B2C E-Commerce Fact-Based Negotiation Using Big Data Analytics and Agent-Based Technologies

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***Abstract*—The focus of this study is application of intelligent agent in negotiation between buyer and seller in B2C Commerce using big data analytics. The developed model is used to conduct negotiations on behalf of prospective buyers and sellers using analytics to improve negotiations to meet the practical requirements. The objective of this study is to explore the opportunities of using big data and business analytics for negotiation, where big data analytics can be used to create new opportunities for bidding. Using big data analytics sellers may learn to predict the buyers' negotiation strategy and therefore adopt optimal tactics to pursue results that are to their best interests. An experimental design is used to collect intelligent data that can be used in conducting the negotiation process. Such approach will improve quality of negotiation decisions for both parties.**

Keywords—negotiations; e-commerce; agent technology; big data; analytics

I. INTRODUCTION

Affordability of smart mobile devices with permanent connection, social networks and real-time conversation streams significantly changed B2C e-commerce. If some time ago we have been talking about negotiations, when negotiating parties had little or no knowledge of attributes and their values, now such information can be retrieved from multiple sources online.

Negotiation is one of the major components of many e-commerce activities, such as auctions, scheduling, contracting, and so on, and is one area that can greatly benefit from intelligent automation. We consider negotiations as a form of interaction between parties with conflicting goals who wish to cooperate in order to reach an agreement that will benefit all negotiating parties, a process that can be both complicated and time-consuming.

E-commerce negotiation is a decision-making process that seeks to find an electronic agreement, which will satisfy the requirements of two or more parties in presence of limited information and conflicting preferences [1]. In e-commerce negotiations buyers and sellers search for possible solutions until agreement is reached or negotiations fail. Both buyers and sellers can conduct their own utility assessment for every solution. The goal of negotiation is to seek a solution that optimizes utility value for both of them.

Due to recent technological advances mentioned above all organizations involved in B2C commerce are forced to improve existing and develop new services to retain old customers and attract new one. Customers negotiate for better deals, and e-commerce business organizations are negotiating in order to keep their customers, to build lasting relationships, and to increase customer satisfaction Negotiation is one of such services. In a view of increased role of negotiations in B2C commerce it is appropriate to give this particular topic the attention it deserves. Negotiation can significantly benefit from big data analytics. Using analytics will allow businesses to shorten negotiation time and effort associated with it on one side. On the other side, it will help customers lacking knowledge of negotiation procedures and negotiation skills.

The success of e-negotiation in B2C commerce depends on volume of provided data and information, and how they are used to optimize the negotiation operations. The size of data is big enough to extract huge volumes of valuable knowledge that may determine firm's success or failure [2]. Using big data analytics a seller may learn to predict the buyer's negotiation strategy and develop and adopt optimal tactics to achieve results that are to his best interests. The ability to manage and transform data into useful information and utilize it as a strategic differentiator is a key contributor to the success of B2C negotiation. The B2C negotiation process must be designed to take advantage of large volumes of consumer data that have become available in recent years due to the Internet, social networking, mobile telephony applications, RFID and sensor applications, and new technologies that create and capture data, size of which is growing exponentially. Collected data are mainly unstructured and contain valuable customers' opinion and behavioral information. Big data analytics can be defined as integrated technologies, techniques, practices, methodologies, and applications that analyze critical business data to help an organization better understand its business and make real time decisions [3].

Despite large number of articles in this area, there has not been enough academic research on effective ways to leverage the big data to create meaningful information for e-commerce negotiations. Proposed model allows negotiators to engage simultaneously in multi-parties' negotiations. This agent-based e-negotiation system has incorporated big data analytics technologies to carry out goal-driven multi-parties' negotiations on several issues at the same time and support vital negotiation mechanism.

Using big data analytics, the seller agent (SA) will be able to predict the price a customer has in mind and find out what's included in other companies' offers in order to negotiate from a

position of strength. Agents can do their research within a given price range and estimate the profit a business will gain. SA will accurately predict profitability based on different variables. These variables include original price, available quantity, delivery time and other attributes. Based on that data SA will derive the best initial asking price and the walk-away price on the spot in order to maximize profit.

In this work framework architecture for the e-commerce negotiation application is developed as one of the services that can be provided by B2C organizations in order to achieve greater online and mobile customers' satisfaction. To achieve this goal the author is integrating intelligent agent technology with big data analytics in an intelligent negotiation model.

This paper is structured as follows. In section 2 the related research works in e-negotiation are represented. Framework of the proposed mobile negotiation system is given in section 3. Section 4 concludes this paper and gives general direction of future research.

