Ph.D. Dissertation of Business Administration

Offer Strategy Model of Integrative for Automated Negotiation Agent: MESOArgN

August 2019

Graduate School of Business
Seoul National University
Management Information System

Hamirahanim Abdul Rahman

Abstract

Hamirahanim Binti Abdul Rahman
College of Business Administration
Seoul National University

Automated negotiation has attracted increasing interest and received phenomenal attention in the area of the electronic market (e-market). Most of the studies on the automated negotiation focused on the distributive (zero-sum) negotiation, and their effectiveness is only illustrated in a single-issue negotiation between software agent-to-software agent interaction. In this study, we propose an offer strategy model of integrative negotiation for an automated negotiation agent and focus on software agent-to-human interaction. Our offer strategy model is based on the integrative bargaining model, which emphasize the importance of exchanging information among negotiators and multi-issue negotiation including package offers helping to achieve an integrative (win-win) outcome. In developing this model, we are incorporating the negotiation strategy of argumentation-based negotiation and negotiation tactic of multiple equivalent simultaneous offers as an offer strategy to achieve an integrative (win-win) negotiation outcome. To evaluate the proposed offer strategy, the agent negotiation was deployed and an experiment was conducted which 49 agent-human negotiation over three-issues online purchase task. Experiment result indicates that the proposed offer strategy with agent negotiation can enhance the persuasiveness of an offer and performance of negotiation outcome (human counterpart's perception toward negotiation process, opponent – agent and desire for future negotiation). The finding confirms the effectiveness of the proposed design and demonstrates an innovative e-commerce transaction.

Keywords: Automated negotiation, software agent, integrative negotiation, argumentation-based negotiation, multiple equivalent simultaneous offers, offer strategy

Student Number: 2014-31420

Table of Contents

List of Figures

List of Tables

List of Abbreviation and Terminology

ABN	Argumentation based negotiation
Counterpart's social psychological outcomes	Buyer's perception on the negotiation performance
Human negotiator	Buyer
MESO	Multiple Equivalent Simultaneous Offers
MESOArgN	Multiple Equivalent Simultaneous Offers and Argumentation
SO	Single Offer
SOArgN	Single Offer and Argumentation
Software agent negotiator	Seller
Opponent	Seller (who another party in negotiation)

Chapter 1. Introduction

1.1. Study Background

Negotiation is a method by which individuals settle differences. It is a pervasive activity and arises in areas of professional lives (e.g., business, government, non-profit organization, legal proceedings, and nations) and private lives (e.g., parenting and everyday life as well). Negotiation is a process by that compromise or agreement is reached, whereas avoiding disagreement and dispute. According to the definition by Carnevale & Pruitt (1992) negotiation as a procedure for resolving opposing preferences between parties, which involves with the goal of reaching an agreement.

Negotiation theorists usually distinguish between two types of negotiation: (i) distributive negotiation, and (ii) integrative negotiation (Walton & McKersie, 1991). Distributive negotiation also is known as win-lose bargaining because of the assumption that one person's gain is another person loses. It is operating under the zero-sum condition and implies that any gain one party makes is at the expense of the other and vice versa. In a distributive negotiation, each side often adopts an extreme or fixed position, knowing it will not be accepted and then seeks to cede as little as possible reaching deal. Distributive bargainers conceive of negotiation as a process of distributing a fixed amount of value. The ultimate aim, under distributive negotiation, is not to come win-win kind of situation but the one side wins as much they can. Both parties will try to the maximum share from the asset or resource which needs to be distributed. Distributive negotiation examples include haggling prices on an open market, including the negotiation of the price of a car or a home.

Second type of negotiation is integrative negotiation also known as win-win negotiation. An integrative negotiation involves a scenario where the interests or objective of each negotiator is not mutually exclusive. This negotiation contains more than one interest or objective. An integrative negotiation allows the negotiators to be creative in the negotiation process and create new or additional value for both parties. It is often involving a higher degree of trust and the formation of a relationship. It can also involve creative problem-solving that aims to achieve mutual gains. An integrative negotiation approaches as a shared problem-solving rather than a personalized interest and insists upon adherence to objective, principled criteria as the basis for agreement. In theory, an integrative negotiation allows for an optimal outcome for all parties without leaving any potential values unclaimed, long term relationship, and a mutually satisfactory outcome that benefits everyone involved. A common example of integrative bargaining is a situation in expanding pie model whereby, if both parties work together to get a bigger pie, then both can have more with the same percentage division.

1.2. Purpose of Study

Negotiations are complex phenomena that are evident from many different scientific disciplines that deal with negotiation problem from very different perspectives (Vetschera, 2013). It is often difficult for human negotiators to identify and make trade-off necessary to reach optimum outcomes due to their limited information processing capacity and capability, cognitive biases, and social-emotional obstacles (Yang, Singhal, & Xu, 2009). Hence, negotiation underwent a paradigm shift from the traditional method, such as face to face negotiation, to automated negotiation that implements artificial intelligent knowledge. Besides that, the paradigm shift was also due to the rapid growth of electronic markets (e-markets) requiring an enhancement entity that can assist human business decision-makers.

Another factor contribute is the adoption of a number of interactive web-based technologies, each has its respective limitation to meet the need for mass customization (Yang, Singhal, & Xu, 2012); as example the marketing and manufacturing technique that combines the flexibility and personalization of customer made product with low unit cost.

Automated negotiation is defined as a form of interaction in which a group of agents with conflicting interests and desire to cooperate try to come to a mutually acceptable agreement on the division of scarce resources (N.R. Jennings et al., 2001; Rahwan et al., 2003). Automated negotiation provides several benefits to e-markets. The benefits are (1) automated negotiation can decrease transaction cost associated with the human operation, (2) automated negotiation can increase the efficiency of settlement even for semi-structured, multi-issue business bargaining problem, and (3) automated negotiation can minimize some negative aspects of human negotiation, such as avoiding face to face encounters with people who are uncomfortable with "bargaining" (Yang et al., 2009). Unfortunately, a poorly designed automated negotiation agent will not be able to deal effectively with a skillful human counterpart adopting flexible strategies (Yang et al., 2009). The designing of the automated negotiation agent for the agent-to-human negotiation is entirely different from agent-to-agent negotiation (Lin & Kraus, 2010). It is due to the external factors such as negotiation issues, rules, and environment that are often predetermined (Yang et al., 2009).

We aim at setting up a research agenda on an enhancement offer strategy model of the integrative negotiation. The offer strategy model is based on the multiple equivalent simultaneous offers of automated negotiation agent for software agent-to-human negotiation. According to social-psychological analysis, a negotiator can be more persistent and persuasive on the value of an offer using the multiple equivalent simultaneous offers technique (Yang et al., 2009). Therefore, we are

interested in studying on the additional element that can be incorporated with multiple equivalent simultaneous offers, which make the offer more persuasive and attractive. Two research questions are proposed:

1) *Is the approach of MESOArgN strategy enhance the persuasiveness of an offer?*
2) *Will the approach of MESOArgN strategy enhance the outcome of negotiation?*

We plan to implement the offer strategy model of integrative negotiation into the decision algorithms that are programmed in the automated negotiation agent. Then, we will do an experiment of the automated negotiation agent in the e-market environment and test its capabilities.

1.3. Previous Study

Numerous studies have been done in automated negotiation. Most of the studies focused on the distributive (zero-sum) negotiation, and their effectiveness are only illustrated in single-issue negotiation (Yang et al., 2009). A single-issue negotiation is the negotiation situation with only one winner, whereby the negotiators will push for a settlement close to the counterparts' resistance point and claim the largest part of the settlement (Faratin, Sierra, & Jennings, 1998; Lee & Chang, 2008; Walton & McKersie, 1991; Yang et al., 2009; Zeng & Sycara, 1998). Second, past studies primarly focus on an agent-agent negotiation context, whereby involvement human as counterpart is lacking in system design and evaluation of agent strategies (N.R. Jennings et al., 2001; Lin & Kraus, 2010; Yang et al., 2009; Yang et al., 2012) . Third, existing study focus on agent design often make assumption about the availaibilty of the past negotiation history (Faratin, Sierra, & Jennings, 2002; Lau, Wong, Li, & Ma, 2008; J. R. Oliver, 1996; Yang et al., 2012; Zeng & Sycara, 1998). Lastly, previous research address the information asymmetry

issue in agent-agent negotiation and using a variety of machine-learning techniques to make inferences about counterparts, including their resistance points, preference, and possible tradeoffs (S Shaheen Fatima & Wooldridge, 2001; Lin, Kraus, Wilkenfeld, & Barry, 2008; Yang et al., 2012).

Chapter 2. Literature Review

2.1 Negotiation

Negotiation can be straightforward and ordinary such as bargaining over a price in the market or deciding on a meeting time or venue; or it can be complex and extraordinary such as involving international disputes and nuclear disarmament issue that affect the well-being of millions (Lin & Kraus, 2010). It is a pervasive activity and arises in areas of professional lives (e.g., business, government, non-profit organizations, legal proceedings, and nations) and private lives (e.g., parenting and everyday life) as well. Negotiation is a procedure for resolving opposing preferences between parties, which involves discussion between parties with the goal of reaching an agreement (Carnevale & Pruitt, 1992; Pruitt, 1981). Negotiation has also been defined as a process that involves decision making in a conflict between two parties while working together to achieve a satisfactory outcome (Johnson & Cooper, 2009). It is a complex phenomenon that is evident from many different scientific disciplines that deal with negotiation problem from very different perspectives (Vetschera, 2013).

The negotiation process is not an easy task as it may demonstrate the complexity of negotiation and the modeling of the environment (Lin & Kraus, 2010) to reach the negotiation successful. The negotiation successful is critical to the negotiator. Unfortunately, the human negotiators are often difficult to identify and make trade-off necessary to reach optimum outcomes due to their limited information processing capacity and capability, cognitive biases, and social-emotional obstacles (Yang et al., 2009). The approach of artificial intelligent

provides methods to transform from human-human negotiation to automated negotiation by implements the usage of agent-based modelling. The transformation is also significant due to the rapid growth of electronic markets (e-markets) requiring an enhancement object that can assist human business decision makers.

