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Forming Buyer Coalition Scheme with Connection of a Coalition Leader

Laor Boongasame[1], Punnarumol Temdee[2], and Farhad Daneshgar[1,3]

[1] Bangkok University, Department of Computer Engineering, Bangkok, Thailand, laor.b@bu.ac.th
[2] Mae Fah Luang University, School of Information Technology, Chiang Rai, Thailand, punnarumol@mfu.ac.th
[3] University of New South Wales, Australian School of Business, Sydney, Australia, f.daneshgar@unsw.edu.au

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Abstract

Despite the variety of existing theoretical models for buyers' coalition in the current e-commerce literature, no existing coalition scheme explicitly takes into consideration issues related to the leadership attributes of the coalition. By adopting a design science research methodology and utilizing theoretical groundings of the Social Networking and Game theory, the current article provides *algorithmic design* of a buyer coalition scheme with explicit focus given to the 'betweenness', 'centrality', and 'closeness' attributes of the coalition leader. Detailed steps for forming the proposed coalition are provided along with related algorithmic designs and explanations for each step. The execution of the proposed algorithmic design and its effectiveness compared to the situation where no leadership attributes is explicitly considered, are demonstrated by using a scenario and associated simulation programs. Results from the simulation programs confirm that the proposed model provides additional discounts for the buyers regardless the number of buyers within the coalition, and with no additional costs to the seller. It is also expected that sellers will benefit from the proposed model as a result of reduced transaction costs associated with the proposed scheme.

Keywords: Buyer coalition, Game theory, Electronic commerce, Social network, Coalition leader, Algorithmic design

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1 Introduction

A buyer coalition is a group of buyers who join to negotiate with sellers for purchasing identical items at a larger discount [7]. Buyer coalitions are increasingly becoming important. One reason is claimed to be that buyers can improve their bargaining power and negotiate more advantageously with sellers in purchasing goods at lower prices [7]. The other reason is that a buyer coalition helps to reduce the cost of communication between buyers and a seller. Buyers will benefit from purchasing the items in large bundles/lots through buyer coalitions if the price of the lot is less than the standard retail price. On the other hand, sellers can benefit from selling the items at larger bundles via buyer coalitions if the cost of the wholesale marketing (such as advertising or bidding costs) is less than that of the retail marketing.

Many buyer coalition schemes already exist. Some of these schemes emphasize on the general and algorithmic aspects of buyer coalition such as substitute item [4], complementary item [12], bundles of items [8], [14], multi-attributes coalition [9], [15], the strategy [7], and the marketing/distribution approach [19]. Others adopt a knowledge management perspective [1], [18], and others focus on the mechanisms [6], [8], [13], [17]. The information system perspective has also been adopted by some for coalitions with uncertain and heterogeneous information [10], and with incomplete information [7], [11] in order. And finally, some explicitly address the relationship attributes such as ‘trust’, ‘power’, etc. [5], [16].

Despite the massive research on the field, little is known about the benefits that are created as a result of assigning a coalition leader to the coalition and that why buyers may want to form such coalitions. Some of the existing schemes explicitly address the relationship attributes such as ‘trust’, ‘power’, etc. Our focus in this paper is the ‘leader’ attributes. That is, the leader will attract more members to the coalition due to his/her ‘closeness’, ‘betweenness’, and ‘centrality’ attributes; the latter concepts have been borrowed from the Social Network theory [8] and this is the major single contribution of our paper. This also means that the proposed scheme can be integrated with other existing schemes that consider the ‘relationship’ attributes.

By adopting a design science research methodology the present study proposes a new buyer coalition scheme called Buyer Coalition Scheme with the Connection of the Coalition Leader Scheme (BCC scheme). The effectiveness of the proposed scheme is demonstrated through results from a simulation program.

The remaining parts of the article are organized as follow: Section 2 presents background theories and related studies. Section 3 provides details of the proposed BCC scheme and applies the scheme to a representative scenario. In section 4 results from the simulation are demonstrated. This is followed by concluding remarks and future work.