II. Related Work

More and more business processes become electronic. This quickly became a part of our life and does not surprise us anymore. Anyone can see the advantages of e-commerce. It simplifies our life, changes the whole concept of business. Some areas of business though are still resistant to changes due to their specifics.

Majority of the business negotiations represent one of such areas. Traditional or partially automated cannot meet the needs of increasingly frequent electronic trading. Automated business negotiation process will improve efficiency of e-Commerce, minimize costs and promote its further development.

During last two decades negotiations have been studied extensively. One of the most commonly applied in e-commerce negotiations methods is artificial intelligence (AI). Different AI approaches have been developed and deployed for research, training and other purposes based on such methods as game theory, Bayesian networks, evolutionary computation, and distributed artificial intelligence models. Most of the earlier negotiation models have been built under fixed and often mismatched assumptions and thus inappropriate for the real-life electronic negotiations, based on complex computations, require high computational power and large memory especially when multiple attributes were involved. Several online negotiation applications have been developed and implemented. The majority of these applications were one-site Negotiation Support Systems and required human participation.

Various existing e-market places employed e-negotiation applications based on intelligent agent technologies. Unfortunately, market agents are trading only by price [1, 4], while in real world, negotiations are conducted not only by price, but often involve multiple issues (e.g., price, quantity, product quality) [5, 6]. Matos and Madeira in their work [7] propose an automated negotiation model between two participants for m-commerce, which is using mobile agents and considering the mobile device personalization through the use of profiles in the negotiation. Buying and selling agents are conducting price negotiation on behalf of the negotiating parties. Heavy-weight calculations are performed on a fixed network. Kattan at el. [8] studied an agent-based model for negotiation using genetic algorithms to investigate outcomes of negotiation. An agent-based negotiation agent system based on artificial neural networks to generate counter-offers, proposed in [9], exploited trading experiences containing negotiators' preferences. Bala [10] and Rajesh [11] proposed a CBR-based distributed multi-agent electronic negotiation system where previous similar cases were retrieved from case base, revised and used to develop new offers/counter-offers, to aid in selecting an appropriate negotiation strategy.

Ronglong at el. [12] proposed an agent based negotiation model that employed Bayesian learning method. Bjelica and Petrović in [13] built three-party QoS negotiation model for the future mobile networks, but in the negotiation procedure they proposed user accepts the first "good" service offer and possibly missing the "best" one. Fu and Nie [14] developed an improved PSO (particle swarm optimization) algorithm which automatically compute an optimal solution to maximize both buyers' and sellers' payoff. Bruns and Cortes [15] used negotiation strategy defined in terms of sub-negotiations with internal or external agents in their hierarchical model of service negotiation, where complex negotiation strategy was decomposed into manageable components having well-defined scope.

Li and Zhong [16] performed analysis of the negotiation protocol, negotiation strategy, negotiation flow and negotiation evaluation that allowed them develop a new mobile commerce negotiation model implementing new negotiation algorithms and new negotiation evaluation methods. Multi-strategy selection model capable of handling dynamically changing negotiation situations was developed by Cao and Dai [17] and Hindriks at el. [18]. A trusted negotiation broker framework for adaptive intelligent bilateral bargaining with well defined mathematical models to map business-level requirements and an algorithm for adapting the decision functions during an ongoing negotiation have been designed by Zulkernine and Martin [19].

III. B2C E-Commerce Negotiation

Negotiation occurs when two or more counterparts are trying to accomplish a deal that satisfies all participating parties. It is a decentralized decision-making process of achieving a compromise in presence of incomplete information and contradictory preferences. As e-commerce environment provides access to much larger community of buyers and sellers, the possibility of better deals emerges for all participating parties, both businesses and customers.

Proposed agent-based negotiation model utilizes big data analytics techniques to identify the best initial offer and adopt multiple criteria decision in the utility function to evaluate offers.

The following assumptions have been made:

- Messages exchanged between two parties to convey offers/concessions.
- Messages are encrypted to protect the privacy of negotiating parties.

- All negotiation activities must be conducted electronically which allows for transparency of the negotiation process.
- Negotiation applications can be used in online/offline mode.
- In case of disconnection execution of the application resumes at the same point.

Goals of the proposed system include helping negotiating parties to derive initial asking price, concessions, developing efficient strategies, minimizing mistakes, etc., especially for those lacking the knowledge of negotiation processes. The proposed system employs software agents to resolve these issues [20].

Buyers' data, such as price, quality, delivery time, etc., are entered by means of an interface agent and stored in buyer's profile on a mediator site. Applicable constraints on such attributes may be included at that point. Buyers' request is carried by mobile agents to a mediator at a fixed location. Missing information on some attributes can be retrieved from DW by a mediator.