Automated negotiation is defined as a form of interaction in which a group of agents with conflicting interests and desire to cooperate try to come to a mutually acceptable agreement on the division of scarce resources (N.R. Jennings et al., 2001; Rahwan et al., 2003). Automated negotiation research can be considered dealing with three research stream; negotiation protocols, negotiation objects and, agents' decision making model (N.R. Jennings et al., 2001). Negotiation protocol refers the flow of information between negotiating parties and it's bound with the set of rules by which negotiating parties must abide (N.R. Jennings et al., 2001). Meanwhile, the negotiation object is the scope of issue or item over which agreement must be reached (e.g.: price) (N.R. Jennings et al., 2001). Lastly, agents' decision making is the decision making object the participants employ to act in line with the negotiation protocol to achieve their objectives (N.R. Jennings et al., 2001). The formalization of automated negotiation has been started since 1980's from multi-agent community (Lomuscio, Wooldridge, & Jennings, 2003). Automated negotiation significantly can decrease transaction cost associated with the human (Yang et al., 2009) and may increase the efficiency of negotiation time and settlement (Lomuscio et al., 2003; Yang et al., 2009). It is also can eliminate some of the uncommunicativeness and unnecessary of humans' behavior during the negotiation (e.g., personality, offended) (Lomuscio et al., 2003) and undesirable outcome from negotiators point of view (Rosenschein & Zlotkin, 1994).

2.2 Software Agent

A software agent is a goal-oriented computer program that reacts to its environment and runs continuously without any direct supervision or human intervention to perform some task for its user. It represents an evolutionary phase beyond the conventional computer programs. Because of the prolonged successful research in this field, "agent" can have a number of definitions:

i. An agent is a persistent software entity dedicated to a specific purpose (Smith, Cypher, & Spohrer, 1994);
ii. An agent is a software entity that can be delegated a task (Janca, 1995; P. Janca, 1995);
iii. An agent is a computer program that implements autonomous and goal-oriented activity to achieve the objective of a particular task on behalf of authority (Nwana, 1996)
iv. An agent is defined as a component of software or hardware that is capable of acting rigorously ignored to accomplish tasks on behalf of its user (Nwana & Ndumu, 1998);
v. An agent is a self-contained program competent in analyzing its own decision-making and reactions based on its own observation of the current environment in achieving one or more objectives (Nicholas R Jennings & Wooldridge, 1995).

The first concept of an agent was introduced by J. McCarthy and G. Selfridge in the mid- 1950s. They proposed a "soft robot," computer software that has a goal, carries out tasks, and seeks feedback from humans (Ehlert, 2001). Later, Hewitt refined the concept of an agent as "a self- contained, interactive, and concurrently executing object, possessing internal state and communication

capability" and introduced a new term "actor" (Hewitt, 1977). Research on agents began in the 1970s (Nwana, 1996) and became a major research topic in the early 1990s (Unland, 2015). It has attracted researchers from not only the computer science discipline but also other research disciplines such as control engineering, psychology, sociology, and biology (Unland, 2015). Over three decades, research on agents has been dismissed due to the demands of dynamic and open environments and the complexity of tasks (Mostafa, Ahmad, Mustapha, & Mohammed, 2017). Agents are increasingly used in a wide range of information system applications. They are ideally suited for process and workflow automation, distributed problem solving, electronic commerce, and internet application.

Research on agent have begun since 1970s (Nwana, 1996) and become a major research topic in early of 1990s (Leitão & Karnouskos, 2015). It is not only attracted the researchers from computer science discipline, but also attracted other research disciplines such as control engineering, psychology, sociology and biology (Leitão & Karnouskos, 2015). There were several definitions of agent that be defined; (1) agent is a persistent software entity dedicated to a specific purpose (Smith et al., 1994), (2) agent as a simulation of computer program regards on human relationship by doing something that another person could do on behalf of you (Selker, 1994), (3) agent as software entity that can be delegated the task (Janca, 1995), (4) agent as computer program that implement autonomous and goal-oriented to achieve the objective of a special task on behalf of authority (Nwana, 1996). To capture these various of definitions, we used definition by Nwana & Ndumu (1998) and Jenning & Woolridge (1996). Agent is defined as a component of software/or hardware that is capable of acting rigorously in order to accomplish tasks on behalf of it user (Nwana & Ndumu, 1998) and a self-contained program competent of analyzing its own decision making and reaction based on its own observation of the current environment in achieving one or more objective (Nicholas R Jennings & Wooldridge, 1996). Agent is progressively being used in wide range of applications from the

simple application such as to email filter program to safety system and complex mission control.

2.2.1 Agent Characteristics

Nwana (1996), has identified three minimal main characteristics of agent; autonomy, cooperation, and learning (figure 1). Autonomy refers to the principle that agent is capable administrate on their own without human intervention in order to reach its goals on behalf of its representative (Nwana, 1996). Cooperation refers to work collaboration with another agent or human to execute the task in order to achieve the aim. It is impossible for agent to organize their act with cooperation, hence the cooperation is supreme for the agent to work with other agents (Nwana, 1996). To establish this cooperation, agent is required to have social ability that able to engage other components through some sort of communication and coordination (Wooldridge & Jennings, 1995). Meanwhile, learning refers to agent is capable to gain and understand the knowledge/situation based on the act and/or interact with external environment, therefore the agent can be really smart (Nwana, 1996).

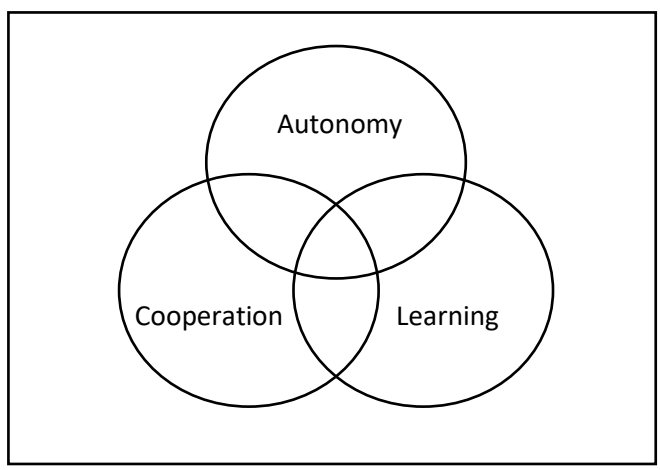

Figure 1: Agent Characteristics

Over the decade, the characteristics of agent is expended. A number of agent characteristic have been discussed and proposed in the literature. Based on the previous literature review (Nicholas R Jennings & Wooldridge, 1996; Leitão & Karnouskos, 2015; Nwana, 1996; Wooldridge, 2001) , we have compiled the agent characteristic in following table 1:

Properties	**Description**
Autonomy	An agent has capabilities to control its behaviors and administrate on their own in order to reach its goals on behalf of its representative (i.e., prioritization, task selection, goal-oriented, decision making without human intervention or external entity).
Responsiveness	An agent has capabilities to operate and react based on the context perceived from its environment. It is equipped with sensor and actuator. The use of sensor to receive the input from its environment, while the use of actuator to responds in timely manner to relevant changes. The reaction reflects it design goals in the sense that it always tries to steer toward these goals.
Proactiveness	An agent is not only responding to its environment but may proactively foresee potential changed in its environment and react to it accordingly.
Goal-orientation	An agent is capable to take initiative if there is an opportunity to work towards its goal.
Smart behavior	An agent has specific knowledge and comprehensive expertise in well-defined area. Hence, it is qualified to deal and solve the problem in the said domain. Commonly, this agent may be equipped with an internal representation of that part of the world it has to act in.

Properties	Description
Social ability	An agent is capable to interact and engage other components through some sort of communication and coordination to pursuit its goal. Agents may have to deal with unpredictable scenario; hence they may require a help from other agents. To interact and engage with other agents, they may need to collect and maintain knowledge about those agent (i.e., contact, trustworthiness, capabilities, reliability and etc.) and their connections' information
Learning capability	An agent is capable to gain and understand the knowledge/situation based on the act and/or interact with external environment. Learning is meant to be incremental, has to take the noise into account, is unsupervised, and can make use of the background knowledge provided by the user and/or the developer of the system

Table 1. Characteristic of agent

2.2.2 Type of Agents

Nwana (1996), derived the first four type of agents based on three minimal main agent characteristics. These are collaborative, collaborative learning, interface, and smart (figure 2):

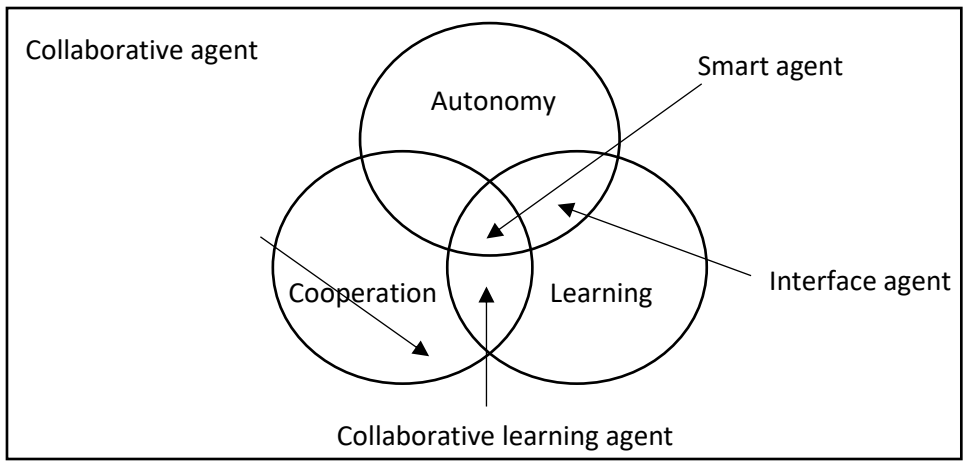

Figure 2: Types of agents

Fundamentally, type of agents be derived from the multi-dimensional space (i.e., collaborative agent derived from the autonomy and cooperation dimensional.). Unfortunately, Nwana (1996) was not use any the matrix of dimension (e.g., two or three dimensional) to classify the agent due to the classification may incomplete and inaccurate. Therefore, the classification of agent was based on the type of agent that frequently be investigated during that time. Initially, collaborative learning agent is listed as agent type, but due to limitation information of the existence, it be dropped from the list. Hence, these are seven types of agent and description as following table 2 (Nwana, 1996):