2 Background Theories and Related Studies

The novelty of the present study is in its ability to explicitly form buyer coalition with the connection of a coalition leader. To demonstrate this concept the *social network analysis of emergent leadership roles identification* is employed [8] and is briefly explained in (1). This is followed by a brief review of current buyer coalitions that exist in the domain of electronic commerce.

2.1 Social Networks

A social network is a set of people connected by a set of social relationships, such as friendship, co-working or information exchange [20]. A Social Network Analyzer (SNA) is a theory that describes relationships which are characterized by *content*, *direction* and *strength*. The resource that is exchanged is called the *contents.* The direction of exchange refers to the type of communication and is directed or undirected. The strength of the communication refers to the frequency or the volume of communications. The SNA measures relationships between any social entities such as people, group, organizations, etc in terms of their content, direction, and strength. The nodes on a social network are social entities and the links show the relationships or information flow between any two nodes [20].

SNA provides two ways of data representations methods: mathematical and graphical methods. The mathematical methods include graph theory, statistical and probability theory, and algebraic models. On the other hand, the relationships can also be depicted by graphical representations such as Sociogram, in which social entities are represented as nodes in two-dimensional space and relationships among pairs of entities are represented by lines that link the corresponding entities.

SNA provides a mathematical model for analyzing the network position of an individual within the social network. Three most popular measurements for each node are: (i) *degree of centrality*, (ii) *closeness*, and (iii) *betweenness*. The focus of the present study is on the ‘degree of centrality’ of the leader however brief descriptions are provided for the other two concepts.

The degree of centrality of actor ‘x’ is defined as the number of direct connections between one node and others. The degree of centrality can be normalized by dividing it by the maximum possible degree, which is $n-1$, where ‘n’ is the total number of nodes within the network.

Let $d(x) =$ degree of centrality of actor ‘x’ (1)

The normalized version of the above definition is:

$$D(x) = \frac{d(x)}{n-1} \tag{2}$$

Degree of Centrality is generally used for revealing the degree of popularity of an actor.

The concept *Closeness* focuses on how close an actor is to all other actors. An actor is ‘close’ to others if it can interact with all others in a short period of time. For example, if actors in the set are engaged in problem solving, and the focus is on communication links, then efficient solutions occur when actor ‘x’ has very short communication paths to the others. In this case, the closeness for actor ‘x’ is defined as:

$$c(x) = \frac{1}{\sum_{y \in U} d(x, y)} \tag{3}$$

Where $d(x, y)$ is the length of shortest path between actor ‘x’ and actor ‘y’, and U is the set of all actors. The normalized closeness is defined as:

$$C(x) = (n-1) \bullet c(x) \tag{4}$$

Closeness is generally used for revealing how quick the actor can reach all other connected actors.

The concept *Betweenness* identifies the number of paths between an actor and all other actors. An actor with high level of ‘betweenness’ will have more control over the flow of information within the network [20],

$$b(x) = \sum_{y<z} \frac{g_{yz}(x)}{g_{yz}} \tag{5}$$

Where $g_{yz}(x)$ is the numbers of shortest paths between y and z through the actor x, and g_{yz} is the numbers of shortest paths between the actors y and z ., Such pairwise relationship applies to all the actors.

The normalized version for the undirected network is

$$B(x) = \frac{b(x)}{(n-1)(n-2)/2} \tag{6}$$

Betweenness is generally used for revealing the bridge of the network; that is, which other actors in the network choose to reach remaining actors within the network.

Another relevant concept for the current study is the *magnitude of leadership* or MOL [18]. This concept relates to the functions that are performed by the leader within the network. It is argued that the leader should occupy maximum amounts of all the three measurements that a typical node possesses within the SNA [20]. Firstly, the leader should have maximum degree of *centrality* because he/she should be the most popular member in the team. Next, the leader should have maximum *closeness* because he/she should have direct connections to all other team members so that they can be reached quickly by the leader. Finally, the leader should have maximum *betweenness* because he/she is the bridge of the network where the information of the network will flow over this actor. The magnitude of leadership (MOL) is thus proposed as the vector combination of above feature as follows (readers may refer to [21] for definitions of the above terms):

$$MOL = \sqrt{D(x)^2 + C(x)^2 + B(x)^2} \tag{7}$$

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Where *D(x)* is the shared degree of centrality as shown in equation (8), *C(x)* is closeness and *B(x)* is betweenness.

$$D(x) = \frac{d(x)}{\sum d(x\ )} \tag{8}$$

The above concept will be further clarified by using the scenario in 3.4.

