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Inter Merchant Negotiation Model in Online Marketplace System

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Abstract: Interaction and transaction between merchants is very common process in traditional or physical market. By using this interaction, merchant can provide product in more quantity even their stock is less than the quantity that is sold in the transaction by using other merchant stock. Unfortunately, this interaction has not occurs in the online marketplace system yet. Although, the online marketplace system has similar characteristic with the conventional market which there are more than one merchant that sell same product, there is not any interaction model that has been developed, so that, these merchants can interact to each others. Based on this problem in this study, we propose new inter merchant negotiation model that can be implemented into online marketplace system. So, merchant can sell more quantity by using other merchant's stock. This negotiation model is developed by using stochastic approach. In this research, there are two models that are developed: serial negotiation model and parallel negotiation model. These proposed models then are implemented into the online marketplace inter merchant simulation application, so that, the model performance can be evaluated. Based on the test result, there are some research findings. First, the parallel negotiation model performs a little bit better than serial negotiation model in producing lower total transaction value. It means that by using parallel negotiation model, buyer pays lower because he gets lower deal price. Second, the number of sellers has negative correlation with the total transaction value. Third, the seller's stock quantity has negative correlation with the total transaction value. Fourth, the requested product quantity has positive correlation with the transaction value.

Key words: Negotiation, online marketplace, stochastic, simulation, e-Commerce, negotiation, interaction

INTRODUCTION

Now a days, online marketplace grows very fast (Mackie, 2011). This growth occurs also in quantity which there are many new online marketplaces are built over last several years (Kestenbaum, 2017). Among these marketplaces, Amazon becomes the main reference (Kestenbaum, 2017). In many researches, it is shown that the fast growth of online marketplace has threatened the conventional retailer industry. The relative performance of retail sector declined compared with other sectors (Gjerstad and Papp, 2017). This condition is worse for conventional retailers that compete directly with strong online marketplace (Gjerstad and Papp, 2017). Rigby (2011) explained that there is disruption in retail industry in every 50 years and as time goes, the e-Commerce takes more proportion in whole retail economic.

This trend also occurs in Indonesia. Basically, the main factor of this fast growth is not only technology but the ability of the online marketplace to solve problem that occurs in conventional and offline transaction (Laumeister, 2014). Besides Foreign based online marketplace such as Lazada, Alibaba or Amazon, there are local online marketplaces too such as Tokopedia, Bukalapak, Blibli, Blanja and any other players.

Online marketplace is one of e-Commerce platforms. Besides online marketplace, there are several types of e-Commerce in Indonesia such as location based e-Commerce, common online shop or ticketing service. Go-Jek and Grab are the example of the location based e-Commerce which their business are ride hailing service. Zalora and Matahari Store are the example of common online shop which sells various products from various brands. Many movie theater providers also sell their ticket through online system.

Among these types of e-Commerce, online marketplace has uniqueness. In online marketplace, there are lots of merchants that sell their products to customers directly. It means that the merchant has autonomy to manage their product arrangement and price. Some online marketplace companies like Blibli and Lazada generate revenue by charging some portion from merchant's sales and this policy is mandatory. Meanwhile, other marketplace companies like Tokopedia and Bukalapak generate revenue by offering more services to the paid merchant rather than to the free merchant. In this model, merchants can use the online marketplace company's payment system, so that, they can receive payment from customer directly through bank transfer mechanism.

These characteristics make online marketplace is similar to the conventional marketplace such as traditional market or modern market. There are lots of merchants in the conventional marketplace. In the conventional one, merchant occupies limited area called booth in the marketplace building. Merchant also has autonomy to manage his product variety and stock as long as these products are not forbidden to be sold in the marketplace and the stock can be stored inside the merchant's booth. Merchant also has autonomy to set the product price.