Types	**Description**
Collaborative	Emphasize autonomous and cooperate. Solve problem that are too large for a centralized single agent to do due to resource limitations or the sheer risk of having one centralized system. Allow for interconnection and

Types	Description
	interoperation of existing legacy system (application programming interface) e.g. decision support system, expert system etc.
Interface	Emphasize autonomous and learn. Support and provide proactive assistance – four ways, by observing and imitating, through receiving positive and negative feedback, receiving explicit instruction, asking other agent for advice. E.g.: calendar agent
Mobile	Software processes capable of roaming wide area networks (WANs) such as WWW, interacting with foreign host and retuning "home" with the result. E.g. simple network management protocol (SNMP)
Information / Internet	Perform the role of managing, manipulating or collating information from many distributed sources. E.g. search engine – google, yahoo, lycos
Reactive	Also known as autonomous agent. Do not possess internal, symbolic models of the environments instead respond manner to the present state of the environment in which they are embedded
Hybrid	Combination of 2 or more agent philosophies with a singular agent. Philosophies include a mobile philosophy, interface agent philosophy, collaborative agent philosophy and etc

Table 2. Types of agents

2.3 Automated Negotiation

Automated negotiation has attracted increasing interest and received phenomenal attention in areas of electronic business, web services, multi-agent systems (Yinping & Singhal, 2009). Beside the electronic business, these are the most promising application fields for automated negotiation; electronic trading of financial instruments, distributed vehicle routing among independent dispatch centers, manufacturing planning and scheduling in subcontracting networks, and bandwidth allocation (Maes, Guttman, & Moukas, 1999). Automated negotiation is a form of interaction in which the software agents with conflicting interests and desire to cooperate and coordinate try to reach a mutually acceptable agreement through an iterative process of making offer (Faratin et al., 2002; N.R. Jennings et al., 2001; Rahwan et al., 2003). Contrast with human negotiation, in automated negotiation, software agent uses to represent the parties and will prepare the bid and evaluate offer on behalf of the parties. (Maes et al., 1999; Minghua, Jennings, & Ho-Fung, 2003).

2.3.1 Type of automated negotiation

Automated negotiation can be distinguished into three basic types, (1) human-to-human negotiation with computer-mediated (Negotiation Support System), (2) agent-to-agent negotiation and, (3) agent-to-human negotiation (Yinping & Singhal, 2009).

i. **Human-to-human negotiation with computer-mediated**

Human-to-human negotiation with computer-mediated (Negotiation Support System (NSS)) is an unique class in decision support system which emphasized the computer-based decision and

communication support to evaluate on factual discrepancy or value judgement between the negotiators (Jelassi & Foroughi, 1989; Yinping & Singhal, 2009). Earlier, the NSS is defined as computer assisted negotiation, where provide the assistance in making the decision which involves multiple decision makers (Jarke, Jelassi, & Shakun, 1987). In NSS, the autonomous agent does not have autonomy control (Yinping & Singhal, 2009) as it is only assists the human negotiator to evaluate decision by equipping detail analysis of available information and means of communication (Bui & Shakun, 2003).

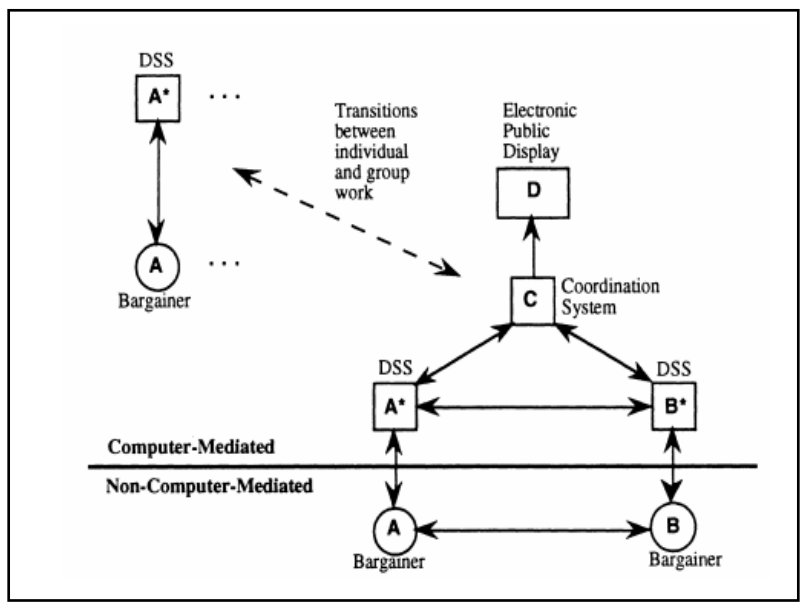

Figure 3. Conceptual configuration for NSS and face to face negotiation adaption

Figure 3 shows the conceptual configuration for NSS (Computer-Mediated) and face-to face communication (Non-Computer-Mediated) between the negotiators adaption from Francis J. Lim, Izak Benbasat (1991) and Lai-Huat Lim, Izak Benbasat (1992). In computer-mediated negotiation, the bargainers are equipped with NSS (A and A*, B and B*) and the communication with each other

may through it. The bargainers (A or B) may communicate with the group thru electronic public display – D, such as electronic blackboard or a large common screen. The electronic public display also served as information displayed for each individual NSS in a section of the screen designated as a public area. The flow of information from the bargainers to electronic public display was controlled by coordinated system – C. Apart controlling the flow information, the coordinated system is functioning to coordinate the public and private displays and supporting group decision process. At the top left of figure 1, A is represented working individually with DSS A". Between joint sessions, and also intermittently during such sessions, a participant may perform work independently with a DSS. The dashed line in figure 1 indicates the necessity in designing the user interface to make appropriate provision for the transitions between individual and group work.

ii. Agent-to-agent negotiation

Agent-to-agent negotiation is described as software agents represent for both parties of negotiators to perform negotiation process (Yinping & Singhal, 2009). These software agents have higher degree of self-determination (Faratin et al., 1998), whereby they capable to make a decision based on current its perception of its environment (Nicholas R Jennings & Wooldridge, 1996). Autonomous agents are being increasingly used in a wide range of industrial and commercial domains [2]. These agents have a high degree of self-determination - they decide for themselves what, when and under what conditions their actions should be performed. In most cases, such agents need to interact with other autonomous agents to achieve their objectives (either because they do not have

sufficient capabilities or resources to complete their problem solving alone or because there are interdependencies between the agents). The objectives of these interactions are to make other agents undertake a particular course of action (e.g. perform a particular service), modify a planned course of action (e.g. delay or bring forward a particular action so that there is no longer a conflict), or come to an agreement on a common course of action. Since the agents have no direct control over one another, they must persuade their acquaintances to act in particular ways (they cannot simply instruct them). The type of persuasion we consider is negotiation

iii. Agent-to-human negotiation

The designing of the automated negotiation agent for the agent-to-human negotiation is entirely different from agent-to-agent negotiation (Lin & Kraus, 2010). It is due to the external factors such as negotiation issues, rules, and environment that are often predetermined (Yang et al., 2009). A poorly designed automated negotiation agent will not be able to deal effectively with a skillful human counterpart adopting flexible strategies (Yang et al., 2009).

2.3.1 Automated Negotiation Research Topic

There are four classes of negotiation theories – game theory, economic models, political models and social-psychological models (Lim & Benbasat, 1992). Despite on negotiation theory that incorporate a wide-ranging of phenomena and makes use of many different approaches (e.g. from social psychology, artificial intelligent and game theory), automated negotiation research can be considered dealing with three broad topics; (1) negotiation protocols, (2)

negotiation objects or issue, and (3) agents decision making model or reasoning model (Faratin et al., 1998; N.R. Jennings et al., 2001).

i. Negotiation Protocol

Negotiation protocol refers the flow of information between negotiating parties. It's bound with the set of rules of how and when offer can be interchange, whereby negotiating parties must abide (Fukuta, Ito, Zhang, Fujita, & Robu, 2016; N.R. Jennings et al., 2001) or the negotiating process will be stopped by the system. The flow information that covers the permissible type of participants (e.g. the negotiators and any relevant third parties), the negotiation states (e.g. accepting offers, negotiation closed), the events that cause negotiation states to change (e.g. no more offers, offer accepted), and the valid actions of the participants in particular states (e.g. which messages can be sent by whom, to whom, at what stage) (N.R. Jennings et al., 2001).