2.2 Buyer Coalition

A number of buyer coalition schemes already exist in the literature. For example, according to He and Ioerger [8] an individual buyer purchases goods in deferent bundles, while sellers offer discounts based on the total cost of goods sold in one transaction. GroupBuyPackage [2] and GroupPackageString [3] schemes on the other hand consider forming buyer coalitions with cumulative bundles of items in order to benefit from further seller prices as a result of buying larger bundles. Chen et al [7], [6] study proposes mechanisms for forming buying-group that permit buyers to share information with one another in order to coordinate their bidding. And finally, the Combinatorial Coalition Formation (CCF) scheme [14] allows buyers to place reserve prices for combinations of items instead of a single item. According to the arguments provided in the current paper, there is a lack of research on how and why buyers form a coalition with connection of a coalition leader. This constitutes the contribution of the current study and is discussed in the next section.

3 Buyer Coalition Scheme with Connection of a Leader (BCC)

This section introduces the proposed BCC scheme. The research methodology of the study is presented in section 3.1 followed by a formalized version of the proposed BCC scheme is presented in 3.2, and a step-by-step process for forming the coalition in 3.3. Section 3.4 provides algorithms required for building the BCC. Section 3.5 describes the scenario used for this study as well as results from a simulation program that demonstrates operation and effectiveness of the proposed BCC scheme.

3.1 Research Methodology

The current study adopts a design science research methodology in order to develop, present and demonstrate the proposed scheme and its effectiveness. It is a prescription-driven research methodology where prescriptions are presented as a solution concept. A solution concept is a general prescription, which has to be translated (by the professional in the field) to a specific problem at hand [20]. In this study the proof of concept is demonstrated by building a design prototype by developing simplistic scenarios to demonstrate the concept, and that how the proposed model, as a business intelligence (BI) component for all existing schemes, can assist those schemes to manage information/knowledge flows within the respective schemes. The effectiveness of the proposed scheme is demonstrated through results from a simulation program.

Detailed steps for forming the proposed coalition are provided along with related algorithmic designs and explanations for each step. The execution of the proposed algorithmic design and its effectiveness compared to the situation where no leadership attributes is explicitly considered, are demonstrated by using a scenario and associated simulation programs. Results from the simulation programs confirm that the proposed model provides additional discounts for the buyers regardless the number of buyers within the coalition, and with no additional costs to the seller. It is also expected that sellers will benefit from the proposed model as a result of reduced transaction costs associated with the proposed scheme.

By adopting a design science research methodology the present study proposes a new buyer coalition scheme called Buyer Coalition Scheme with the Connection of the Coalition Leader Scheme (BCC scheme). The research methodology in the present study is design science.

3.2 Formalization of the BCC Process

Given a set of members in a website $M = \{m_1, m_2, ..., m_k\}$, each member m_i in the website has connection with each other m_j by talking or interacting in some ways. This corresponds to the concept *degree of centrality* already introduced in 2.1. Let $d(m_l)$ be the degree of centrality of member m_l, and $D(m_l)$ be the normalized degree of centrality of member m_l. Members become buyers $\{B\} = \{b_1, b_2, ..., b_k\}$ when they intend to join other buyers in a group of buyers in order to purchase an identical item G at a discount, as well as to place their bids or their reservation prices $\{R\} = \{r_1, r_2, ..., r_k\}$. Each Buyer's reservation price is the maximum price that the Buyer is