A negotiation process is considered a combination of one-attribute negotiation processes. Negotiable attributes may differ from one buyer to another and may include all or some of the following: price, qualities, delivery time, guarantee period, specific constraints, and other important to a buyer features. It is assumed that all attributes are negotiable.

Exchange of offers and counteroffers is an iterative process that step by step leads to a compromise acceptable to both negotiating parties. Private information of both parties, such as negotiation strategies, negotiable attributes' constraints are hidden and must not be disclosed. Opponents' negotiation strategies can deducted from a sequence of their concessions.

Big data analytics system is used to derive an initial offer. Negotiator agent (NA) delivers the generated offer to other participating parties. As an offer is received by a negotiating party, it's evaluated, a counteroffer is generated, send back, and so on, until negotiation either succeeded or failed. If the mobile agent of the buyer accepts the price offered by the seller mobile agent, then the negotiation process is completed. Then agents return to the place of origin, where data are evaluated, the best counteroffer selected and delivered to prospective buyer in a suitable form. If the initiator of negotiation accepts it, the negotiations are concluded. If not, the user will have two options: either quit the negotiation or start the new process with re-adjusted attributes.

IV. E-Commerce Negotiation Architecture

Negotiation system made of several agents: interface agent, agent server, presentation agent, buyer and mediator mobile agents (both fixed and wireless), seller and buyer negotiation agents. Functions of each agent are described below.

The design of the e-negotiation system, needed to assist buyers in searching for prospective counterparts, acceptable offers, negotiating terms, and finalizing deals, is based on the architecture developed in our previous works [20, 21] and shown on Fig. 1.

S-agents are representing seller's interests. M-agent is usually located on a desktop of seller and buyer devices or server and acts as a mediator between S-agents (seller) and B-agents (buyer).

An agent framework and a development environment are needed in order to build the proposed system. Infrastructure supports the interactions between agents that might be geographically dispersed on the Internet. The architecture has a 3-tier structure: the buyers' mobile and fixed devices, a mediator, and seller negotiation systems. The first tier is a buyer (with wireless or fixed) device, equipped with interface and intelligent mobile agents, installed on the buyer devices, to help communicate with the system and act as personal assistants to the buyers. Wireless buyers' access to the E-commerce services is facilitated by a mediator employing multiple mobile agents that search for potential sellers. The final decision is usually made by a buyer and is based on recommended offers delivered by the buyer's negotiation agent.

The second tier consists of a mediator site whose functions are:

- Collecting buyer's data from client's agent;
- Filling in buyer's profile;
- Generating an offer;
- Generating mobile agents on behalf of each mobile client;
- Evaluating incoming offers, selecting the best and continue negotiation with the seller that made this best offer.
- Content adaptation.

The intermediary server is controlling the adaptation process to meet the user preferences and supports mobile devices with different capabilities and limitations, and diverse wireless technologies used by users. It is in charge of content delivery.

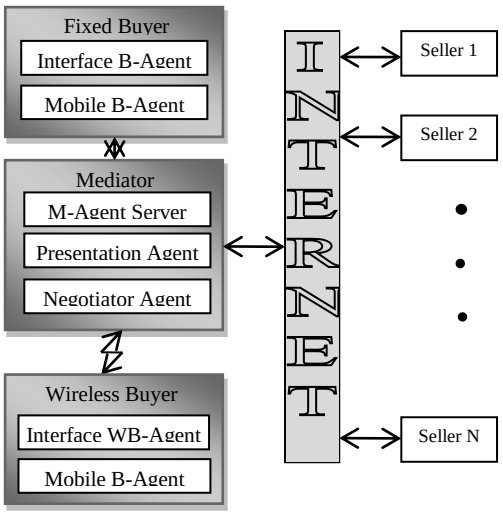

Fig. 1. Negotiation Framework Architecture

The server holds stationary agents (administrator and presentation agents), user profiles, and device specifications database. A user profile is created when a user requests a negotiation service for the first time and contains the client's device specifications. A presentation agent specifies which presentation type is most appropriate to the user according to predefined set of rules. Such a way, each buyer can receive an adaptive content that meet his preferences and is compatible with his mobile device and wireless technology used.

The third tier is a seller negotiation system whose functions are:

- Assigning weight of each negotiation attribute;
- Selecting of the concession strategy to be used;
- Evaluating of the buyer's offer;
- Creating of a counter-offer.

Mobile agents are used as means of communication between the tiers, and distribution of the recourses is managed across this system architecture.