Figure 4 shows an example of negotiation protocol diagram. The diagram indicates the information flow between two agents, *a* and *b*, square represent terminal states, and the double circle represent the initial state (Soh, Tsatsoulis, & Sevay, 2003)

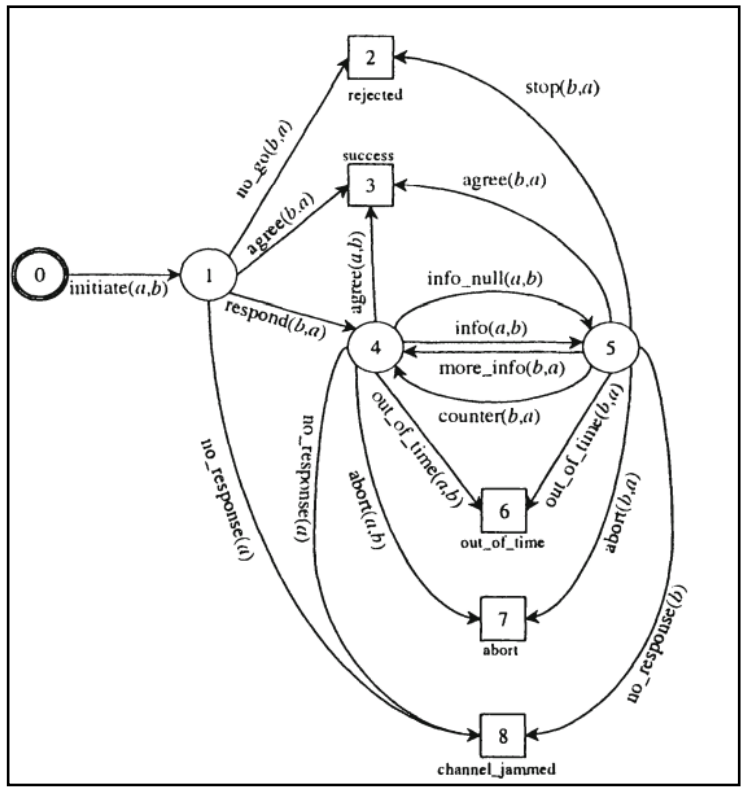

Figure 4. Negotiation protocol

State 0 is the initial state, *State 1* is the first handshake showing the initiated negotiation either the negotiation can be proceeded and vice versa, *State 4* is the initiating state, and *State 5* is the responding state. The information flow of negotiation starts at *State 0*, where *Agent a* request negotiation to *Agent b* by sending the initiate message *(initiate (a, b),* and the transition to *State 1*. At this state, there are four possibility scenario (Soh et al., 2003):

1. *Agent b* may decline the request by sending a message *(no_go (b, a))* and the final state of failure (*State 2, rejected)*
2. *Agent b* may accept to the request by sending a message *(agree (b, a))* and the final state of success *(State 3, success)*
3. *Agent b* may decide to consider the request by sending a message *(respond (b, a))* and the transition state change to *4*

4. *Agent b* not giving any respond to the request from *Agent b*, thus *Agent a* will declare no response message *(no_response (a))* after waiting for some time and change to a state of failure *(State 8, channel_jammed)*

In the scenario 3, the argumentation negotiation begins and iterates between *State 4* and *State 5*. The iteration will stop if any of sides opt out or both sides opt out or both sides agree. During the iteration, *Agent a* will provide information or argument by sending message *(info (a, b))*. If *Agent b* demands more info, its will sends message *(more_info (b, a))* to *Agent a*. And if the *Agent a* run out of argument, its will send message *(info_null (a, b))* to *Agent b*. If *Agent b* runs out of patience, its will send message *(counter (b, a)* to *Agent a*. Then, if *Agent a* agree to the counteroffer *(agree (a, b))* by *Agent b*, the transitions to the State of success *(State 3)*. During the state 4 or 5, if the both agents are run out of time, they send message (*out_of_time(a, b*)) *or* (*out_of_time(b, a*)) and the negotiation is failed (Stated 6, out_of_time). At the same state also, if any agents are not agreed with negotiation, they can simply send message to stop the negotiation (abort (a, b)) or (abort (b, a)) and the negotiation is failed (State 7, abort)).

ii. Negotiation Object or Issue

Negotiation object is the scope of issue or item over which agreement must be reached and it can be a single issue (e.g. price) or multi issues (e.g. price, quality, term and conditions, etc.) (N.R. Jennings et al., 2001). The type of operation that be performed on negotiation object is depending on the structure of agreement, and

negotiation protocol (N.R. Jennings et al., 2001). For example, the simplest agreement, whereby the content and the structure of agreement are fixed and negotiators only have two options either accept or reject on the issue of negotiation object (N.R. Jennings et al., 2001). At the next level, the content and structure of agreement are flexible, whereby the negotiator allows to change the value of the issues in the negotiation object such as the negotiator can make counter-proposal in order to fits their negotiation objective (N.R. Jennings et al., 2001). Finally, negotiators might have permission to dynamically alter the structure of the negation object by adding or removing issue depending on the negotiation situation and objective (i.e., a car salesman may offer extra a year free insurance to close the deal) (N.R. Jennings et al., 2001).

iii. Agents' decision making or reasoning model

Agents' decision making is the decision making object the participants employ to act in line with the negotiation protocol to achieve their objectives (N.R. Jennings et al., 2001). It is also known as software agent. The software agent is a component of software and/or hardware that is capable of acting rigorously in order to accomplish tasks on behalf of its user (Huang, Liang, Lai, & Lin, 2010; Nwana & Ndumu, 1998) and "a self-contained program capable of controlling its own decision making and acting, based on its perception of its environment, in pursuit of one or more objective" (Nicholas R Jennings & Wooldridge, 1996).

There are three key features of agents' decision making is the decision making that led to implementation of automated negotiation; (1) they act on behalf of other entities in an autonomous

fashion; (2) they are able to be reactive and proactive in deciding on undertaking an action; and (3) they exhibit some level of such capabilities as learning, co-operation and mobility (Kersten & Lai, 2010).

2.4 Automated Negotiation Agent

Agent that was capable of competing with other human or other agent in a negotiation. During negotiation agent exchange offer to following the alternating-offers bargaining protocol and the negotiation terminates when they make an agreement, or their negotiation deadline approaches. The negotiation agent's objective is to reach negotiation agreement to maximize its utility (An & Lesser, 2012). There are 3 main characteristics of software agent technologies that led to implementation in automated negotiation; (1) they act on behalf of other entities in an autonomous fashion; (2) they are able to be reactive and proactive in deciding on undertaking an action; and (3) they exhibit some level of such capabilities as learning, co-operation and mobility (Kersten & Lai, 2010). Unfortunately, a poorly designed the software agent will not be able to effectively deal with a skillful human counterpart adopting flexible strategies (Yang et al., 2009), which it quite different deal with another automated agent (Lin & Kraus, 2010). It is due to the external factors such as negotiation issues, rules and environment are often predetermined (Yang et al., 2009).

The three major negotiation approaches are the game-theoretical approach, the heuristic approach, and the argumentation-based negotiation approach. The game-theoretical approach usually attempts to determine the optimal strategy by analyzing the interaction as a game between participants and seeking its equilibrium (Rahwan et al., 2003). The heuristic approach is the rule of thumb that produces satisfactory

outcomes rather than optimal outcomes and is usually based on empirical testing and evaluation (Rahwan et al., 2003). Meanwhile, the argumentation-based negotiation approach allows the agent to exchange information or to argue about beliefs and other mental attitudes during the negotiation process (Rahwan et al., 2003).

Negotiation is an attractive environment for automated agent. The many benefits of such agents include alleviating some of the efforts required of human during negotiations and assisting individuals who are less qualified in the negotiation process, or in some situation, replacing human negotiators altogether. Another possibility is for people embarking on important negotiation tasks to use these agents as a training tool, prior to actually performing the task. Thus, success in developing an automated agent with negotiation capabilities has great advantages and implications. The design of automated agents that proficiently negotiate is a challenging task, as there are different environments and constraints that should be considered (Lin & Kraus, 2010)

Many of the automated negotiation agents are not intended to replace human in negotiations, but rather as an efficient decision support tool or as a training tool for negotiations with people. Thus, such agents can be used to support training in real-life negotiations, such as e-commerce and electronic negotiations (e-negotiation). The benefits are (1) automated negotiation can decrease transaction cost associated with the human operation, (2) automated negotiation can increase the efficiency of settlement even for semi-structured, multi-issue business bargaining problem, and (3) automated negotiation can minimize some negative aspects of human negotiation, such as avoiding face to face encounters with people who are uncomfortable with “bargaining” (Yang et al., 2009)

Chapter 3. Theoretical Background

3.1 Theory

Research on negotiation behavior can be conducted from one of three theoretical traditions: (i) the individual differences approach, (ii) the motivational approach or (iii) the cognitive approach (Thompson, 1990). Individual difference approach examines the types of personal characteristics that affect negotiation behavior, the negotiation process and outcome (Carnevale & Pruitt, 1992; Ogilvie, 2016). While motivational approach seeks to establish how negotiator aspirations and goals influence bargaining behavior and the resultant outcome, and cognitive approach attempts to ascertain on how individual negotiators acquire and use knowledge in negotiation (Carnevale & Pruitt, 1992; Ogilvie, 2016). Cognitive approach is grounded in information processing theory (Carnevale & Pruitt, 1992; Carroll & Payne, 1991; Thompson, 1990), which suggest that, when individuals experience events, stored information is activated in the mind and is then used to reach the next decision (Ogilvie, 2016).

3.1.1 Integrative Bargaining Model

The aim of integrative negotiation (also known as "non-zero-sum-game or win-win game") is to achieve a mutually beneficial agreement that maximizes settlement efficiency and fairness under appropriate conditions (Yang et al., 2009). Integrative approaches employ objective criteria to create the condition of mutual gain and emphasize the importance of exchanging information among the negotiators (Alfredson & Cungu, 2008). The notable

contribution of integrative bargaining model was described by Walton and McKersie. According to them, this is a negotiation approach in which negotiators employ problem-solving behavior (Walton & McKersie, 1991) that refers to a state of desire for finding a solution to the problem to reach a definite goal. Problem-solving is generally recommended to achieve an integrative settlement (Lewicki & Litterer, 1985; Rahim, 1990). Negotiators attempt to redefine the problem, analyze the cause of settlement difficulties, and explore a wide range of mutually acceptable, alternative solutions through maximum sharing of information and disclosure of each party's needs and interests (Fisher & Ury, 1983; Lewicki & Litterer, 1985; Rahim, 1990). The effectiveness of the problem-solving depends upon the presence of some psychological and information conditions, that are motivation, information and language, and trust and a supportive climate (Walton & McKersie, 1991). Motivation describes the parties must have the motivation to solve the problem, thus anticipate the problem as significant enough to take to discuss (Walton & McKersie, 1991). Information and language state that those participating in the problem-solving process must have access to the information relevant and be authorized to use it (Walton & McKersie, 1991). Meanwhile, trust and support climate is marked by encouragement and freedom to behave spontaneously without fear of sanctions (Walton & McKersie, 1991).

