DANP-PROMETHEE approach to evaluate distribution strategy of an e-tailer

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Abstract

This study proposed a hybrid multi criteria decision making model to solve distribution strategy evaluation framework of an e-tailer, which combines Decision Making Trial and Evaluation Laboratory (DEMATEL), DEMATEL based Analytic Network Process and Preference Ranking Organization method for Enriched Evaluation (PROMETHEE) method. Data collected from the experts (e-tail manager, logistics manager, operations manager and distribution centre manager) using two questionnaires. DANP with PROMETHEE method calculation prioritizes distribution strategies as following: drop shipment, distribution centre shipment, store shipment, click and reserve and click and collect.

Keywords: Distribution strategy, DANP, PROMETHEE

Introduction

One of the segments of e-commerce is e-tailing which consists the online retail, and online marketplaces which have grown with 56% cumulative annual growth rate (CAGR) in 2014 and at present this segment valued at USD 3 billion (KPMG, 2015).. These research insights and statistics stipulate that online sales are expected to grow in India. Growing e-commerce market and demands of customers will bring challenges for the e-tailer's mainly pertaining to meeting the expectations of customers by delivering products at the right time and right place with minimum cost in the competitive e-tailing environment. This becomes much more important when online retailers are finding it difficult to survive, and it is essential for them to win customer's trust by delivering products efficiently and effectively (Kumar et al., 2014). Heim and Sinha (2001) have argued that customers expect on-time delivery of products and realization of the promises made by the company on the website which in turn affects their loyalty. If the e-tailer hampers the delivery services, expected product quality, post-transaction service are not delivered as expected or promised, then customers may not buy the product from that website again (Pyke et al., 2001). Hence, it becomes very important for an e-tailer to focus on the product delivery and fulfillment process to create loyal and satisfied customers. Technically, it is the distribution strategy makes a difference between the tradition retailer and online retailer, online retailer provides the customer product at their home, but this is not possible in traditional retailer (De Koster, 2003). This difference realizes that the online retailer should focus on distribution strategy which requires the decision on the product pickup location, delivery area to served, delivery time window, delivery lead time and the which delivery conditions (Attended home delivery, unattended home delivery, and the pickup point.). Distribution strategy based on the product pickup and destination location are drop shipping, DC shipment, dedicated fulfillment centre, partner fulfillment centre, store delivery (own store or local store), customer pickup, manufacturer delivery, click and collect and hybrid structure etc. (De Koster, 2002; Randall et al., 2006; Agatz et al., 2008; Lim and Srai, 2015 and Kumar et al., 2016).This has set the preliminary motivation for evaluating the distribution strategies for smooth product fulfillment process.

Distribution strategy selected for this study mainly relates to distribution centre shipment, drop shipment, click and collect, store shipment and click and reserve extracted from the literature review. These distribution strategies for customer order are influenced by many factors which are related to a product, service level, delivery

time requires, performance metrics, etc. (Randall et al., 2005). Evaluation of these distribution strategies by influencing factors (Criteria) requires a decision making model that is enabled to address the conflicting criteria (Influencing factors) and interaction among criteria. We are utilizing Multi criteria decision making method (MCDM) to deal with above problem. The present study adopted hybridization of DANP and PPROMETHEE method to offer a solution for the proposed problem.

Literature Review

A customer wants different fulfillment strategies for different product types, and satisfaction with these distribution strategies also varies across product types (Thirumalai and Sinha, 2005). A decision on particular distribution strategies should take keeping the customer and e-tailer convenience in mind. Most of the distribution strategy configuration is done on the basis of the combination of origin of the product (Retailer warehouse, supplier warehouse, traditional store and collection centre), delivery mode (Parcel delivery, air delivery) and the destination of the product (Attended and unattended home delivery, collection point, store pickup etc.). Literature shows that most of the distribution strategies classification based on the product origin (inventory) and the product destination with a different delivery mode. Product origin can be distribution centre, store, dedicated fulfillment centre, supplier warehouse and manufacturer warehouse (De Koster, 2002; Alptekinoglu and Tang, 2005; Agatz et al., 2008; Lang and Bressolles, 2013; Hubner et al., 2016) and destination are customer home and customer pick up centre.