A. Seller Module

Seller Negotiation module consists of Knowledge Base (KB) that specifies set of rules to derive an advice for negotiators, different negotiation mechanisms, and Big Data system consisting of data warehouse of e-market data and analytic tools integrating text mining (e.g., information extraction, topic identification, question-answering), web mining, social network analytics, and existing database. Fig. 2 illustrates how big data and business analytics can be used to support negotiation. These tools are used to analyze all types of marketing data using sophisticated quantitative methods such as data mining, statistics, predictions, forecasting, visualization, and optimization.

Customers also have access to these sources of data, thus businesses have a unique opportunity to influence customers' opinions and behavior, understand the likelihood of a customers' willingness to spend money in a certain product category, optimize price for better profitability, and increase competitive edge of organization over competitors [22 - 25]. Using big data analytics a seller may learn to predict the buyer's negotiation strategy and therefore adopt optimal tactics to attain results that are to his best interests. Information on past selling instances is stored in the data warehouse, and the classification analytics tool will select an instance that has the highest similarity with current selling situation. Once such instance is identified, a price offer can be made based on the price information attached to the selected instance.

Content of DW system includes data on specific negotiation circumstances, negotiating parties' profiles, result of negotiations (success, failure, and terms of the reached agreements), negotiation strategy, etc., in other words any relevant information that can be used to derive a sequence of concessions made by both negotiating parties, and so on.

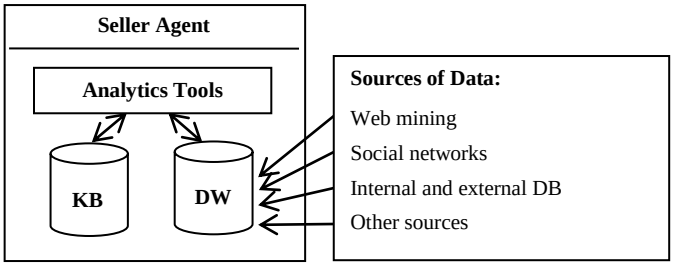

Fig. 2. Seller Negotiation System

Seller negotiation system retrieves and analyzes big data to generate an advice on offer's calculations. The negotiating agents' behaviors are built on these analytical results. Each agent has inference mechanism based on the rule-base system located in the seller's knowledge base. For more complex knowledge processing, powerful analytics tools may be used. The agent's cooperation helps to detect various offer conditions which, in turn, assist decision makers in their negotiation process. We can improve the negotiation process by applying a methodology propose by Lee and Hsu [26] to predict the negotiation strategy used by buyer through the calculation of the relative concession rate.

B. Buyer Module

Buyer module houses interface and buyers' mobile agents.

1) Interface Agent (IA): A buyer fills necessary information with an interface agent. This information will be stored in the buyer's profile and contains such data as price, quality, delivery time, guarantee period, etc. In the case if a user has no information on some attributes, he will have an option to perform the search by himself, or else he can choose to delegate this job to an agent server. Recorded preferences are delivered to a mediator by a buyer's mobile agent.

2) Buyer's Mobile Agent: is representing the buyers' interests and delivers buyer's negotiation initiation request to the agent server, where such a request will be processed. Note that buyers can be located at a fixed location or be on a move.

C. Mediator Module

The architecture of Mediator Negotiation system has the following components:

1) Agent Server (AS): distributed, intelligent. Its roles include provision of a standard interface to other agents, managing resources to satisfy requests of the buyer's agent, etc. An agent server performs the following main tasks:

- Creating and maintaining of an execution environment and protection and regulatory mechanisms for agents;
- Facilitating migration of agents' code;
- Monitoring agents' actions;
- Allowing co-existence of and communications between agents working on the same negotiation;

- Prohibit direct interference and, in general, any kind of communications between agents of different buyers in order to avoid sharing confidential information on negotiation strategies, constraints, negotiation status, etc;
- Handling communications with other servers and access available services through them.

2) Presentation Agent (PA): With the emergence of heterogeneous devices, content adaptation became unavoidable. Its main goal is to enable the presentation of digital content of on different mobile devices. The device context is information that is used to characterize a user's mobile device. It includes some of the main parameters that characterize mobile devices, such as device type and device screen resolution. Nowadays mobile devices can be connected to the Internet via different wireless technologies. Each has a different data transfer rate.

- As a result, we have to specify the type of wireless technology that will be used by the user to connect his device to the Internet. The layout structure, image size, and font size, may not be compatible to present on portable device. So, a presentation agent dynamically creates new images based on original. Using different media conversion tools for text, image this agent develops a new content based on the device characteristics recognition such as mobile device type (Notebook computers, PDAs, smart phones or cell phones); types of the operating system (Apple OS X, Blackberry OS, Windows Mobile, Palm OS, etc.); type of format; web browsers; network type; upload and download speed of the mobile device.