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willing to pay for a unit of item. For simplicity, it is assumed that at any given time there is only one seller S who is willing to supply unlimited units of the item G . A seller's price list, *P,* is a descending function $P: a \rightarrow real\ number$ and $P(a)$ is a unit price that the seller would expect from selling a bundle of size '*a*' of good *G*. After buyers place their bids and form a buyer coalition, some buyers, called winners $W = \{w_1, w_2, ..., w_k\}$ will join the coalition in order to purchase the item *G* at a discount. A winner bid is the one whose bid will maintain a positive value for the existing pool of *utility of the coalition, u(C).* The *u(C)* in turn can be defined as: $u(C) = \sum_{b_k \in C} R_k - P(|C|) \times |C|$ where $P(|C|)$ is the coalition price of an item for the coalition C [1]. The set of winners create coalition C^* . The winners will then select a coalition leader, CL. The CL will then invite other members m_t who have connection with the CL called con_{t-CL} , to join the coalition and form a new coalition, C^* . The invitation remains active until either a specified calendar time T is reached, or all the invited members accept the invitations.

3.3 Steps Towards Forming a BCC

The overarching assumption adopted in the current study is that the entire coalition network would benefit from having a leader with maximum value of centrality for attracting more members to the coalition. The methodological steps for forming buyer coalition with the connection of the coalition leader are listed below and are further explained in the subsequent sections:

- Step 1, Formation of the coalition structure
- Step 2, Emergence of a coalition leader based on his/her degree of centrality
- Step 3, Inviting potential buyers who have connection with the coalition leader.

The above steps are further explained below

Step 1: Selection of a coalition structure:

In the first step, a set AC of all coalitions with non-negative utility are found. The set VC_C of the coalition with maximum number of buyers will then be derived from the set AC . And finally, the set LVC_C of the coalition is derived from the VC_C that has the highest utility. Let $\{B\} = \{b_1, b_2, ..., b_k\}$ be a set of buyers, and $C^* \subseteq \{B\}$ be a subset of buyers who can join coalition to purchase identical items with larger discount. Each member in C^* is called winner and are the subject of the next step:

$$\begin{aligned} AC &= \{C^* \subseteq \{B\} : u(C^*) \geq 0\}, \\ VC_C &= \{C^* \in AC : |C^*| \geq |C''|, \forall C'' \in AC\}, \\ LVC_C &= \{C^* \in VC_C : u(C^* \geq u(C''), \forall C'' \in VC_C\}. \end{aligned} \quad (9)$$

Step 2: Selection of a coalition leader

The winners will select a coalition leader CL who has the maximum Magnitude of Leadership. As mentioned earlier, the current literature provides three attributes/measures for a coalition leader [8]. These include 'centrality', 'closeness', and 'betweenness'. This study will focus on the 'centrality' attribute only. This is based on the assumption that the 'closeness' and 'betweenness' measures have little relevance to the concepts introduced in the current study. As a result the equation (7) can be revised as follows:

$$MOL(w_i) = \sqrt{D(w_i)^2} \quad (10)$$

Replacing the 'w' in (10) for 'x' in (7) indicates a shift by actor 'x' to the winner 'w'. Also, the *closeness* and *betweenness* concepts that existed in (7) are removed from (10).

The revised MOL in (10) indicates the level of expertise the leader provides in inviting maximum number of members as potential buyers of the coalition.

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Step 3: Inviting new members by the coalition leader

The members are invited to join the coalition by the coalition leader in order to increase the utility of forming the coalition and are the final step in forming the coalition. In the next section the algorithmic design of the proposed coalition is explained.

3.4 The Algorithmic Design of the BCC

The algorithm starts by including all buyers in the coalition. Buyers with lower reservation prices are repeatedly removed from the coalition until one of the two conditions arise: (i) the utility of the coalition is non-negative, and (ii) the set of buyers is empty. Under the first condition a coalition structure C^* is identified with the maximum number of buyers in the coalition with a non-negative utility. Under the second condition the coalition structure C^* is empty and the algorithm will terminate. This is shown in Figure 1.

