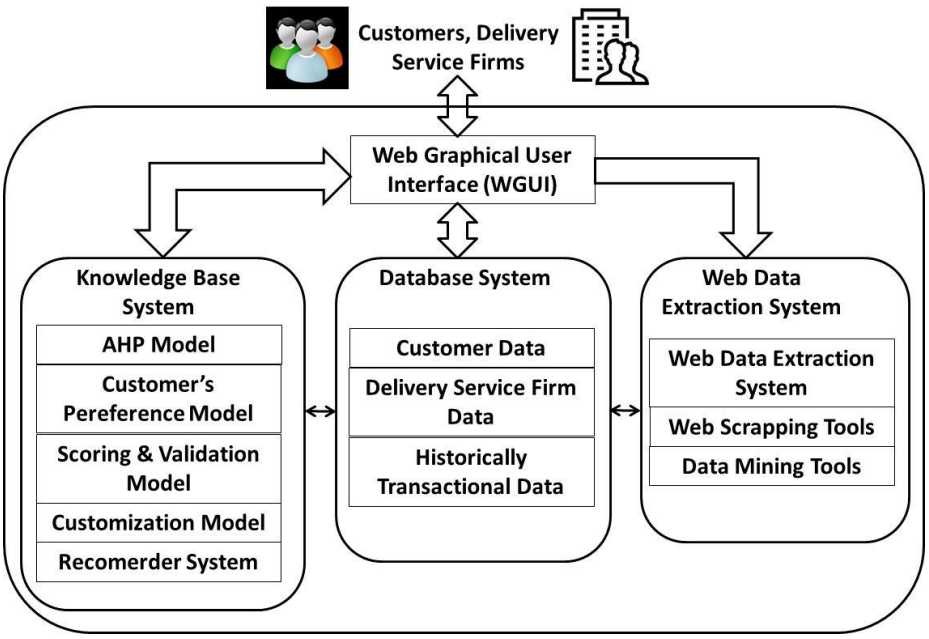


Figure 1. The architectural model of the DSS.

Scoring and validation model is utilized for supporting priority scoring of criteria or subacriteria under consideration and for validating the scoring priority in the AHP model. The customization model is employed to provide customized services to certain customers, based on their references and historical transactions recorded or extracted by the DSS. The recommender system produces the recommendation of delivery service firm choices ranked from the highest score to the lowest and let customers choose the most suitable one. All the data required in the DSS can be stored on cloud-based storage system or local storage based on the data size (volume) and security and reliability purposes.

System Implementation

The developed DSS has been implemented in web environment using open source programming language and database manajemen system (DBMS). The AHP method generally provides recommendations based on

hierarchical calculations as a whole, whereas it may not be true that all the criteria or subcriteria present in the hierarchy are important to customers. In the developd DSS selection of delivery services on e-commerce, customers can choose the criteria and subcriteria that interest them. This is because the specific needs of each customer will vary from each other. This will improve the convenience of customers when they want to shop online and choose delivery services. Figure 2 shows the facility for customers to specify criteria and sub-criteria and of alternatif delivery service firms of their preferences.