2.2 Influencing factors of distribution strategy

Customer convenience and e-tailer's economic profit are main deciding factors to select distribution strategy. Customer convenience regarding faster delivery, shorter lead-time, free home delivery, reliable delivery and product availability. E-tailer's economic profit in terms of lower inventory and transportation cost with higher sales volume. Product type, weight, and size of product, timeliness, firm age and revenue are the primary factor which influences the inventory location decision of the e-tailer and the inventory location decision as an input to decide the distribution strategy for product delivery (Randall et al., 2006).

The previous studies define different influencing factor. These factors are price, product, cost, demand, customer service level, and delivery time, order size, and population density, mode of delivery and status of e-tailer (Randall et al., 2006; Lang and Bressolles, 2013 Hubner et al., 2016; Kumar et al., 2016). We classify these factor in

four dimensions based on performance, product, e-tailer and external characteristics. Figure 1 shows the dimension and their criteria's.

Framework to evaluate distribution strategies

Framework to evaluate and prioritize the distribution strategies based on the review of literature shown in figure 1. Where goal at the top and the dimensions and criteria after that and alternative at the bottom.

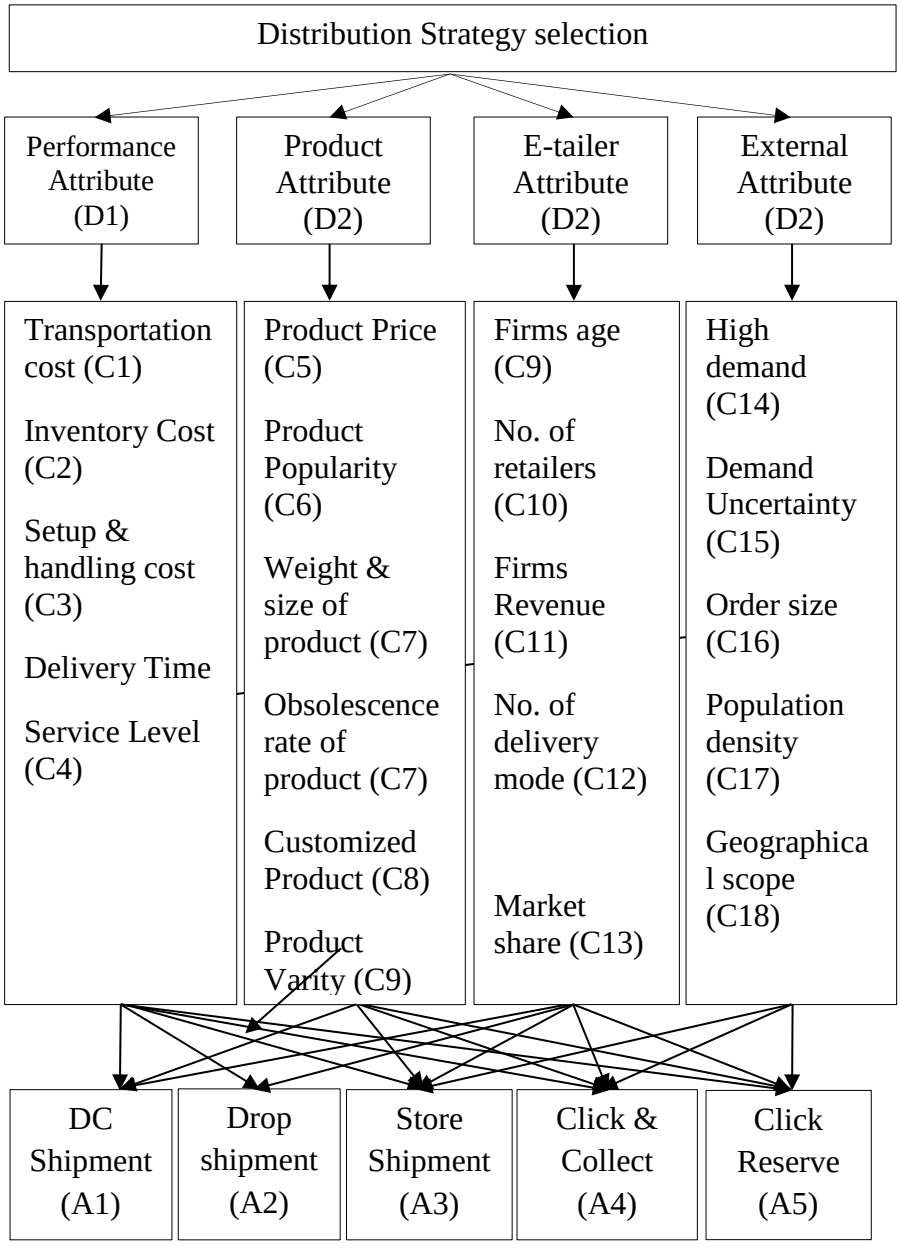

Figure 1.Framework to evaluate distribution strategy

Methodology to evaluate distribution strategy using integrated DANP and PROMETHEE Method

The review of the literature indicates that evaluation of distribution strategy selection requires consideration of many complex and conflicting criteria's to prioritize them. These criteria are related to price, product, cost, demand, customer service level, and delivery time, order size, and population density, mode of delivery and status of e-tailer. So, to evaluate distribution strategies based on conflicting criteria we have to classify this as an MCDM. MCDM deals with many conflicting criteria and provides the solution. In literature, many methods are available for modelling and solution of MCDM problem and these are analytic hierarchy