One of the differences between the online marketplace and the conventional marketplace is that in the conventional market, merchant can sell other merchant product. This process occurs when the merchant cannot provide the product that is asked by the customer but the merchant knows that there is at least one other merchant that has this product or the merchant has the product that is asked by the customer but his stock is not enough to provide the quantity of the product that is asked by the customer and the merchant knows that there is at least one merchant that can provide the rest quantity of the requested product. This process is very common in the conventional marketplace. This process gives advantages for the stakeholders. For customer, he does not need to search to find and to negotiate with other merchants in the marketplace. For merchant that interacts with the customer, he can generate more sales and revenue from single transaction. For merchant that his stock is used by other merchant, he can generate sales and revenue without interacting, serving and negotiating with any customers.

Meanwhile, this process has not occurred in online marketplace yet. In online marketplace, merchant cannot interact with other merchants who have same product. So, the relation type among merchants is competitive. Even this condition benefits the customer in finding cheapest product faster, the side effect is triggering price war among merchants. This condition makes the merchant's condition worse because it reduces merchant's profit in short term and business continuity in long term.

Based on this problem, the goal of this research is developing inter merchant negotiation model that can run in online marketplace system automatically. The negotiation method is used in the proposed model because in the conventional market, inter merchant interaction occurs based on bilateral negotiation process. The process must be done automatically because in online marketplace, system must be able to handle many transaction processes simultaneously.

This research is the continuation of our previous research in online marketplace area. In our previous research in online marketplace modeling, the collaborative approach has been proposed, so that, the customer can interact with more than one merchant with various prices for single product request simultaneously (Kusuma and Osmond, 2018). The involved actors are the buyer and the merchants, so that, the buyer interacts with merchants directly (Kusuma and Osmond, 2018). In this current research, the involved actor is merchants only. One merchant becomes buyer of the other merchants.

This research is also the continuation of our previous research in negotiation modeling. In our previous research, we develop buyer-trader negotiation model in traditional market (Kusuma and Pulungan, 2016). In this previous research, the negotiation model is developed based on multi issues negotiation model which the product represents the issue (Kusuma and Pulungan, 2016). In this previous research, there are three types of negotiated products: requested product, complementary product and substitution product (Kusuma and Pulungan, 2016). In this research, the proposed model is based on single issue negotiation model.

MATERIALS AND METHODS

Inter merchant interaction in conventional market: In conventional market, the interaction among merchants is very intensive. This situation occurs because of some reasons. First, they are near to each other physically. It is because they usually stay in the same building. Second, it is common that some merchants sell same or similar products. In one case, these merchants receive products from same suppliers. In other case, some merchants become other merchant's suppliers. Even they sell similar and or same products in many situation, price war among merchants can be avoided. Besides intensive interaction and communication, price war can be avoided because they share common purposes and needs. The situation in conventional marketplace can be illustrated in Fig. 1.

The explanation of Fig. 1 is as follows. Suppose that there are eight merchants in some area in a conventional computer marketplace. These merchants sell similar products such as laptop, battery, speaker, external hard disk and many more products. The main problem in this business is there are many brands and many variants in single brand only for one product category such as laptop. So, it is impossible for single merchant to sell brand and variant completely in adequate quantity because of limited capital and or storage capacity.

The example is as follows. Suppose that there are five brands in laptop category. If there are ten variants in every brand, there will be 50 Shop Keeping Units (SKU) in laptop category. Based on this situation, some

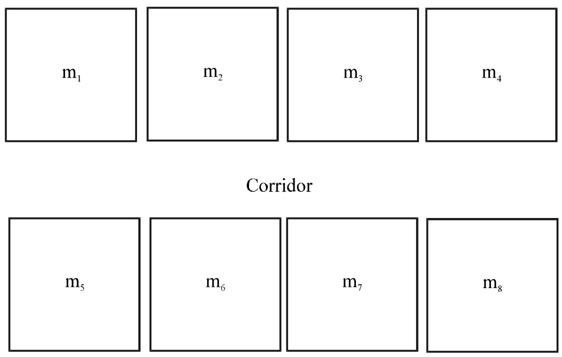

Fig. 1 : Physical illustration in conventional marketplace

Table 1: Relation between merchants and SKUs

Merchants	SKUs
m_1	s_1, s_2, s_4, s_7, s_8, s_9, s_{10}
m_2	s_1, s_2, s_3, s_{47}, s_{48}, s_{49}, s_{50}
m_3	s_2, s_3, s_4, s_5, s_6, s_7
m_4	s_{11}, s_{12}, s_{13}
m_5	s_{41}, s_{42}, s_{43}, s_{45}, s_{46}, s_{47}, s_{48}
m_6	s_5, s_6, s_7, s_8, s_9, s_{10}
m_7	s_7, s_8, s_9, s_{10}, s_{11}, s_{12}, s_{13}
m_8	s_{43}, s_{44}, s_{45}, s_{46}