3) Mediator's Mobile Agent: can move from one system to another. Mobile agents are generated dynamically during the execution. They can reconfigure themselves dynamically based on changes of the services.

An offer, which will be presented to the negotiation system, is built based on user's preferences accepted by an interface agent and consequently passed to an agent server. The agent server creates mobile negotiator agents whose job is to carry an offers to prospective buyers. A negotiator agent above all contains an offer to be delivered to counterparts, and an address, explicitly specified by a client or provided through search. Each agent engages in bilateral negotiations, exchanges offers/counter-offers with other party, evaluates counter-offers, and so on, until either preliminary agreement has been reached or negotiations have failed. In both cases a negotiator agent returns back to the mediator informing it about the results. The agent can make a better decision when it learns more about its counterpart. However, the reasoning strategy of the agent may be changing with accumulating knowledge as the negotiation goes on. The best outcome is selected and presented to the buyer. If the buyer accepts the final agreement then it finalized, thus negotiation process is considered completed. If not, then negotiation is considered a failure.

V. Proposed Negotiation Model

Negotiation issues (attributes: i=1, 2, …, n) to be agreed on by both buyer and seller, which are the decision objects that the negotiation agents are using to negotiate. Each attribute (i) have three different values: for a seller a maximum value (A_i^{max}) which is the asking or starting point, a lowest acceptable value (A_i^{min}) and the best expectation value (A_i^{s}) of the negotiation; for a buyer a highest acceptable value (A_i^{max}), best expectation value (A_i^{b}) of the negotiation and a minimum value (A_i^{min}) which is the starting point. The early prediction of the values of these supportable solutions variables discovered and captured from the analytics of big data which depends on context and situation. These attributes' values will help in calculation of relative concession rates. Attributes of the same values can't be negotiated. Each attribute is associated with a weight (w_i) which reflects the importance of the negotiation attribute. Both buyer and seller decide the weight of each attribute according to their preferences of each negotiation attribute.

Description of the Fact-Based E-negotiation model: initially, buyer and seller assign the weight of each negotiation attribute and choose the concession strategy (anxious, careful, or greedy type [27]), and submit them to their negotiation agents. Both concession strategies and attribute weights of each side are unknown to the other side. The values of negotiation attributes are delivered to the relevant opponent agent. The objective of e-negotiation is to maximize utility function and the worst case should not make the utility function value lower than a predefined one. Otherwise the negotiation process should be terminated. In every negotiation round, the SA will estimate the buyer's intention and forecast his acceptance probability. The seller agent must calculate its own evaluation function, and then determine its actions and refresh its parameters for the next round. In each negotiation round, the negotiation agent (either buyer's or seller's) receives an opponent's offer and checks if it is within its expectation, then makes a decision whether to accept, reject or continue the negotiation. In case of continuing the process, one side changes its bid to show a motivation to compromise, and continues negotiation with the other side. The latter evaluates the proposal of the opponent, and decides whether to accept it or not. If the opponent rejects the proposal, he adjusts the attribute value, generates counter-proposal, and returns it to the bidder. The process continues until the attribute values reach a balance where both sides accept the proposal, or one or both side(s) reached their least acceptable limit, and therefore the negotiation is failed.

In order to measure the merits of the negotiation proposal, it is needed to calculate the value of the current proposal's utility. Utility function is given below.

In each round the negotiation seller agent calculates the total utility (T_{su}) value:

$$T_{su} = \sum_{i=1}^{n} C_i^s \times w_i \quad (1)$$

where: w_i is the weight of each attribute; C_i^s is the seller concession rate between two consecutive negotiation rounds (*t*) and (*t-1*) of attribute (*i*).

$$C_i^s = \left(O_{i,t}^s - O_{i,t=1}^s\right)/O_{i,t-1}^s \quad (2)$$

where: $O_{i,t}^s$ and $O_{i,t=1}^s$ are current (*t*) and previous (*t-1*) offers for negotiation attribute (*i*) respectably.

$$O_{i,t}^s = A_i^{max} - \left(A_i^{max} - A_i^{min}\right) \times t/A_{i,t} \quad (3)$$

where: $A_{i,t}$ is the value of attribute (*i*) at round (*t*); A_i^{max} is the attribute value on the previous round, and A_i^{min} is lower limit not to be exceeded.

$$A_{i,t} = T_{su,t-1} \times A_i^{max} \quad (4)$$

The seller utility evaluation function evaluates the value of each negotiation attribute (i) in each negotiation round (t). At the beginning of a negotiation utility function is set to its maximum value which usually equals to 1. When negotiation time reaches deadline, the target utility should be decreased to the least acceptable value that seller agent can accept.