Algorithm 1*: Coalition structure selection.*

Input: $\{B\} = \{b_1, b_2, ..., b_k\}$ is a set of buyers, $\{R\} = \{r_1, r_2, ..., r_k\}$ is a set of reservation prices of buyers *B.*

Output: C^* is a set of winners.

1. $C^* \leftarrow \{B\}$.

2. If $u(C^*) \geq 0$ then terminate with coalition structure C^* found and *{B}* become *W*.

3. If $C^* \neq \varnothing$ then: (i) the buyer with the lowest reservation price in the coalition C^* is removed from C^* and becomes a member, and (ii) algorithm 2 is executed. Else: terminate.

Figure 1: Coalition structure selection

The winners will then select a coalition leader CL who has the maximum *MOL.* The algorithm for the selection of a coalition leader of the coalition C^* is shown in Figure 2. In the absence of a CL, this algorithm will be skipped.

Algorithm 2*: Selecting a coalition leader.*

Input: C^* is the set of winners W , $d(w_l)$ is *degree of centrality of winner* w_l .

Output: CL is a coalition leader.

1. Calculating $D(w_l) = \dfrac{d(w_l)}{\sum_{j \in W} d(w_j)}$ of all winners**.**

2. Selecting winner w_l who has the maximum $MOL(w_l) = \sqrt{D(w_l)^2}$ as a coalition leader CL; execute algorithm 3.a or 3.b depending on whether a leader invites Buyers or not.

Figure 2: Selecting a coalition leader

Based on Algorithm 2 the CL will invite members to join the coalition. After both the new members and existing buyers place their bids, the algorithm in Figure 1 will be executed. Such process will continue until either a maximum time limit is reached, or all the invited members accept the invitation. The algorithm to invite new members by the coalition leader is shown in Figure 3.a. Figure 3.b shows a modified version of 3(a) with the absence of a CL. These two algorithms will be evaluated later on for the proof of concept.

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***Algorithm* 3.a**: *Inviting new members by the coalition leader*

Input: $M=\{m_1, m_2, ..., m_k\}$ is a set of members, $\{B\}=\{b_1, b_2, ..., b_k\}$ is a set of buyers, $\{R\}=\{r_1, r_2, ..., r_k\}$ is a set of reservation prices of buyers $\{B\}=\{b_1, b_2, ..., b_k\}$, CL is a coalition leader, con_{t-CL} connection between member m_t and leader CL, specified maximum time limit for accepting invitations (T) is reached

Output: $\{B\}=\{b_1, b_2, ..., b_k, ...b_n\}$ is a set of buyers, $\{R\}=\{r_1, r_2, ..., r_k, ..., r_n\}$ is a set of reservation prices of buyers $\{B\}=\{b_1, b_2, ..., b_k, ...b_n\}$.

1. $\exists m_k \in M$ may want to join a bid is placed along with a reservation price

2. $\forall m_k \in M$, If $\exists con_{t-CL} \geq 0$ and real-time < T, CL invites m_t to join the coalition and then go to the next step; otherwise terminate**.**

3. If m_k decides to join a bid is placed along with a reservation price.

4. go to step 1.

Figure 3 (a): Inviting new buyers by the coalition leader

Algorithm 3.b: modified version of 3(a) without selecting a CL

Input: $M=\{m_1, m_2, ..., m_k\}$ is a set of members, $\{B\}=\{b_1, b_2, ..., b_k\}$ is a set of buyers, $\{R\}=\{r_1, r_2, ..., r_k\}$ is a set of reservation prices of buyers $\{B\}=\{b_1, b_2, ..., b_k\}$

Output: $\{B\}=\{b_1, b_2, ..., b_k, ...b_n\}$ is a set of buyers, $\{R\}=\{r_1, r_2, ..., r_k, ..., r_n\}$ is a set of reservation prices of buyers $\{B\}=\{b_1, b_2, ..., b_k, ...b_n\}$.

1. $\exists m_k \in M$ may want to join, a bid is placed along with a reservation price and terminate.

Figure 3 (b): Modified version of 3(a) without selecting a CL

3.5 Scenario

The following scenario demonstrates formation of the BCC. This process is described by three algorithmic steps as shown below.