merchants will sell some SKUs while other merchants will sell other SKUs. In some case, there will be SKUs that are sold by more than one merchant. Meanwhile, there is condition which there is not any merchant that sells certain SKUs. It means that these variants are not sold in the marketplace.

The example is as follows. Related to Fig. 1, the merchants can be represented as set M which contains {m_1, m_2, m_3, m_8}. In laptop category, there are 50 SKUs that can be represented in set S which contains {s_1, s_2, s_3, s_{50}}. The relation between merchants and SKUs is shown in Table 1.

Based on relation map in Table 1, the condition of the SKUs is as follows. There is not any merchant sell s_{14}-s_{40}. So, these SKUs are not provided in this marketplace. Some SKUs such as s_{41} and s_{42} are provided by single merchant. Some SKUs such as s_1-s_3 are provided by more than one merchant. The transaction scenarios in this marketplace are as follows.

In the first scenario, there is a customer visits merchant m_5 to purchase s_{41}. Let us assume that m_5 has 10 units of s_{41}. This merchant requests 6 units of s_{41}. After this transaction occurs, the remained stock of s_{41} is 4 units. Then, there is the second customer that requests 8 units of s_{41}. Because merchant m_5 has only 4 units of s_{41}, then this customer can get only 4 units of s_{41}. This customer is failed to fulfill his target because he still needs more 4 units of s_{41} and there is not any s_{41} is remained in this marketplace.

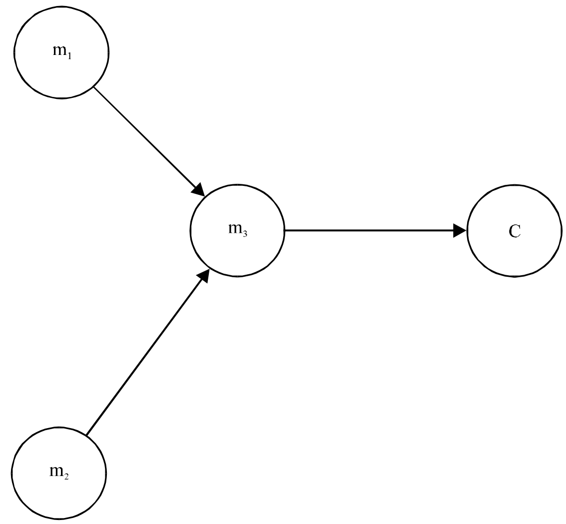

Fig. 2: Inter merchant relationship

In the second scenario, there is a customer who wants to purchase 2 units of s_2. Based on Table 1, this variant is sold by merchant m_1, m_2 and m_3. The stock quantity of s_2 among merchants is 3, 6 and 4 units consecutively. Then this customer meets the merchant m_3. In this case, merchant m_3 can provide this customer's request independently. After this transaction, the remained stock of s_2 in merchant m_3 is 2 units. Then, there is next customer who visits this marketplace and requests 6 units of s_2. If this customer visits merchant m_2, this merchant can fulfill this customer's request independently. If this customer visits merchant m_1 or m_3, then these merchants cannot provide this request by using their own stock. So, they need other merchants stock.

In those scenarios above, the assumption is that if a merchant needs more stock to provide customer's request, he or she can get it from any other merchants. This process will always successful as long as this other merchant has stock for the requested product. In this scenario, price is ignored.

In reality, this process is not always success. Besides stock, price does matter. This transaction can be executed as long as there is profit for both merchants. The previous case can be used for example. Suppose that the merchant m_3 has possibility to get more stock from merchant m_1 and m_2. The illustration is shown in Fig. 2.