At the buyer side, the negotiation buyer negotiation agent calculates the total utility (T_{bu}) represents the maximum level the buyer is willing to pay for related attributes or minimum level the buyer wish to accomplish for important related attributes.

$$T_{bu} = \sum_{i=1}^{n} C_i^b \times w_i \quad (5)$$

where: w_i is the weight of each attribute; $C^b_{i,}$ is the buyer's concession rate between two consecutive negotiation rounds (*t*) and (*t-1*) of attribute (*i*).

$$C_i^b = \left(O_{i,t}^b - O_{i,t-1}^b\right)/O_{i,t-1}^b \quad (6)$$

$$O_{i,t}^b = A_{i,t}^{max} - \left(A_i^{max} - A_i^{min}\right) \times t/A_{i,t} \quad (7)$$

$$A_{i,t} = T_{bu,t-1} \times A_i^{max} \quad (8)$$

In case if the buyer conducting at the same time negotiation with a number of sellers to buy the same items then buyer will adjusts his offer based on the overall information receiving from all sellers agents.

If the seller agent accepts the counter-offer, then the deal is completed. If rejected, then the buyer agent may adjust the offer by decreasing its goal utility for next round of negotiation until the process is completed with an agreed deal or failure. In case if a viable buyer is not willing to agree to bottom line (best expectation value or least acceptable value) then a course of action of switching strategy is recommended.

VI. EXPERIMENT

Simulation prototype was developed using Java Agent Development Framework as the platform to simulate the actual operation of multi-agent negotiation. Based on the definitions of the proposed negotiation model the data as shown in Table I are used to test the model.

TABLE I. ATTRIBUTE VALUES

User	Price P ($$)		Quantity Q		Time to Deliver TD (days)	
	Start	***Max***	***Start***	***Max***	***Start***	***Max***
Buyer	500.00	780.00	10	15	7	14
	Start	***Min***	***Start***	***Min***	***Start***	***Min***
Seller1	1000.00	750.00	20	13	21	13
Seller2	1200.00	732.76	5	5	18	10
Seller3	1300.00	1000.00	20	10	14	7

In this simulation example, there is one buyer's agent B negotiates with three sellers, agents: S1, S2, and S3 separately. And there is one item for negotiation. The attributes of the item are price, quantity and delivery date. In the first round the agents of the sellers are initialized according to the recommendations from their business analytics systems as shown in Table I. In this round both buyer and sellers provide the weight of each attribute according to their preferences of each negotiation attribute. In this example we consider the scenario in which sellers using business analytics while buyer does not. In case if the buyer provided help from Web-based negotiation support system, he will be in better negotiation position. In each round buyer takes advantage of the information receiving from negotiations with sellers to adjust his offer and counteroffers. Buyer hides that negotiation information of each seller from the other sellers which gives him more negotiation power.

At the end of round one, sellers will not accept the initial proposal of the buyer, and further negotiation is needed. Based on the weight of each attribute, buyer and sellers adjust the proposal values of price, quantity, and delivery time. The proposal values of each negotiation round are shown in Table II.

After 11 rounds of negotiations, the buyer accepts the proposal of the seller S2 because of best acceptable price compared to that of S1 and S3 sellers (739.76 compared with 748.11for S1 and failure for S3) while quantity and time of delivery attributes have similar values. The negotiations with other sellers are terminated.

Graphical representation of the results of negotiations on price can be seen correspondently on Fig. 3, on quantity on Fig. 4 and on delivery time on Fig. 5.