Description of the Scenario

A coalition website has already been made accessible to the potential members who intend to buy cameras [10]. Members in the coalition connect to the website and interact with one another through a discourse or other methods. The connection among the members is expressed by a diagram called Sociogram [20] as shown in Figure 4.

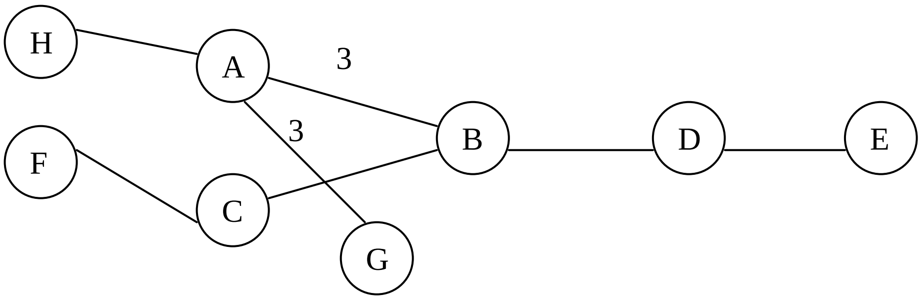

Figure 4: A sociogram of the scenario network with eight members

In Figure 4 eight members are connected. Member A regularly interacts with member B, but not with member D. Therefore, member A and member B are directly connected. At the same time, member B interacts more often with member A than with member C as indicated by the number of interactions on corresponding links. Links with no number indicate number ‘1’. More details on various connections are shown by a Sociomatrix in Table 1.

Table 1: Sociomatrix for sociogram of the scenario

	A	B	C	D	E	F	G	H
A	0	3	0	0	0	0	3	1
B	3	0	1	1	0	0	0	0
C	0	1	0	0	0	1	0	0
D	0	1	0	0	1	0	0	0
E	0	0	0	1	0	0	0	0
F	0	0	1	0	0	0	0	0
G	3	0	0	0	0	0	0	0
H	1	0	0	0	0	0	0	0

In Table 1 numbers in each cell represent the quantity of direct connections between the corresponding pair of members. In the above scenario ‘A has the maximum number of direct connections with other members.

The potential seller gives a price list corresponding to various bundles. A hypothetical selling price list for various bundles is shown in Table 2**.** The rationale is that if buyers order more, they we will pay a lower price per unit.

Table 2: Seller’s price schedule for a particular model of camera

Number of units sold in bundle	Unit Price ($)
1	100
2	95
3	90
4	85
5	80

Members in the website who are interested in forming a coalition for purchasing a particular model of camera become buyers. It is assumed that each buyer knows the seller’s price list and posts his/her reservation price on the coalition website. Different buyers generally have different reservation prices. For example, buyer A posts a reservation price of at most $90. Member D does not want to join the coalition. This information is shown in Table 3. The price lists of those who do not intend to join the coalition need not be announced.

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Table 3: Members' initial status in the scenario

Members	Status of buyers*	Status of winners**	Reservation Price R_k ($)
A	1	0	90
B	1	0	64
C	1	0	100
D	0	0	-
E	0	0	-
F	0	0	-
G	0	0	-
H	0	0	-

* a value of 1 means the member wants to join the coalition
** a value of 1 means the buyers becomes winners.

Using the information provided in Table 3 in conjunction with the algorithm 1, a coalition can be formed. According to the algorithm 1, all buyers (A, B and C in Table 3) are initially included in the coalition C^*. The utility of the coalition C^* at this stage is: (100+90+64) – (90*3) = -16 meaning that buyer B who has the lowest reservation price will be removed from the coalition C^* and remains a member but not a winner. The updated value for the utility of the coalition C^* is (100+90) – (95*2) = 0. This algorithm will terminate with members A and C becoming winners. The updated version of Table 3 is shown by Table 4.