The price mechanism is as follows. Originally, merchant m_3 get the s_2 from his supplier at 30,000 rupiah and sell this product to end customer at 40,000 rupiah. So, if he sells this product to an end customer, he gets 10, 000 rupiah for its margin. Meanwhile, merchant m_1 gets this product from his supplier at 32,000 rupiah and sells to the end customer at 38,000 rupiah. For the last, merchant m_2 gets this product from his supplier at price 30,000 rupiah and sells to the end customer at 42,000 rupiah.

The question is from whom merchant m_3 get the product for the first round. In this inter merchant interaction, merchant m_3 becomes the buyer and merchant m_1 and merchant m_2 becomes the seller. For m_3, the target point will be 30,000 rupiah and the reservation price will be 40,000 rupiah. For merchant m_1, the target point will be 38,000 rupiah and the reservation price will be 32,000 rupiah. For merchant m_2, the target point will be 42,000 rupiah and the reservation price will be 30,000 rupiah.

The explanation is as follows. For merchant m_3 who acts as a buyer, his target point will be the price which he usually gets from his common supplier. So, he will start the proposal price at his target point, so that, he hopes he will get the purchasing price as near to as he gets from his common supplier. Meanwhile, his common end customer selling price will become his reservation price. So, he will defend his stance as far as possible from his reservation price. When the price balance exceeds his reservation price he will get nothing from the transaction because he must spend more money rather than he receives from his end customer. In the other side for merchant m_1 or merchant m_2, his target point is his end customer price. He will try to make agreement at price as near as his common end customer price. Meanwhile, he will try to defend the price as far as his reservation price because if the price exceeds his reservation price, he will receive money from other merchant less than he must spend to his common supplier.

Based on this scenario, transaction can be reached from both merchants. It is because there is intersection area or popular as Zone of Possible Agreement (ZOPA) (Fisher *et al*., 1991) or settlement zone (Herman *et al*., 2001). For interaction between m_1 and m_3, this intersection area ranges from 32,000-38,000 rupiah. For interaction between m_2 and m_3, this intersection area ranges from 30,000-40,000 rupiah. In this case, there are two possible ends. If the negotiation process is serial then the winner is the seller who interacts for the first time. Meanwhile, if the negotiation process is parallel, then the winner is the seller who reaches deal for the first time.

Proposed model: Based on the explanation above in this research, we propose two negotiation models. The first model is serial negotiation model. The second model is parallel negotiation model. This model is developed based on vertical marketplace which is a marketplace that sells same or similar products from many merchants (Kestenbaum, 2017). The first model can be seen as one-to-one negotiation while the second model can be seen as one-to-many negotiation (Wooldridge, 2002). Both negotiation models are single issue negotiation model (Balakrishnan and Eliashberg, 1995; Chevaleyre *et al*., 2005).

Some variables are used in these models. Variable m represents the merchant. Variable b represents the merchant who acts as a buyer. Variable s represents the merchant who acts as a seller. Variable p represents the price. There are several price types. Variable p_b represents buyer's proposed price. Variable p_s represents seller's proposed price. Variable p_d represents the deal price. Variable p_{tp} represents the target point. Variable p_{rp} represents the reservation price.

In the first model, the negotiation process runs serially. It means that if there is more than one seller that is possible to interact with the buyer, then the next seller will interact with the buyer after the buyer finishes his current interaction and the buyer still needs more stock to fulfill his customer request. Meanwhile, the negotiation process will end based on some scenarios. The first scenario is that the buyer does not need more stock anymore. The second scenario is that the buyer still needs more stock but there is not any seller that is possible to interact with. The algorithm of the serial negotiation model is shown in Algorithm 1.

In this main algorithm of the serial negotiation, some new variables and functions are used. Variable n_r represents the quantity of a requested SKU. Variable status represents the status of the process. Variable s represents the selected seller's index. Variable r represents the negotiation result. Function getnextseller is used for finding the next seller that will interact with the buyer. Function negotiate is used for executing the interaction between buyer and the selected seller. Function transaction is used for closing the transaction between buyer and the selected seller.