Fig. 3. Price Negotiation Process

TABLE II. NEGOTIATION PROCESS WITHOUT BUYER'S ANALYTIC TOOLS

	Buyer			Seller1			Seller2			Seller3		
Round	***P***	***Q***	***TD***	***P***	***Q***	***TD***	***P***	***Q***	***TD***	***P***	***Q***	***TD***
0	500.00	10.00	7.00	1000.00	20.00	21.00	1200.00	5.00	18.00	1300.00	20.00	14.00
1	501.00	11.00	9.00	999.00	19.00	19.00	1198.60	5.50	16.43	1294.67	19.00	13.00
2	519.63	12.45	11.22	980.37	17.55	16.78	1172.50	6.50	14.78	1284.11	17.55	12.11
3	541.96	13.68	12.71	958.04	16.32	15.29	1140.86	7.93	13.83	1269.39	16.32	11.87
4	579.93	14.45	13.52	920.07	15.55	14.48	1086.21	9.61	13.47	1251.50	15.55	12.14
5	624.69	14.83	13.88	875.31	15.17	14.12	1019.58	11.29	13.49	1232.20	15.17	12.65
6	671.25	14.97	13.98	828.75	15.03	14.02	946.21	12.72	13.66	1212.75	15.03	13.18
7	710.88	15.00	14.00	789.12	15.00	14.00	877.03	13.77	13.82	1193.92	15.00	13.58
8	739.96	15.00	14.00	760.04	15.00	14.00	815.29	14.43	13.92	1175.80	15.00	13.82
9	751.89	15.00	14.00	748.11	15.00	14.00	770.54	14.77	13.97	1158.13	15.00	13.94
10	745.66	15.00	14.00				739.76	14.92	13.99	1140.12	15.00	13.98
11	714.73	15.00	14.00				718.77	14.98	14.00	1120.73	15.00	14.00
12										1098.01	15.00	14.00
13										1068.99	15.00	14.00
14										1027.55	15.00	14.00
15										959.56	15.00	14.00
16												

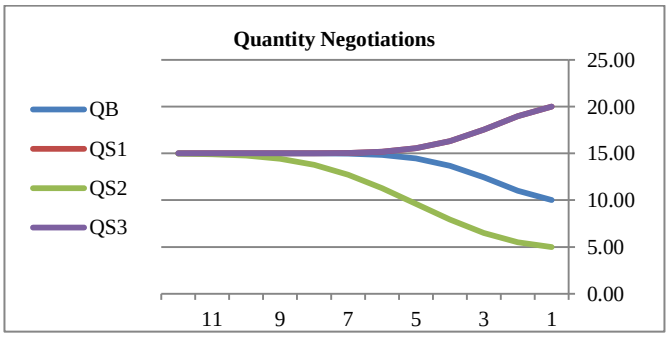

Fig. 4. Quantity Negotiation Process

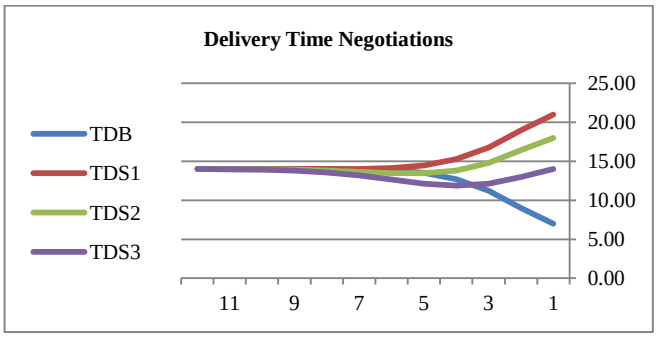

Fig. 5. Delivery Time Negotiation Process

VII. Conclusions and Future Work

In this work a description of B2C e-commerce negotiation model is presented. The primary job of this model is to conduct negotiations on behalf prospective buyers and sellers representatives. It employs multiple software agents that represent specific functional of the system and applies big data analytics. Based on analytics results, agents are able to improve their behaviors over time and take proactive and reactive negotiation actions. From that analytics knowledge, they may get better with selecting and achieving goals and taking correct actions.

The system provides the customizable user interface. Information filled in by the buyer will be stored in the buyer's profile and used for generation of the original offer. Negotiations are conducted by multiple negotiator agents with several organizations in parallel to speed up the negotiation process; the best counter-offer is selected by the agent server and presented to the buyer.

Our future research will be concentrated on developing a secure fact based e-commerce negotiation agent-based system.

References

[1] P. Braun, J. Brzostowski, G. Kersten, J. B. Kim, R. Kowalczyk, et al., "Intelligent decision-making support systems: foundations, applications and challenges", Springer, London, 2006, pp. 271-300.

[2] A. Rajpurohit, "Big data for business managers — Bridging the gap between potential and value Big Data", 2013 IEEE International Conference on Digital Object, 2013 , pp. 29-31.

[3] H. Chen, R.H.L. Chiang, and V.C. Storey, "Business intelligence and analytics: from big data to big impact", MIS Quarterly, vol. 36(4), 2012, pp. 1165-1188.

[4] K. D. Ahmadi, N. M. Charkari and N. Enami, "E-negotiation system based on intelligent agents in B2C e-commerce, advances on information sciences and service sciences", vol. 3(2), March 2011.

[5] L. Liu, Y. Ma, and C. Wen, "Multilateral multi-issue automated negotiation model based on GA", Int. Conf. on Intelligent Computation Technology and Automation, 2008, pp.85-89.