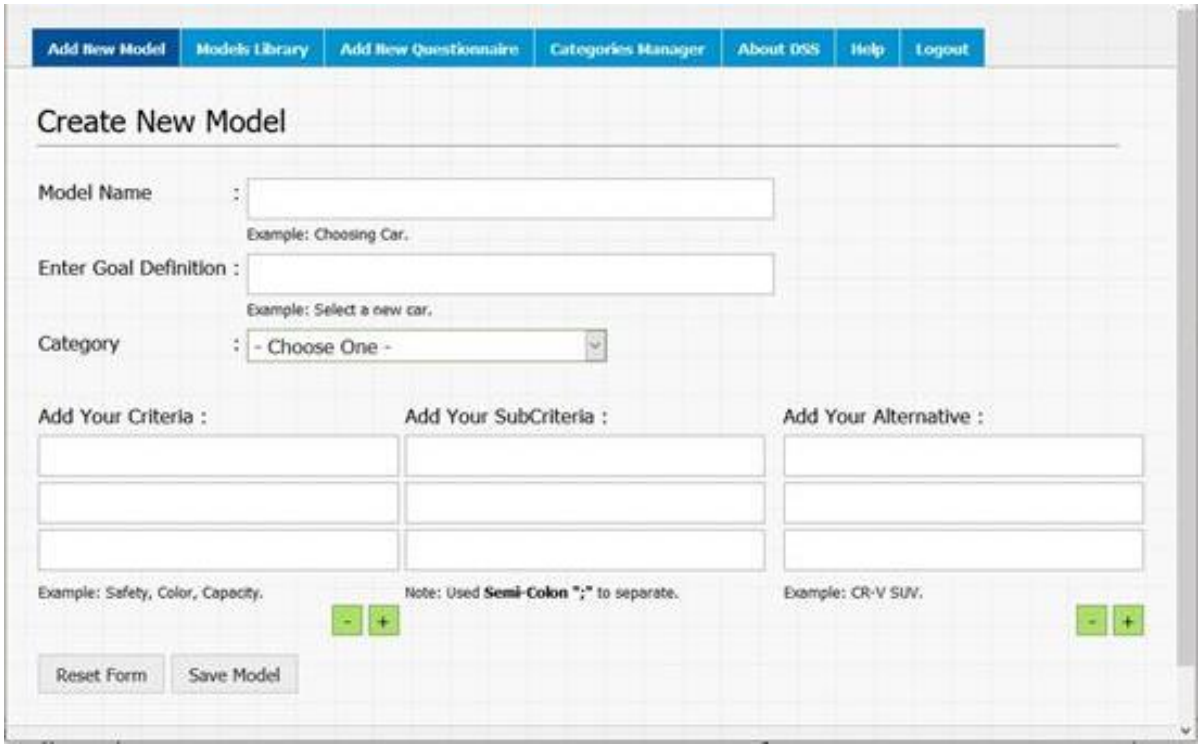


Figure 2. Facility of specifying customer preferences on criteria and sub-criteria.

Furthermore, more detailed specification of criteria and subcriteria specified by customers can be entered as shown in Figure 3. The provision of overall update of data, knowledge, criteria & sub-criteria, delivery alternatives and business categories is presented in Figure 4.

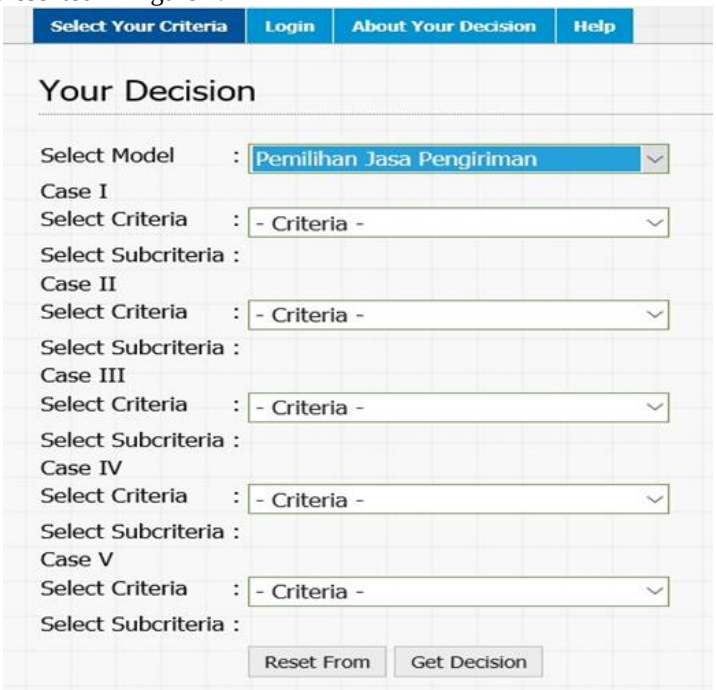


Figure 3. Detailed specification of customer preferences on criteria and sub-criteria.