Algorithm 1; Serial negotiation algorithm:

```
begin
  set (n_r)
 status7"run"
 while status = "run" do
 begin
  s_sel7getnextseller()
  if s_sel = 0 then
   status7"end"
  else
  begin
   r7negotiate(b, s_sel)
   if r = "success" then
   begin
    transaction (b, s_sel)
    if n_r = 0 then
     status7"end"
   end
  end
 end
end
```

At the beginning, this n_r variable value is the product quantity that is needed to be gotten from other merchants. After the n_r value is set then the negotiation process status is set "Run". This process will continue and iterate as long as the status is still "Run". At the beginning of the iteration, the getnextseller function is executed. This function contains some processes that are represented in Eq. 1 and 2 consecutively:

$$S_{cand} = n(s) \left| s \in S \wedge s_{stat} = 1 \wedge n_{stock}, s > 0 \right. \quad (1)$$

$$S_{sel} = \begin{cases} s \left| s \in S_{cand}, \right. \min (P_{tp}), \; n\,(S_{cand}) \neq \phi \\ 0, \; n\,(S_{cand}) = \phi \end{cases} \quad (2)$$

Based on Eq. 1 it is shown that the first work is defining the seller candidate set (S_{cand}). This set contains all sellers that possible to become the seller candidate to interact with the buyer. Based on Eq. 1, it is shown that to become the seller candidate, the seller status must be "1" which means that this seller never interacts with the buyer for the selected SKU. Another requirement is the seller must have stock for the selected SKU. Based on Eq. 2, the selected seller value will be 0 if the S_{cand} set is an empty set. Otherwise, the selected seller will be the seller who becomes the member of set S_{cand} and has the lowest target point. It means that in case that the S_{cand} is not an empty set, the seller who proposes the lowest opening price among other sellers in set S_{sel}. The reason in choosing the seller who proposes the lowest opening price is because first offer is an important aspect in predicting the negotiation outcome (Galinsky and Mussweiler, 2001; Magee *et al*., 2007).

When the selected seller is chosen, the next process is executing negotiation process between the buyer and the selected seller. This process is done by executing the negotiate function. This function returns two possible values: "Success" or "Fail". This function value is determined by using Eq. 3- 7:

$$r = \begin{cases} \text{Success, Ab, n} = 1 \text{v As, n} = 1 \\ \text{"Fail", else} \end{cases} \quad (3)$$

$$p_{b,\,0} = P_{tp,\,b} \quad (4)$$

$$A_{b,\,n} = \begin{cases} -1, \; p_{s,\,n} = \text{Ps, n-1} \wedge p_{s,\,n} > p_{rp,\,b} \\ 0, \; P_{s,\,n} \leq \text{Ps, n-1} \\ 1, \; P_{s,\,n} \leq P_{b,\,n} \end{cases} \quad (5)$$

$$P_{con,\,b} = \text{random}\,(\Delta_{b\,min} - \Delta_{bmax}) \quad (6)$$

$$P_{b,\,n} = \begin{cases} P_{b,\,n-1} + P_{con,\,b,} \; P_{b,\,n-1} + P_{con,\,b} < P_{s,\,n} \\ P_{s,\,n}, \text{ else} \end{cases} \quad (7)$$

The explanation of Eq. 3-7 is as follows. In Eq. 3, the result is success if seller's action or buyer's action is approving the negotiation. In Eq. 4, the buyer's initial price is the buyer's target point.

In Eq. 5 there are 3 possible actions that may be taken by the buyer, reject (-1), propose (0) and approve (1). Buyer will reject the seller's proposal if seller's current price is equal to seller previous price and seller's current price is higher than buyer's reservation price. Buyer will send new proposal if seller's current price is lower than seller's previous price. Buyer will approve the seller's proposal if seller's current price is higher than or equal to buyer's current price.