Table 4: Members' status after going through algorithm 1

Members	Status of buyers*	Status of winners**	Reservation Price R_k ($)
A	1	1	90
B	0	0	-
C	1	1	100
D	0	0	-
E	0	0	-
F	0	0	-
G	0	0	-
H	0	0	-

A coalition leader will be identified by using Table 4 and Table 1 in conjunction with the algorithm 2. This is done by finding the magnitude of leadership for all buyers, and then assigning leadership status to the buyer with highest value of MOL. The updated version of Table 4 is shown by Table 5. However without a CL the algorithm in 3(b) will be executed instead of 3(a).

Table 5: Magnitude of leadership of buyers

Members	Status of buyers*	Status of winners**	$d(w_k)$	$D(w_k)$
A	1	1	3+3+1 = 7	$7/9$
B	0	0	-	
C	1	1	1+1 = 2	$2/9$
D	0	0	-	
E	0	0	-	
F	0	0	-	
G	0	0	-	
H	0	0	-	

For both scenarios we assume that buyer F wants to join the coalition. S/he will then place a bid at $90 and become a buyer in the set *{B}* defined in 3.2. Under the presence of a CL the coalition leader (member A) will send a timed invitation to other members with whom s/he already had connections, that is, members B, G and H in Table 1. It should be noted that initially, members B, G and H had not intended to join the coalition however under the current established leadership with connections they are given a renewed opportunity to join the coalition. Also, the invitation remains open to the above members until a specified calendar time. At this stage each member will decide whether to join the coalition and become a 'buyer', or to remain an outsider and possibly wait for an appropriate time in future to join, or until the invitation set time elapses. Let us assume that only member *G* decides to join the coalition. S/he will then place a bid at $90 and become a buyer in the set *{B}* defined in 3.2. The algorithm will stop when either all invited members accept the invitation and join the coalition, or the invitation set date is reached. Table 6 shows an updated version of Table 5.

Table 6: Members' information of this scenario after through algorithm 3(a)

Members	**Status of buyers***	**Status of winners****	**Reservation Price R_k ($)**
A	1	1	90
B	0	0	-
C	1	1	100
D	0	0	-
E	0	0	-
F	1	0	90
G	1	0	90
H	0	0	-

However, in the absence of a CL the member F will place a bid at $90 and becomes a buyer in the set *{B}* defined in 3.2. Table 7 shows an updated version of Table 4 for this second scenario.

Table 7: Members' information of this scenario after through algorithm 3(b)

Members	**Status of buyers***	**Status of winners****	**Reservation Price R_k ($)**
A	1	1	90
B	0	0	-
C	1	1	100
D	0	0	-
E	0	0	-
F	1	0	90
G	0	0	-
H	0	0	-

In order to demonstrate the effectiveness of the proposed BCC framework the performance of BCC scheme is compared to the situation where no coalition leader existed. Results of this comparison are shown in Figure 5 using the set of parameters for such simulation in Table 8.

Table 8: Simulation parameters

Entities	**Parameter**	**Ranges**
Seller	The number of sellers	1
Buyers (*IB*)	The initial number of buyers	2, 4, 6, 8,10,12
Reservation Prices (*R*)	The maximum price that buyers are willing to pay for purchasing a unit of an item	80 – 100
Round (*Rn*)	The number of repeat performance	6
Percent of acceptance (*PA*)	The ratio of accepted buyers to invited buyers	100%
Percent of new buyers (*PNB*)	The ratio of new buyers to existing buyers	50%
Connection distribution		Random

4 Analysis of Results

Using the information in Table 2 and the set of parameters in Table 8, a simulation experiment was designed to demonstrate the comparative advantages of the proposed BCC over a situation with no coalition leader. Results of this analysis are shown in Figure 5.