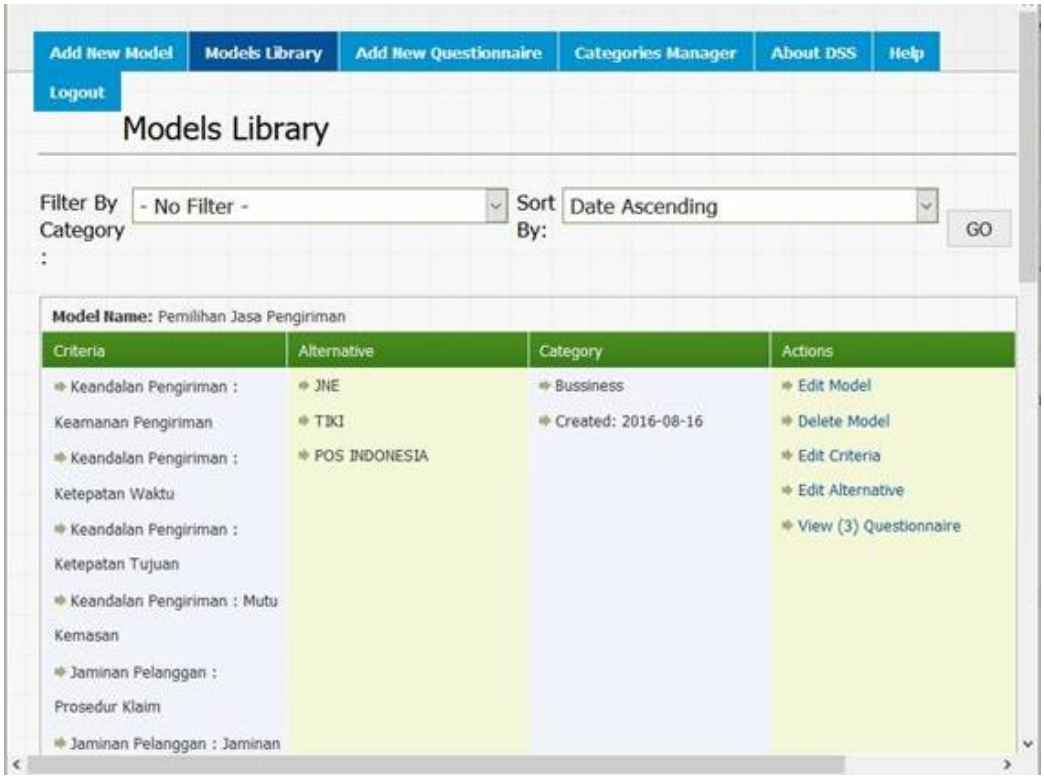
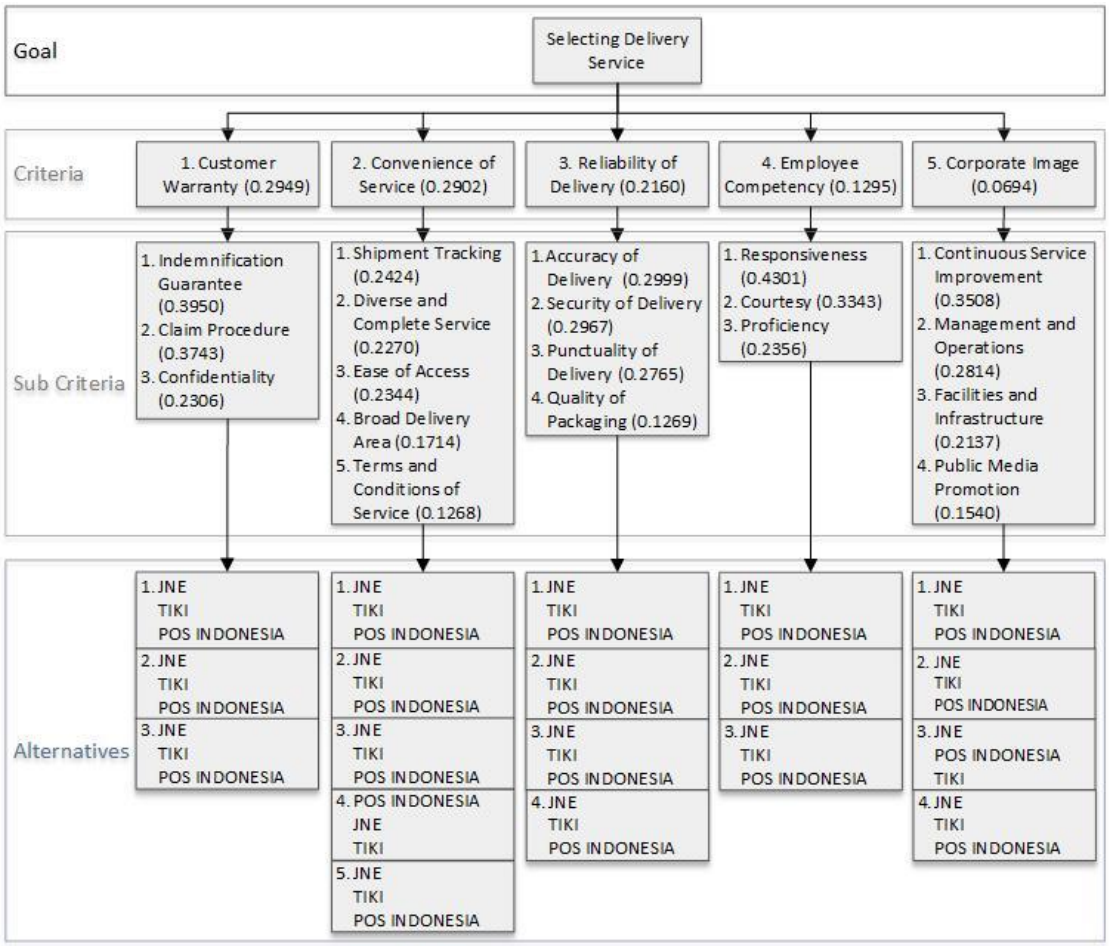