In case that buyer sends next proposal, this buyer will set new price. This process is determined by using Eq. 6 and 7. Equation 6 is used to determine the concession point. This concession point is determined stochastically and the random function follows uniform distribution with ranges from buyer's minimum deviation price $()_{bmin}$) to buyer's maximum deviation price $()_{bmax}$). This process is different from another model that it is determined deterministically (Balakhrisnan *et al*., 1995). In Eq. 7, buyer's final proposal price then is buyer's previous proposal price plus buyer's current concession point if this value is still less than seller's current proposal price. Else, the seller's current proposal price will become buyer's new proposal price. In the other side, seller may take similar action. Seller also has 3 possible actions: reject, propose and approve. These actions and the seller's price mechanism are determined by using Eq. 8 -11:

$$P_{s,\,0} = P_{tp,\,s} \quad (8)$$

$$A_{s,\,n} = \begin{cases} -1, \; P_{b,\,n} = P_{b,\,n-1} \wedge P_{b,\,n} < P_{rp,\,s} \\ 0, \; P_{b,\,n} > P_{b,\,n-1} \\ 1, \; P_{b,\,n} \geq P_{s,\,n} \end{cases} \quad (9)$$

$$P_{con,\,s} = \text{random}\,(\Delta_{s\,min}, \Delta_{s\,max}) \quad (10)$$

$$P_{s,\,n} = \begin{cases} P_{s,\,n-1-P_{con,\,s}}, \; P_{s,\,n-1} - P_{con,\,s} > P_{b,\,n} \\ P_{b,\,n}, \text{ else} \end{cases} \quad (11)$$

The explanation of Eq. 8-11 is as follows. In Eq. 8, the seller's target point will become the seller's initial price. In Eq. 9, seller will reject the negotiation if the buyer's current price is equal to buyer's previous price and this price is still lower than the seller's reservation price. Seller will propose new price if buyer's current price is higher than buyer's previous price. Seller will approve the negotiation if buyer's current proposal price is higher than or equal to seller's current price.

In case that seller's action is sending new proposal price, seller will create new concession point. As it shown in Eq. 10, the seller's concession point is determined stochastically and it follows uniform distribution that ranges from seller's minimum deviation price ( )$_{smin}$) to seller's maximum deviation price ( )$_{smax}$). The seller's final price is seller's previous price minus seller's current concession point if this value is more than buyer's current price. Else, seller's final price is buyer's current price.

In case that the negotiation is success, transaction mechanism will occur, so that, there is some amount of products that will be moved from seller to buyer. Then, buyer will give some money to seller depend on the product quantity that is given by the seller. The transaction mechanism is determined by using Eq. 12-14:

$$n_{purchased,\ b,\ s} = \begin{cases} n_{r,\ n},\ n_{r,\ n} \leq n_{stock,\ s} \\ n_{stock,\ s},\ else \end{cases} \quad (12)$$

$$P_{trans} = n_{purchased,\ b,\ s}.P_d \quad (13)$$

$$n_{stock,\ s,\ n} = n_{stock,\ s,\ n-1} - n_{purchased,\ b,\ s} \quad (14)$$

The transaction process is as follows. First, the quantity of product must be determined by using Eq. 12. If the quantity that is requested by buyer is equal to or less than the seller's stock, the purchased quantity will be the requested quantity. Else, the purchased quantity will be the stock quantity. Then by using Eq. 13, transaction value is determined as purchased quantity multiplied with deal price. Then by using Eq. 14, the seller's stock is updated by reducing the previous stock with the purchased quantity.

In the second model, the parallel approach is chosen. It means that the buyer negotiate with all possible sellers simultaneously. So, while buyer is negotiating with one seller, he may also be negotiating with other sellers. This second model main algorithm is shown in Algorithm 2.

Algorithm 2; Parallel negotiation main algorithm:

```
 begin
 set (n_r)
 sendbroadcastproposal ()
 status 7 "run"
 while status = "run" do
 begin
  for i=1 to n_s do
  begin
   if s_status,i = 1 then
    run_interaction (b, s_i)
  end
  check_possibility ()
 end
end
```

In Algorithm 2, some variables and procedures are used. Variable s_{status} indicates the the indexed seller's status. Value 1 means that the interaction with this seller still occurs while value 2 means the interaction with this seller is finished. The n_s represents the number of sellers. Procedure send broadcast proposal is used to start the interaction with all sellers by sending the initial purchasing proposal. While the status still runs, the buyer will interacts with all active sellers simultaneously by using the run_interaction procedure. Procedure check_possibility is used to check whether the negotiation session is still possible to be continued.