3.1.2 Social Judgment Theory

Social judgment theory (SJT) was proposed by Carolyn Sherif, Muzafer Sherif, and Carl Hovland in 1961. It is a framework that studies of human judgment. According to this theory, person's attitude change will be influenced by cognitive judgment process in which a proposed position is compared with a person's existing of attitude (Sherif & Hovland, 1961). Attitude change is the fundamental objective of persuasive communication

(Siero & Doosje, 1993). The theory describes the internal processes of an individual's judgment of a communicated message (Sherif & Hovland, 1961). There are three zones or latitude in SJT: (i) latitude of acceptance, (ii) latitude of non-commitment, and (iii) latitude of rejection. Latitude of acceptance describes the range of positions a person is ready to accept or agree on the communicated message (Sherif & Hovland, 1961). Meanwhile, the latitude of non-commitment is the range of positions a person feels neutral or indifferent about the communicated message (Sherif & Hovland, 1961). In another hand, latitude of rejection states the range of positions a person finds objectionable on the communicated message (Sherif & Hovland, 1961)

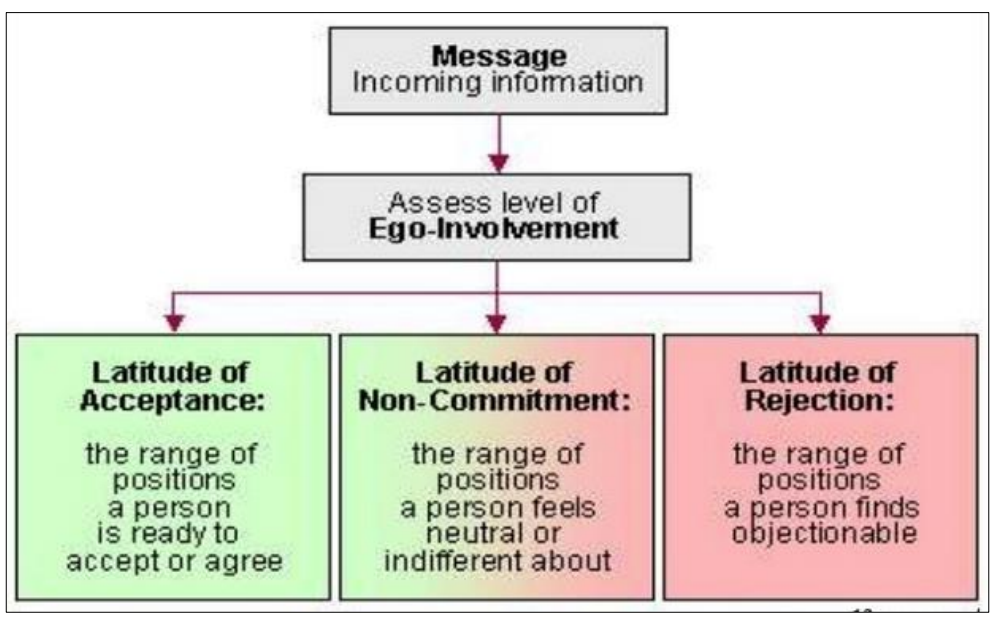

Figure 5. Social Judgment Theory

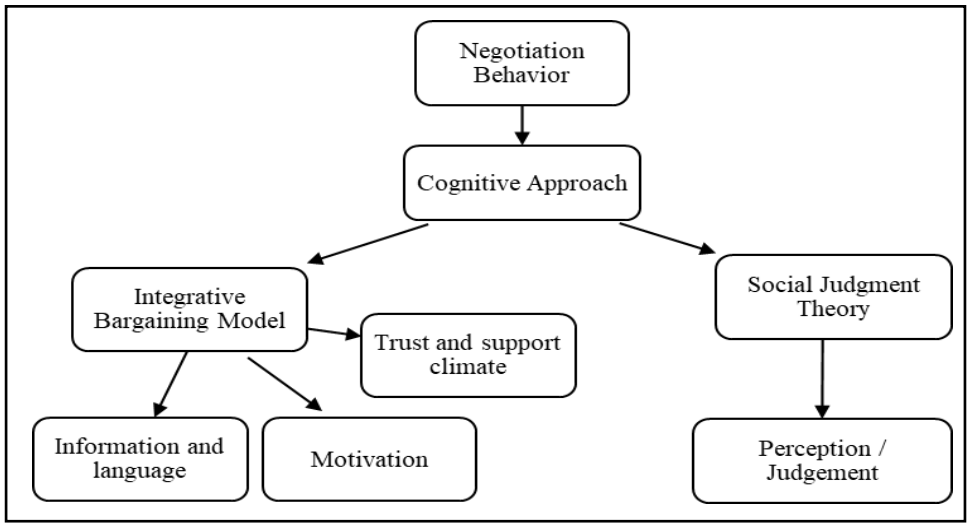

Figure 6. Theoretical background

3.2 Research Model

Underpinned by the integrative bargaining model and social judgment theory (refer to diagram 5), the context of our research model is described below in concerning (1) multiple equivalent simultaneous offers, (2) argumentation-based negotiation as an offer strategy. We created the term as MESOArgN to describe proposed offer strategy. We then describe how our expectation of negotiation outcome changes when the software agent makes that offer strategy. Additional of two research model diagram, we added another factor to our research study, that is success rate.

3.2.1 Negotiation Offer Strategy

An offer strategy is a plan of action connected to the decision of a negotiator in making offers. To achieve the integrative negotiation outcome, we propose an offer strategy model that incorporates two elements in negotiation: (1) strategy – argumentation-based negotiation and (2) tactic – multiple equivalent simultaneous offers technique. The offer strategy model is

based on the integrative approach and negotiation theory, which emphasize the importance of exchanging information among negotiators (Alfredson & Cungu, 2008) and multi-issue negotiation including package offers helping to achieve an integrative (win-win) outcome (Husted Medvec, Leonardelli, Galinsky, & Claussen-Schulz, 2005).

3.2.1.1 Multiple Equivalent Simultaneous Offer (MESO)

The multiple equivalent simultaneous offers (MESO) technique was proposed as an alternative to basic strategy – a sequential-single offer[1]. The MESO technique allows a negotiator to make multiple offers which are mutually equivalent at each round. For example, a software vendor presents three similar software packages to a client simultaneously: $1 million software package with payment in 30 days, the same software package for $1.5 million with payment in 120 days, or an enhanced software package for $1.35 million with payment in 30 days. Negotiation theory and previous research have revealed that multi-issue negotiation including package offers is superior in achieving integrative outcome (Husted Medvec et al., 2005). Prior studies have shown that people who highly value choice preferred multiple options rather than having a single alternative (Iyengar & Lepper, 2000) and suggested that integrative benefits can be achieved when both sides are using MESO (Husted Medvec et al., 2005). Furthermore, an experiment of human-to-human negotiation showed that MESO technique had better acceptance rate and improved opponent's satisfaction towards the offer (Husted Medvec et al., 2005; Yang et al., 2009).

[1]An offer strategy when a negotiator adopts a concession-based approach by starting with a tough offer, and concedes by making by offers of a lower self-utility sequentially in subsequent rounds (Yang et al., 2009)

3.2.1.2 Argumentation-based Negotiation (ABN)

Argumentation theory is the interdisciplinary study of how deductions can be reached across logical reasoning. The logical reasoning is based on claim, sound or not, and on premises[2]. It includes the arts and science of civil debate, persuasion, dialogue, and conversation (Van Eemeren & Grootendorst, 2004). Arguments constitute the major part of real-life negotiations on personal matter (e.g., a fight between family members over which TV channel to watch), up to business deal (e.g., a contract between the supplier and the retailer). In the context of negotiation, an argument is viewed as a piece of information that may allow an agent to justify its negotiation standpoint and influence another agent's negotiation standpoint (Rahwan et al., 2003). For example, in trade union dispute, an agent representing the workers' union might refuse an offer for a modified pension plan by the organization's management; as a response, the management agent might offer a different pension plan (Rahwan et al., 2003) to persuade a workers' agent to have win-win settlement because the agent can accept, reject or critique the offer. Two aspects make it necessary to incorporate arguments into the negotiation model: (1) argumentation is a tool in the negotiation for the agent to gather information and disclose information strategically to adjust its utility functions and to update its beliefs about counterpart (Lopes et al., 2014), and (2) in reality, agent frequently has limited (as opposed to zero or full) knowledge of its opponent, and argumentation is used by an agent to exchange information strategically (Lopes et al., 2014).

[2] A premises is an assumption that something is true (The Cambridge Dictionary of Philosophy, 2nd Edition).

3.2.1.3 Integrative Settlement

The aim of integrative negotiation (also known as "non-zero-sum-game or win-win game") is to achieve a mutually beneficial agreement that maximizes settlement efficiency and fairness under appropriate conditions (Yang et al., 2009). Integrative settlement employ objective criteria to create the condition of mutual gain and emphasize the importance of exchanging information among the negotiators (Alfredson & Cungu, 2008). The notable contribution of integrative negotiation was described by Richard Walton and Robert McKersie. According to them, this is a negotiation approach in which negotiators employ problem-solving behavior (Walton & McKersie, 1991). Problem-solving is generally the recommended for achieving an integrative settlement (Lewicki, Weiss, & Lewin, 1992; Rahim, 1990). Negotiators attempt to redefine problems, analyze the causes of settlement difficulties, and explore a wide range of mutually acceptable, alternative solutions through maximum sharing of information and disclosure of each party's needs and interests (Fisher & Ury, 1983; Rahim, 1990; Walton & McKersie, 1991). A supportive and trusting facilities joint problem-solving (Walton & McKersie, 1991). Building trust is absolutely essential in negotiation (Fisher & Ury, 1983) because the negotiators must have sufficient trust that other will use the information only for purposes of problem solving (Walton & McKersie, 1991).