Figure 4. The overal update facility provided by the DSS.

To demonstrate the functional workability our our DSS, we present sample case of best three alternatives of delivery service firms in Indonmesia: JNE, TIKI and POS INDONESIA. In Indonesia, the top 3 shipping services based on the Top Brand Index survey conducted by Frontier Consulting Group are PT. Pos Indonesia, TIKI, and JNE. The companies have been ranked as the top 3 best courier brands in Indonesia for 5 consecutive years from 2012 to 2016 (Top Brand Award, 2016). Moreover, the exemplified criteria and sub-criteria used in the the selection model consist of 5 criteria and 19 sub-criteria, as shown in Figure 5.



Description:

- The numbers 1 - 5 at the criteria and subcriteria level indicate the order of interest of the element.
- The numbers 1 - 5 at the alternative level indicate the subcriteria element in the order of importance of each subcriteria
- The order of delivery services at the alternative level shows the level of alternative importance on each subcriteria

Figure 5. The sample AHP structure of criteria and subcriteria (Ligar & Banowosari, 2017).

Based on the above data, the developed DSS produces recomendation of ranked delivery services firms as shown in Figure 6.

Figure 6. The recommendation produced by the DSS, resulting in JNE and POS INDONESIA with the highest and the lowest score respectively.

To evaluate the usefulness of our DSS prototype, a user survey is conducted using SUS (System Usability Scale) questionnaires whose scoring using Likert scale. Questionnaires distributed to 10 respondents who are potential users for delivery services. The number of respondents is based on John Brooke's (2013) assertion that with a small sample size (8-12 respondents), SUS can produce a good and reliable assessment of how a user views a system. The SUS analysis results show that the average SUS score is 72, which means the system is good enough and usable (Bangor et al, 2008).

Conclusions & Future Directions

The web-based DSS for selection of delivery services has been developed, implemented and evaluated to support smart e-commerce systems (SESs). This DSS comprises four modules, some of which provide functional features for intelligent reasoning based on pertinent data resulted from web data extraction. The customers of delivery services are provided with tools for specifying their preferences on criteria and sub-criteria selections, scoring and weighing scenarios, and delivery service alternatives to allow the DSS to learn, infer and recommend the best possible solution(s). The customers and delivery service firm data and historical transaction data can also be extracted from the web using tools available in web-data extraction system module. Several future improvements can be made on incorporation of fuzzy method in the AHP model and the automation of data extraction from the web based on request, periodicity, web data update, or event-based trigerring. Furthermore, delivery transparency can be enhanced by providing a tracebility system module enabling movement tracking of the product from a sender to a receiver.

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