This parallel negotiation algorithm starts with broadcasting the initial purchase proposal from buyer to seller. In this process, this proposal is sent to all sellers. After this proposal is sent then the negotiation process begins by changing status to run. As it is shown in Fig. 4, negotiation process still runs as long as the status is still run. In the negotiation, the iteration scans all of sellers. If the seller status is still available then interaction action is still run between buyer and indexed seller by using the run_interaction procedure. This procedure algorithm is shown in Algorithm 3.

Algorithm 3; Parallel negotiation interaction algorithm:

```
begin
 if n_r >0 then
 begin
  if token = 1 then//seller's action
  begin
   A 7 action(s_i)
   token 7 0
  end
  else
  begin
   A 7 action(b)
   token 7 1
  end
  if A 7 1 then
  begin
   transaction (b, s_i)
   s_status,i 7 0
  end
  if A 7 -1 then
   s_status,i 7 0
 end
end
```

Some variables are used in the parallel negotiation interaction algorithm. Variable token is used to control who takes action in this session, seller or buyer. Variable A is used to store the action value that is done. This action result is determined by using the action procedure and this process follows Eq. 5 for buyer and Eq. 9 for seller. If the result is 1 then the transaction procedure is executed. This transaction mechanism is determined by using Eq. 12-14. If the action result is 1 or -1 then the seller's status will be inactive.

Each time all sellers have been scanned then the system will check whether negotiation can still be continued. This process is done by executing the check_possibility procedure. The negotiation must be finished if one of these two conditions is reached. First, the requested quantity that is needed to be fulfilled is zero. Second, there is not any sellers has stock for the requested product.

RESULTS AND DISCUSSION

This model then is implemented into the online marketplace simulation application. This application is limited only to observe inter merchant negotiation process. This simulation application is developed by using PHP language, so that, this application is a web based application. In this application, there is only one product and one merchant that act as buyer. Meanwhile, some merchants are generated and they act as seller. Each seller has his own stock and price range. The stock and price range is generated randomly and these values follow Poisson distribution.

After the application has been developed, the testing procedure is executed by running the simulation. The testing is run to observe the relation between the adjusted parameters and the observed parameters. In this testing, both serial and parallel negotiation models are run and the result will be compared to each other. The adjusted parameters are number of sellers (n_s), requested product quantity (n_r) and seller's stock quantity (n_{stock}). The observed parameter is the transaction amount that must be paid by buyer to fulfill all requested product quantity and the success ratio ($r_{success}$). In this simulation, some default values are set. These default values are shown in Table 2.

In the first test, we observe the relation between number of sellers (n_s) and the observed parameters. In this test, the number of sellers ranges from 5-50 sellers. The step size is 5 sellers. In each step, we run 10 simulation sessions (Table 3).

Based on data in Table 3, it is shown that the increasing of the number of sellers makes the total transaction value gets lower. It means that for same requested product quantity, higher number of sellers makes the buyer pays lower. Meanwhile, when the number of sellers is too low as it is shown when the number of sellers is 5 persons, the success ratio may be lower than 100% which is means not all requested product quantity is fulfilled. By comparing the serial negotiation and parallel negotiation, the parallel negotiation performs little bit better than the serial one in producing lower transaction value.

Table 2: Parameters default values

Parameters	Default values
n_s	25 seller
n_r	100 units
n_{stock}	25 units
)$_{bmin}$	200 rupiah
)$_{bmax}$	400 rupiah
$p_{tp,s}$	20,000 rupiah
$p_{rp,s}$	15,000 rupiah
$p_{tp,b}$	15,000 rupiah
$p_{rp,s}$	20,000 rupiah

Table 3: Relation between number of sellers and the observed parameters

	Serial		Paralel	
n_s (seller)	$r_{success}$ (%)	p_{tot_trans} (Rupiah)	$r_{success}$ (%)	p_{tot_trans} (Rupiah)
5	97.6	1,683,270	97.6	1,677,130
10	100	1,660,660	100	1,656,610
15	100	1,630,680	100	1,602,340
20	100	1,569,660	100	1,556,990
25	100	1,562,990	100	1,549,940
30	100	1,541,510	100	1,533,190
35	100	1,526,010	100	1,517,540
40	100	1,516,830	100	1,512,670
45	100	1,523,340	100	1,519,260
50	100	1,503,230	100	1,501,920