3.2.1.4 Counterpart's social-psychological outcome

Measure the negotiation performance based on social perception concept that includes most aspects of perceivers' social worlds such as people, their behaviors, and its situation (Thompson, 1990). According to Thompson, counterpart's social-psychological outcome consists three important elements: (i) perception of negotiation situation, (ii) perception of the other party, and (iii) perception of the self (Curhan, Elfenbein, & Xu, 2006; Thompson, 1990). The first categories is perception on negotiation situation describes on the judgement and feeling about the negotiation process, for fairness and justice involve (Curhan et al., 2006; Thompson, 1990). Meanwhile, the second categories is perceptions of the other party, describes the person perception and impression formation applied to one's negotiation counterpart, for example: cooperatives and friendliness (Curhan et al., 2006; Thompson, 1990). The perception of the self, the third categories involve turning the person perception process inward (Curhan et al., 2006; Thompson, 1990).

3.3 Hypothesis Development

The objective of negotiations is to reach an outcome that satisfies both parties. Negotiation outcomes be measured by two categories: intergative settlement – to create an agreement benefical for both parties (Fisher, Ury, & Patton, 2011), and counterpart's social psychological outcomes – the subjective social perceptions held by negotiating parties following the encounter (R. L. Oliver, Balakrishnan, & Barry, 1994; Thompson, 1990).

3.3.1 Trust

Building trust is absolutely essential in negotiation (Fisher & Ury, 1983) because the negotiators must have sufficient trust that others will use the information only for purposes of problem-solving (Walton & McKersie, 1991). As such, the work can only be delegated to the designated party, if they can be trusted without there being a constant need for inspection of their work (Jonker & Treur, 1999). Trust is composed several of beliefs such as dealing with the ability (competence/intelligence), and the integrity (honesty) (Gefen & Straub, 2004). Therefore, we offer the following hypotheses:

H1a: *The human negotiator's trust in the ability of the software agent negotiator will has a positive influence to reach an integrative settlement*

H1b: *The human negotiator's trust in the integrity of the software agent negotiator will has a positive influence to reach an integrative settlement.*

3.3.2 Information

Information is crucial to problem-solving, there is a relatively great emphasis on fact-finding (Walton & McKersie, 1991). Negotiators are sharing information and disclosure of each party's needs and interest in order to find a mutually acceptable solution (Fisher & Ury, 1983; Pruit & Rubin, 1986; Rahim, 1990; Thompson, 1990). Hence, we provide the following hypotheses:

H2: *The human negotiator who provides information about his/her interest to the software agent negotiator will has a positive influence to accept the offer and reach an integrative settlement.*

3.3.3 Perception of Negotiation Situation

Perception of negotiation situation refers to a negotiator's judgments on the negotiation process and outcome, such as his/her judgment of the fairness of the process and outcome of negotiation. It also includes the view of the negotiation structure task: purely competitive, cooperative or integrative (Thompson, 1990). Cognitive psychology studies indicate that human decision maker tends to assign more positive attribution to the choice he/she made after the event of choosing (Yang et al., 20120). While, the argumentation is persuasive because the exchanges are able to alter the mental state of the agent involved (Sierra, Jennings, Noriega, & Parsons, 1997). By using the MESOArgN, we suggest the following hypotheses:

H3a: *Compared to SOArgN offer strategy, MESOArgN offer strategy will have a positive influence on the negotiation process which leads satisfaction to counterpart's social-psychological outcome*

H3b: *Compared to SOArgN offer strategy, MESOArgN offer strategy will have a positive influence on the negotiation outcome which leads satisfaction to counterpart's social-psychological outcome*

3.3.4 Perception of Other Party

Perception of other party refers to a negotiator's judgment towards his/her negotiation opponent, such as intelligence, sociability, expertise, skill, ability, cooperativeness, and competitiveness of his/her opponent (Thompson, 1990). Buyer's satisfaction with negotiation is critical, researchers found that

levels of satisfaction with an agreement may affect the cooperativeness and desired for continued contact between the parties (Patton & Balakrishnan, 2012). By using the proposed offer strategy, we posit the following hypotheses:

H4: *Compared to SOArgN offer strategy, MESOArgN offer strategy will have a positive influence on software agent negotiator's cooperativeness leads satisfaction to counterpart's social-psychological outcome.*

3.3.5 Desire for Future Negotiation

The *desire for future negotiation* refers to the negotiator's subject evaluation on the perception of negotiation situation and the perception of the other party. Satisfaction with current negotiation situation may influence the negotiator to work together in the future. By using the proposed offer strategy, we expect this following hypothesis:

H5: *Compared to SOArgN offer strategy, MESOArgN offer strategy will have the human negotiator's satisfaction with negotiation process and outcome as well as the perceived cooperativeness of the software agent negotiator is positively influence with a desire for future negotiation*

3.3.6 Settlement Ratio

Another variable that used in our study is the settlement ratio. *Settlement ratio* refers to the number of successful or unsuccessful negotiation cases over the total number of negotiation cases (Tripp & Sondak, 1992). By making the multi equivalent simultaneous offer in each round, the agent

communicates a high concern for the counterpart by increasing the likelihood that its offer appeal to the counterpart (Yang et al., 2012). In another hand, argument quality has proven to be an important factor influencing information usefulness and knowledge adaption (Sussman & Siegal, 2003). By using the MESOArgN, we propose the following hypothesis:

H6: *Compared to SOArgN offer strategy, MESOArgN offer strategy will have higher settlement ratio (success rate).*

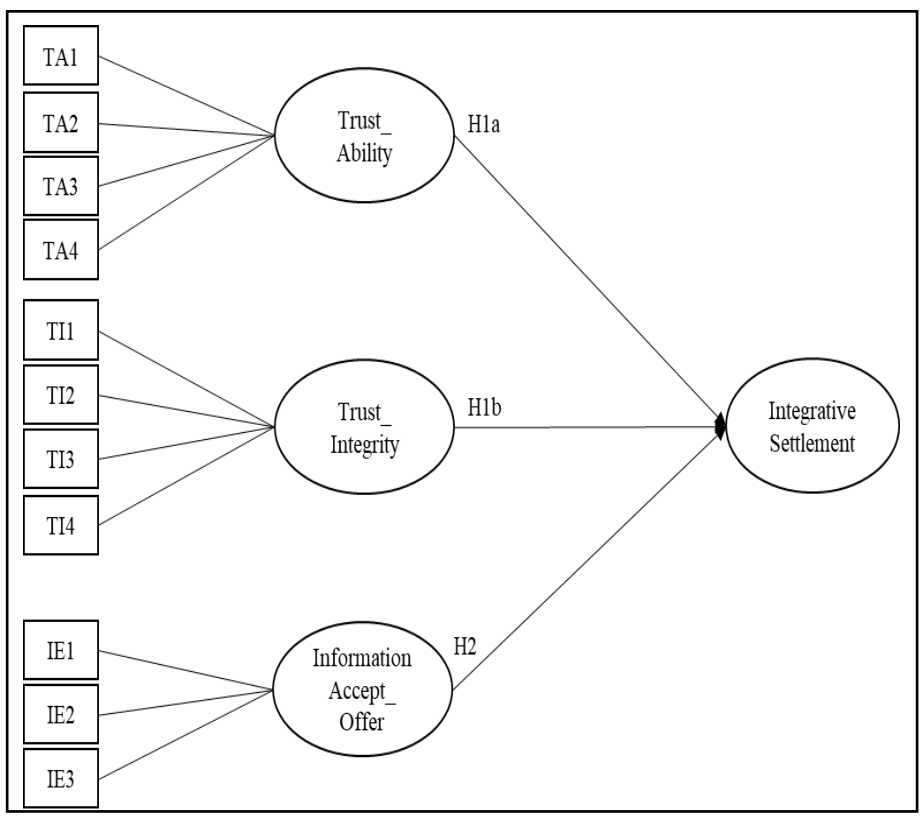

Figure 7. Research model 1 based on Integrative Bargaining Model (Walton &Mckersie, 1965)

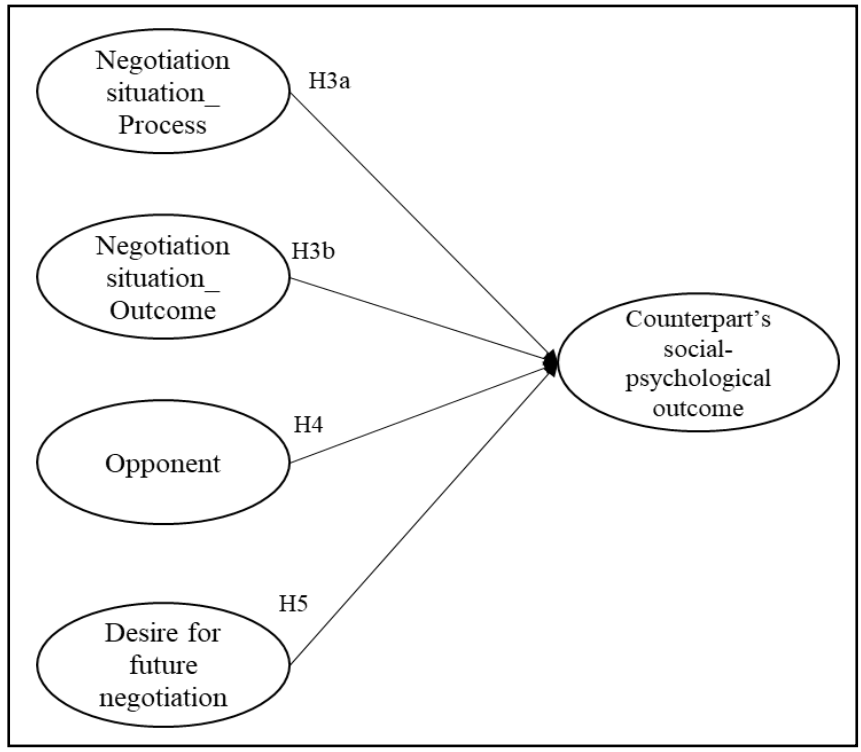

Figure 8. Research model 2 based on Social Judgment Theory (Sherif & Hovland, 1961)

Chapter 4. Methodology

4.1 Research Methodology

This study implements a design science research method. Design is a problem-solving paradigm that seeks to create innovation, define ideas, practices, technical capabilities, and products through which the analysis, design, implementation and use of the information system can be effectively and efficiently accomplished (Hevner, March, Park, & Ram, 2004). Design science research in Information Systems must produce an artifact in the form of either construct, model, method, or instantiation (Hevner et al., 2004). The research approach in this study consist of two methods:

i. Prototype/IT artifact - we developed the negotiation interface in e-commerce as IT artifact. Besides that, we will also develop a decision algorithm that is programmed in the automated negotiation agent for the software agent-to-human negotiation. The software agent represents the seller, and the human is the buyer.

ii. Laboratory experiment- an experimental study designed to test the hypotheses. The experiment is divided into three stages of procedures. The three stages are pre-negotiation, during negotiation, and post-negotiation. In the pre-negotiation stage, participants will be briefed about the general instructions and procedure of the experiment. In the second stage, the negotiation stage, the participants will negotiate with the automated negotiation agent until they reach an agreement or until the negotiation is terminated without an agreement, whereby the participants reject the automated negotiation agent's final offer. Lastly, the post-negotiation stage

occurs upon completion of the negotiation task. Participants are asked to record the negotiation settlement. During the post-negotiation, the participants are required to complete the questionnaire reflecting on their social perceptions held by negotiating parties following the encounter. This experiment is to answer our second research question.