process (AHP), TOPSIS, analytic network process (ANP), ELimination and Choice Expressing Reality (ELECTRE), and VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) etc. The common assumption in most of the MCDM method is the assumption relating to the independence among the criteria which is not true in many real-world problems because several forms of interactions that take place among the influencing factors. To deal with criteria interaction in MCDM problem sophisticated/intelligent technique is required. In recent years, many methodologies have been developed to handle multi criteria interaction, and one of the evolving and recent methodologies is an integration of different MCDM techniques to handle the multi criteria interaction.

The focus of this study is an evaluation of distribution strategies and prioritize them based on conflicting and interdependent criteria's. To overcome the interdependence among the criteria we utilize the DANP with PROMETHEE as a hybrid methodology. The stepwise procedure of solution methodology shown in figure 2.

Application of the hybrid MCDM for distribution strategies evaluation

We applied DANP (Fontela and Gabus 1974) and PROMETHEE Brans et al., 1986 method to prioritize the distribution strategies for an e-tailer based on certain criteria. We used two type of questionnaire to get the data. The first questionnaire was about the inter-influence of criteria for DEMATEL method calculation. This questionnaire for a pairwise comparison of criteria, e.g. "does the transportation cost have an influence on service level"? And asked to rate statement on five-point rating scale which ranges from "0" (no influence) to "4" (very high influence). Influence relation among the criteria would be the result of this questionnaire. This questionnaire was filled by experts (e-tail manager, logistics manager, operations manager and

distribution centre manager, etc.) of different e-tailer firms of India. The second questionnaire was designed to ascertain the preference degree of each alternative (Distribution strategies) across each criteria function. These questionnaires were distributed to the 35 experts to know the preference of each alternative against each Criteria. We approached 35 experts and out of them