Table 4: Relation between requested product quantity and the observed parameters

	Serial		Parallel	
n_r (units)	$r_{success}$ (%)	p_{tot_trans} (rupiah)	$r_{success}$ (%)	p_{tot_trans} (rupiah)
20	100	302,800	100	302,040
40	100	609,630	100	607,220
60	100	910,690	100	910,490
80	100	1,232,970	100	1,227,910
100	100	1,541,490	100	1,541,340
120	100	1,886,090	100	1,870,420
140	100	2,193,320	100	2,180,860
160	100	2,528,590	100	2,507,970
180	100	2,880,660	100	2,859,740
200	100	3,239,800	100	3,213,230

In the second test, we observe the relation between requested product quantity (n_r) and the observed parameters. In this test, the requested product quantity ranges from 20-200 units. The step size is 20 units. In each step, we run 10 simulation sessions. The result is shown in Table 4.

Based on data in Table 4, it is shown that when the number of stock and the number of sellers are fixed, the increasing of requested product quantity makes the transaction value is increased too. This increasing pattern is linear. By comparing the serial negotiation and parallel negotiation with the same requested product quantity, the parallel negotiation model performs lower transaction value rather than the serial one.

In the third test, we observe the relation between seller's stock quantity (n_{stock}) and the observed parameters. In this test, the seller's stock quantity ranges

Table 5: Relation between seller's stock quantity and the observed parameters

	Serial		Parallel	
n_{stock} (unit)	$r_{success}$ (%)	p_{tot_trans} (Rupiah)	$r_{success}$ (%)	p_{tot_trans} (Rupiah)
5	98.1	1,709,600	98.1	1,704,550
10	100	1,633,600	100	1,610,560
15	100	1,607,810	100	1,595,230
20	100	1,589,220	100	1,567,310
25	100	1,544,650	100	1,536,520
30	100	1,535,040	100	1,522,990
35	100	1,518,820	100	1,516,980
40	100	1,517,740	100	1,517,040
50	100	1,501,990	100	1,501,890

from 5-50 units. The step size is 5 units. In each step, we run 10 simulation sessions. The result is shown in Table 5.

Based on data in Table 5, it is shown that when the number of sellers and the requested product quantity are fixed, the increasing of number of seller's stock makes the total transaction value is reduced. This condition occurs both in serial and parallel negotiation models. The increasing trend is linear. With the same number of stock, the parallel negotiation mode performs lower than the serial one.

CONCLUSION

Based on the explanation above, it is shown that inter merchant negotiation model has been developed and has been implemented into inter merchant negotiation simulation application. In this research, there are two proposed models. The first model is serial negotiation model that the buyer has to complete its current negotiation session before starting new negotiation session with other seller if it is needed. The second model is parallel negotiation model. Different from the serial one in parallel negotiation model, buyer can negotiate with one seller while he still negotiates with other sellers.

Based on the test result, there are some research findings. First, the parallel negotiation model performs a little bit better than serial negotiation model in producing lower total transaction value. It means that by using parallel negotiation model, buyer pays less money because he gets lower deal price. Second, the number of sellers has negative correlation with the total transaction value. Third, the seller's stock quantity has negative correlation with the total transaction value. Fourth, the requested product quantity has positive correlation with the transaction value.

RECOMMENDATIONS

There are some future research potentials as the continuation of this research. In this research, the relation types are one-to-one for serial negotiation and one-to-many for parallel negotiation. So, it is very interesting to develop and explore the many-to-many inter merchant negotiation model. In this research, there is only one product that is negotiated in a single negotiation session. So, developing multi products negotiation model is very interesting too. In multi products model, the negotiating party may defend stronger in some products but give more concession in other products. Besides negotiation aspect there are some aspects in online marketplace system that are interesting to be explored, so that, the online marketplace system will give more benefits to its stakeholders, merchant, buyer and company such as automatic and dynamic pricing strategy, display mechanism, etc.

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