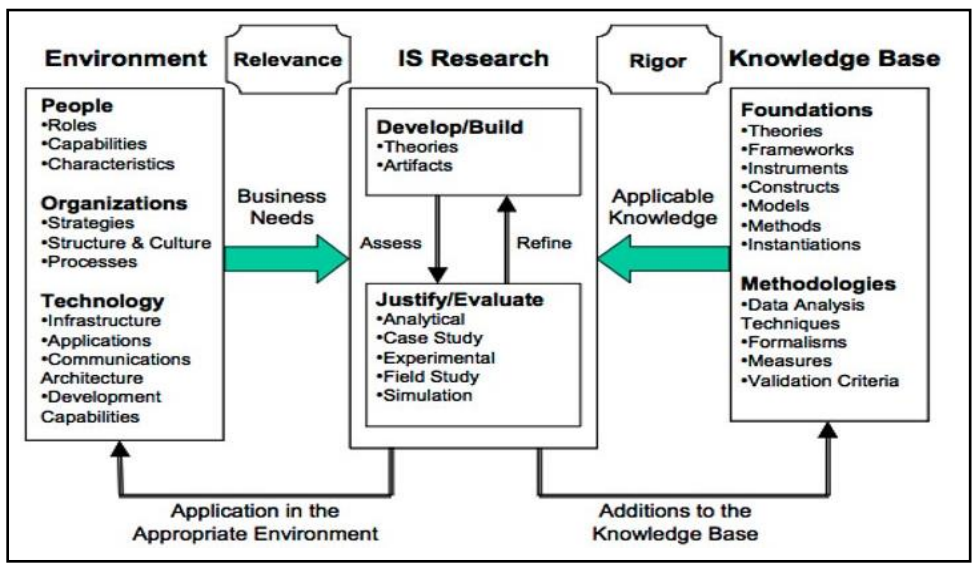

Figure 9. : Information System framework (Hevner et al., 2004)

4.2 Design – System Architecture

IT Artifact, prototype of the negotiation offer strategy and chatbot for automated negotiation agent in the e-commerce portal for the agent-human negotiation. It was developed using Php and MySQL language. The e-commerce website accessible at compute2u.name.my. The core functional components of the system include the negotiation agent that implemented the negotiation offer strategy. Another function that implemented in system is the chatbot for interaction between negotiation agent and human. The chatbot is an artificial intelligence (AI) software that can simulate a conversation (or a chat) with a human in natural language through

websites (Hill, Ford, & Farreras, 2015). The negotiation agent represented the seller and the human negotiator represented the buyer.

The negotiation process starts after the buyer selected a product and login to the website. In the negotiation offer strategy, the negotiation agent compares counteroffer utility to check if it falls within negotiation agent's accepted or rejection region. If the counteroffer falls in the acceptance region, the negotiation agent will feedback "accept". If the counteroffer falls in the rejection region, the negotiation agent will feedback "failed" and will forward the counteroffer to the administration of the website for a record for future reference and analysis. Meanwhile, the chatbot will provide an option for the buyer to choose the offer strategy before proceeding with the negotiation process. Following is the screen capture of prototype – compute2u.name.my

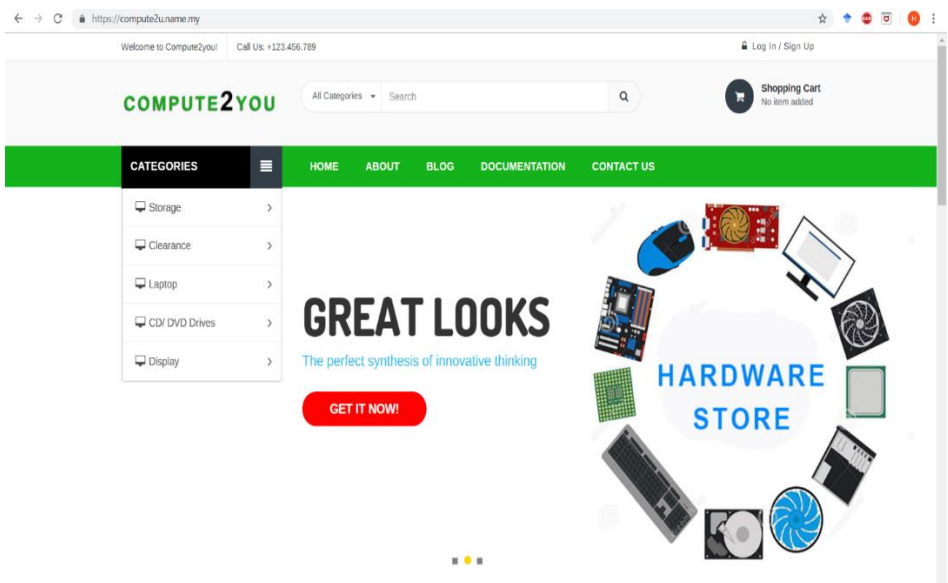

Figure 10. Main pag

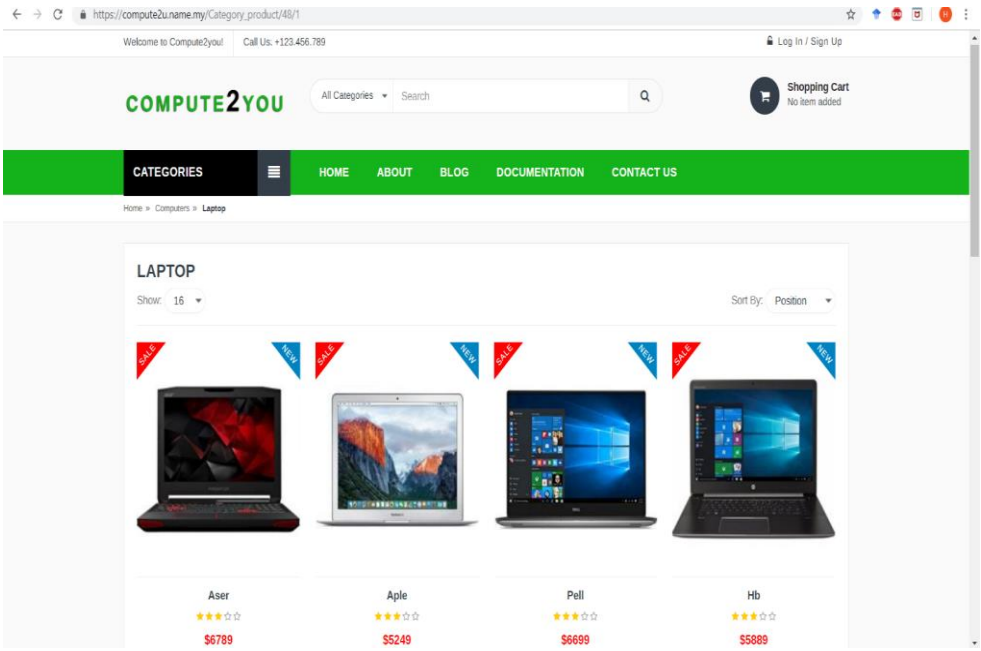

Figure 11. Laptop menu (submenu)