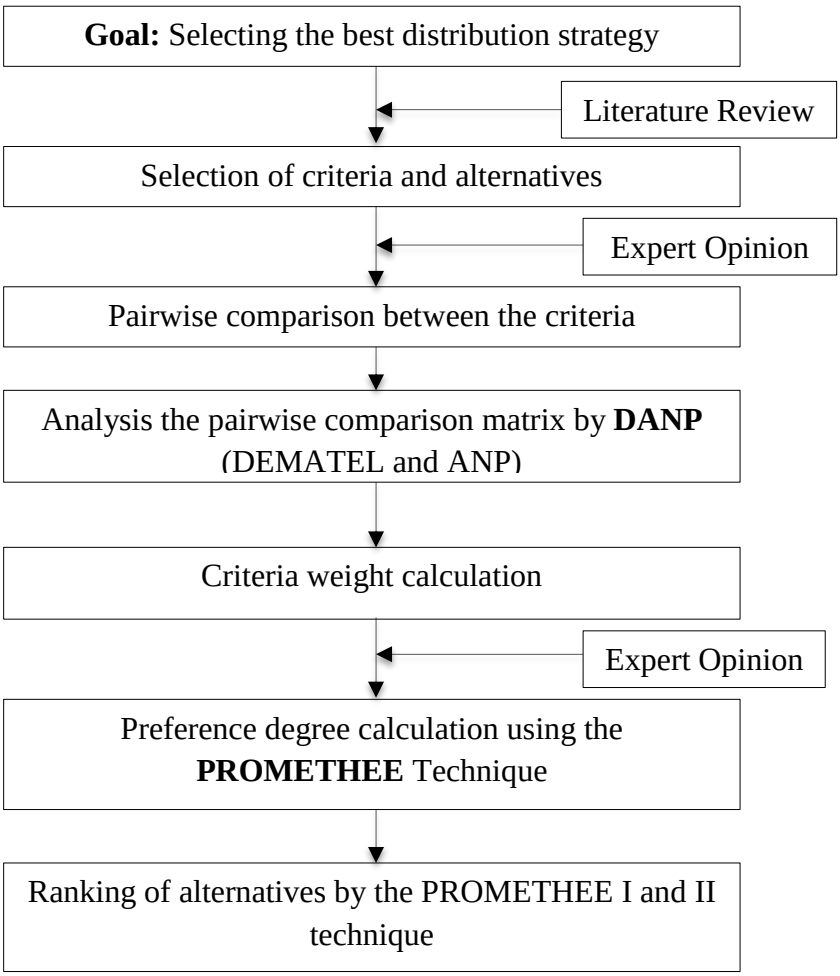

Figure 2. Step wise procedure to solve Hybrid MCDM

Only 30 e-tailing experts agreed to fill these questionnaires. Questionnaire utilized 5 point rating scale ranging from the "0" (Very bad preference) to 4 (Very high preference). Each respondent took about 60 to 70 minute to complete the questionnaire and data was collected from the 1st September to 15th October 2017. PROMETHEE method provides the ranking of alternatives based on these preference degree.

Results and discussion

DANP method provides the weight of the criteria which given in table 1. These weights are utilized to calculate Leaving flow, entering flow and the net flow by PROMETHEE method which is shown in table 2. The prioritization of the alternative done by the value of entering, leaving flow and the net flow. Based on the values of the entering and leaving flow the PROMETHEE I & II ranking provides the alternative drop shipment at a top among other distribution strategies.

Table1- Criteria Weights by DANP

Criteria	Weights	Criteria	Weights	Criteria	Weights
C1	0.051	C9	.048	C17	.039
C2	.057	C10	.046	C18	.048
C3	.054	C11	.046	C19	.053
C4	.052	C12	.046	C20	.044
C5	.052	C13	.046	C21	.048
C6	.050	C14	.047		
C7	.042	C15	.048		
C8	.044	C16	.041		

Table 2 -Evaluation of distribution strategy using the PROMETHEE

Alternatives	Leaving Flow	Entering Flow	Net Flow	PROMETHEE I Ranking	PROMETHEE II Ranking
A1	.9	.45	.45	**2**	**3**
A2	.95	.59	.36	**1**	**1**
A3	.85	.67	.18	**3**	**2**
A4	.35	.94	-0.59	**5**	**5**
A5	.45	.77	-0.32	**4**	**4**

Conclusion: The study finds the following prioritization of distribution strategies: Drop shipment > DC shipment > store shipment > click and collect > click and reserve. The ranking of

dimension regarding influences are as product attribute > external attribute > firms attribute > performance attribute. Another contribution of this paper is the general decision making framework proposed for the evaluation of distribution strategies. This study also provides the knowledge base understanding for an e-tailer to decide distribution strategies for a specific customer order. This is the first kind of study which prioritizes the distribution strategies of an e-tailer based on certain criteria.

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