[6] K. C. Lee, H. Lee and N. Lee, "Agent based mobile negotiation for personalized pricing of last minute theatre tickets", Expert Systems with Applications, vol. 39, 2012, pp. 9255–9263.

[7] F. Matos and E. Madeira, "An automated negotiation model for m-commerce using mobile agents", ICWE'03 Pr. of the 2003 Int. Conf. on Web engineering, , Springer-Verlag, 2003, pp. 72-75.

[8] A. Kattan, Y.-S. Ong, and E.G. an-L´opez, "Multi-agent multi-issue negotiations with incmplete information: a genetic algorithm based on discrete surrogate approach", IEEE Congress on Evolutionary Computation, 2013.

[9] S. J. Hussain and M. Kumar, "Meta architecture to support layered banking systems ' In Proc. of ICET'06, Int. Conf. on Emerging Technologies, vol. 13-14, pp.754 – 760.

[10] M. I. Bala, S. Vij and D. Mukhopadhyay, "Intelligent agent for prediction in e-negotiation: an approach", Int. Conf. on Cloud & Ubiquitous Computing & Emerging Technologies, 2013, pp. 183 – 187.

[11] Rajesh and Shiv Kr. Tayal, "An intelligent multi agent framework for e-commerce using case based reasoning and argumentation for negotiation". Int. J. of Business & Man. Research, vol. 2 (6), 2012, pp. 232-243.

[12] K. Ronglong and J. Tongqiang, "E-commerce automated negotiation model research based on multi-agent", IHMSC, 2013 5th Int.. Conf. on Intelligent Human-Machine Systems and Cybernetics, vol. 1, 2013.

[13] M. Bjelica and Z. Petrović, "A framework for QoS negotiation in future mobile networks", WSEAS Trans.s on Com., 2004.

[14] K. Fu and G. Nie, "Application of particle swarm optimization algorithm in e-commerce negotiation", The 6th Wuhan Int. Conf. on E-Business — e-Business Track, 2001.

[15] G. Bruns, and M. Cortes, "A hierarchical approach to service negotiation", 2011 IEEE Int. Conf. on Web Services (ICWS), 2011, Washington, DC, pp. 460 – 467.

[16] P. Li and Y. Zhong, "A new multiple-attribute negotiation model of mobile e-commerce". ISECS '09 Proc. of the 2009 2nd Int. Symp. on Electronic Commerce and Security, Publisher: IEEE Comp. Soc., 2009, vol. 2, pp. 14-18.

[17] M. Cao, and X. Da, "Multi-strategy selection model for automated negotiation", 47th Hawaii Int. Conf. on System Science, 2014.

[18] K. Hindriks, C. M. Jonker and D. Tykhonov, "Let's dance! An analytic framework of negotiation dynamics and strategies", Web Intelligence and Agent Systems: An Int. J. vol. 9, 2011, pp. 319–335.

[19] F. H. Zulkernine and P. Martin, "An adaptive and intelligent SLA negotiation system for web services". IEEE Trans. on Services Computing, vol. 4(1), pp. 31- 43.

[20] I. Serguievskaia, H. Al-Sakran, and J. Atoum, "A multi-agent experience based e-negotiation system", Inf. and Com. Technologies, ICTTA'06, 2006.

[21] H. Al-Sakran, M. Alsudairi, and I. Serguievskaia, "Mobile e-loan negotiation architecture", J. of Internet Banking and Commerce, 2007, vol. 12(2), (http://www.arraydev.com/commerce/jibc/).

[22] T.H. Davenport, L.D. Mule and J. LuckerKnow, "analytics know what your customers want before they do", Harvard Business Review. December 2011.

[23] R.S. Sathyanarayanan, "Customer analytics –the genie is in the Detail, J. of Marketing & Communication, vol. 7(3), 2012.

[24] D. S. Putlerand and R. E. Krider, "Customer and business analytics: applied data mining for business decision making using R", Int. Stat.l Review, Aug, 2013, pp. 328-328.

[25] Earley, "Big data and predictive analytics: what's new? IT S. Professional, IEEE Computer Society, 2014, vol. 16(1), pp. 13 – 15.

[26] W.-M. Lee, and C.-C. Hsu, "An intelligent negotiation strategy prediction system", In Proc. of the 9th Int. Conf. on Machine Learning and Cybernetics, Qingdao, 11-14 July 2010.

[27] R. H. Guttman, and P. Maes, "Cooperative vs. competitive multi-agent negotiations in retail electronic commerce". In Proc. of the 2nd Int. Workshop on Cooperative Information Agents, vol. 1435, pp.135-147.