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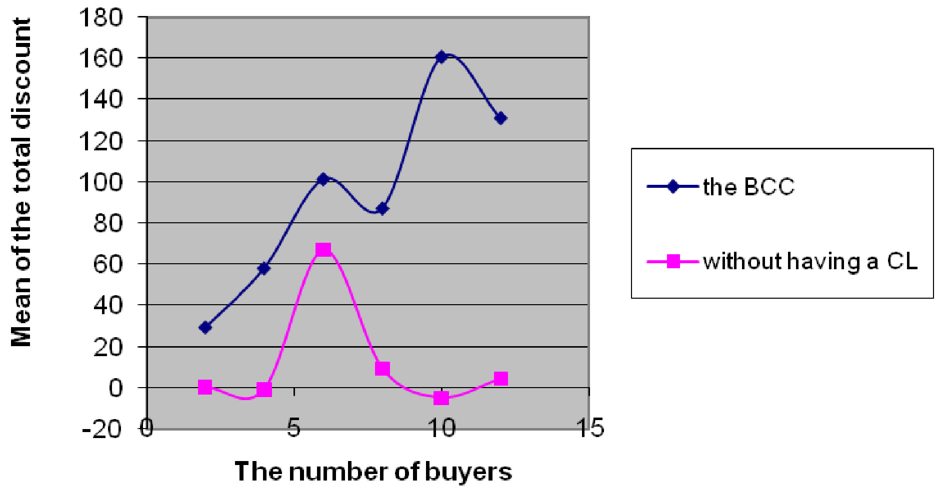

Figure 5: A comparative analysis of total discounts with and without a CL

In Figure 5 the vertical axis represents mean of the total discounts provided by the seller to the corresponding number of buyers, and the horizontal axis represents different number of buyers. The simulation is replicated 100 times. The differences between the mean of the total discount under two scenarios 3.a and 3.b represents the additional discount for the buyers under the BCC scheme. As shown, for any number of buyers, the total discounts under the BCC scheme is higher that the scenario without a CL. One explanation for small portions of the lower curve in Figure 5 showing negative total discount is when most of the buyers act selfishly by proposing a lower reservation price which is less than the cost of the coalition. The value of the added discount in BCC curve increases as the number of buyers in the BCC coalition increases.

5 Conclusion, Limitations, and Future Work

This article proposes a novel framework for forming buyers' coalition by integrating a coalition leader (CL) into the process. The main responsibility of the CL is to invite more members to the coalition by using his/her high level of centrality within the process. The effectiveness of the proposed coalition framework was demonstrated by using a simulation program with 100 iterations. Results from this experiment showed that (i) inviting a coalition leader will increase the value of total discount, and (ii) as the number of buyers increases within the coalition the positive effects of the coalition leader also increases perhaps as a result of improved coordination and collaboration among the buyers.

There is a number of limitations to our study. Firstly, we have not considered situations where a buyer may not be willing to accept the leadership of the coalition. Secondly, costs associated with the logistics have not been taken into consideration. Such costs may vary depending on the bundle size and many other factors.

It is intended to extend the present study along the following directions:

In the current algorithm array structure is used to construct the sociomatrix space to accommodate members of the BCC coalition. This involves pre-allocation of large chunk of memory space. This however becomes problematic when the number of buyers increases. In order to optimize the memory space usage for larger numbers of buyers other techniques, such as pointer lists, will be used instead.

Furthermore, in the current study the network topology of the buyers has not been taken into consideration. Future studies should consider the effects of network topology as various network topologies will affect the degree of centrality of the coalition leader differently, which in turn will change the results.

One limitation of this study is that it focuses on the added benefits of the buyers only and little attention is given to the value creation from the seller's perspective, other than briefly mentioning the seller's savings as a result of reduced transaction costs associated with the proposed BCC scheme. Future studies should consider the latter issue and develop an integrated framework that provides market evaluation of the proposed BCC where benefits for both buyers and sellers are taken into consideration simultaneously. And finally, as also mentioned earlier, the current study is an early attempt in incorporating a coalition leader into the existing buyer coalition schemes, and for that reason only one item is considered at any given time. In future studies the authors plan to take into consideration a basket of items and develop more sophisticated algorithms accordingly.

In this study we have structured reservation prices using uniform distribution in order to simplify the process of applying social network theories to e-commerce, the latter being the main contribution of the study. Future studies may extend our study by incorporating other types of distributions.

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