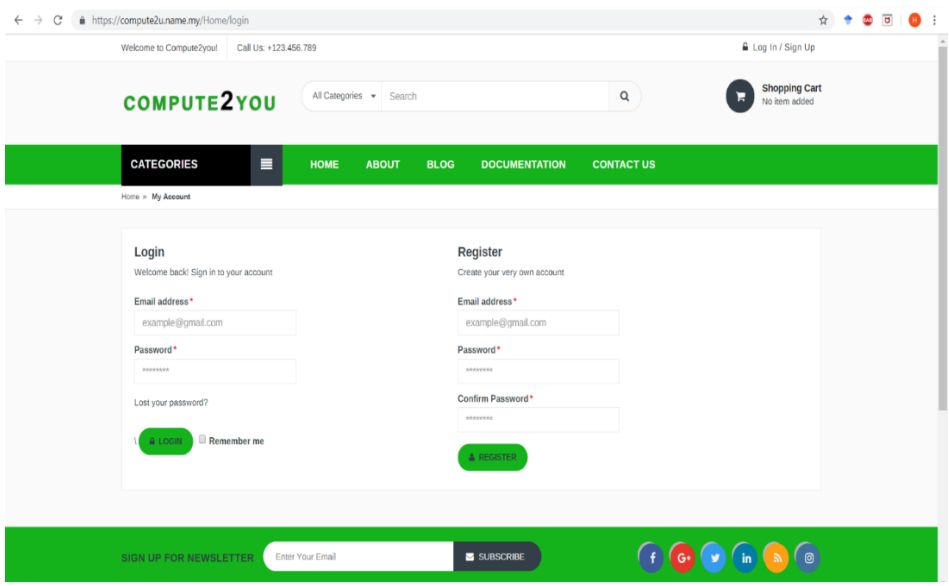

Figure 12. Login menu

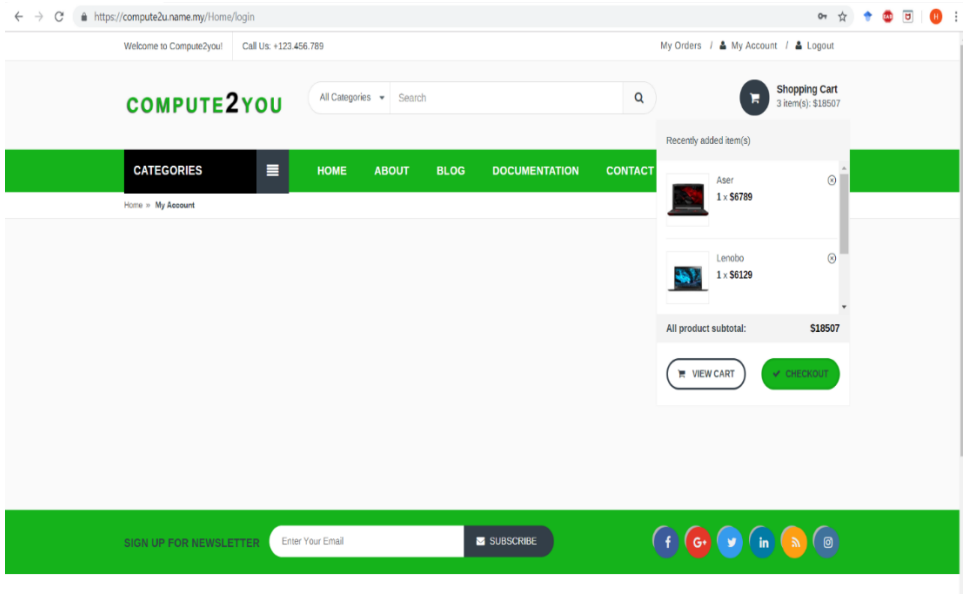

Figure 13. User menu

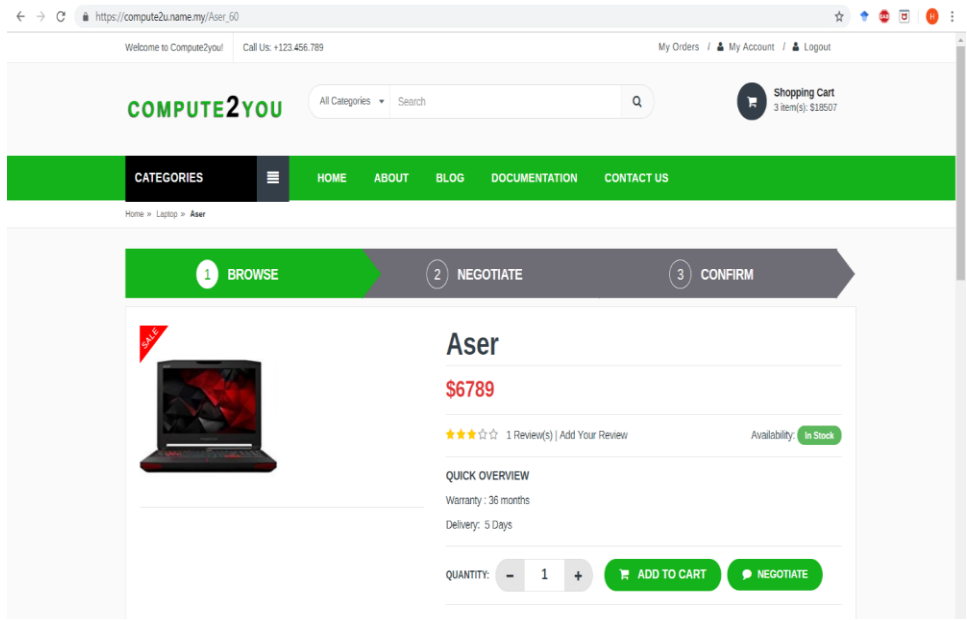

Figure 14. User's cart menu

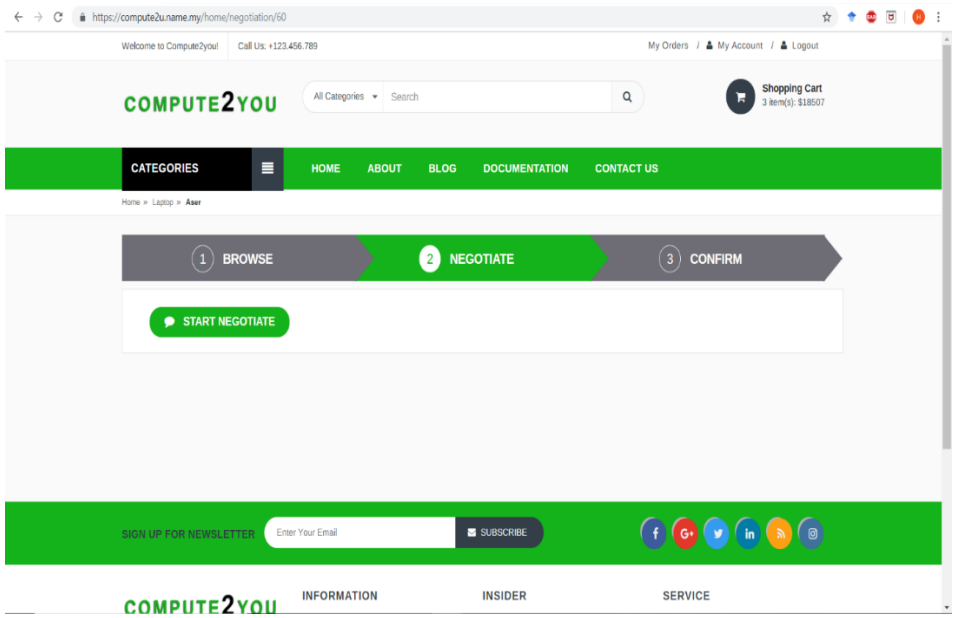

Figure 15. Negotiation page

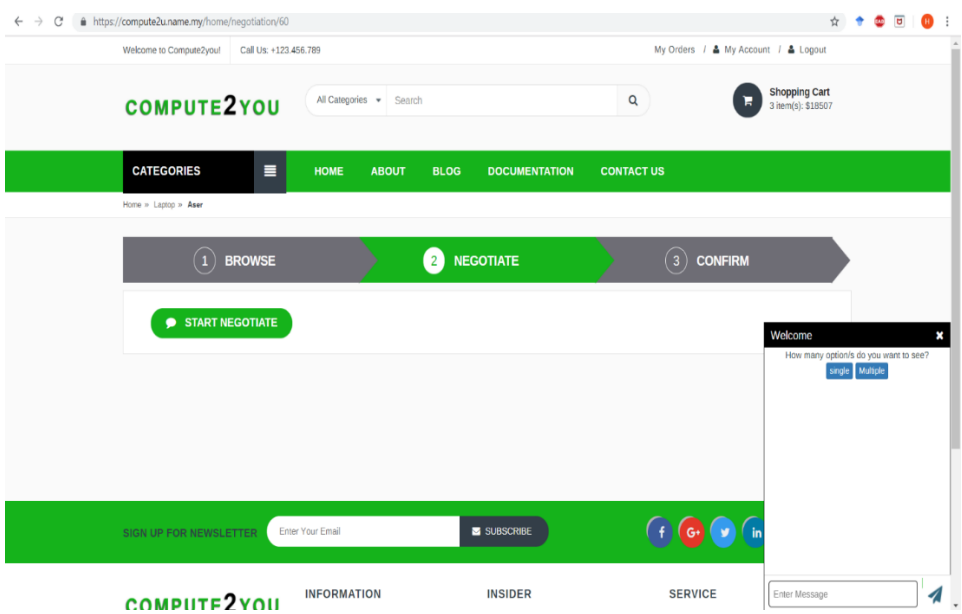

Figure 16. Negotiation page and chatbot

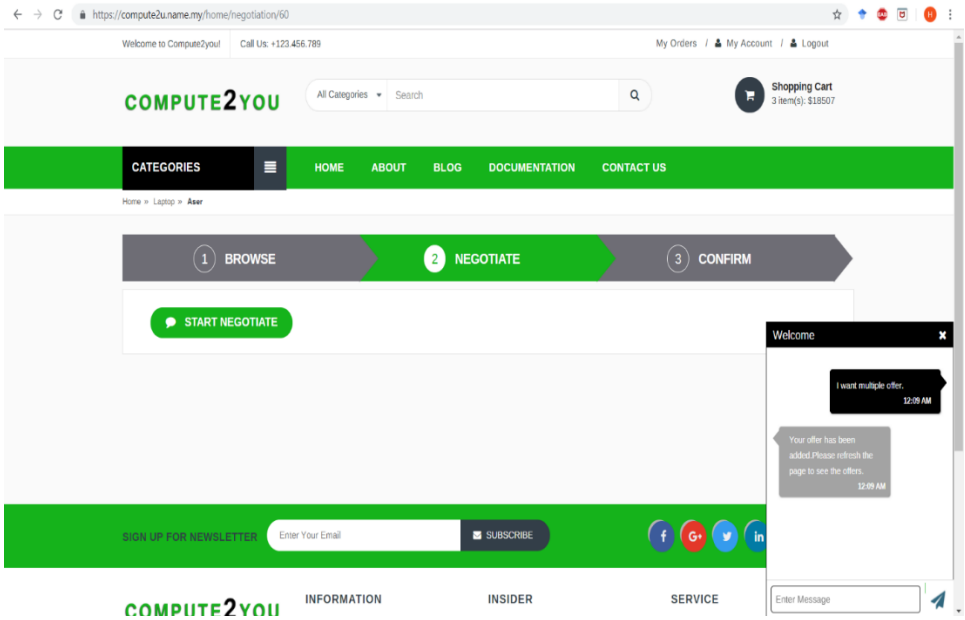

Figure 17. Chatbot

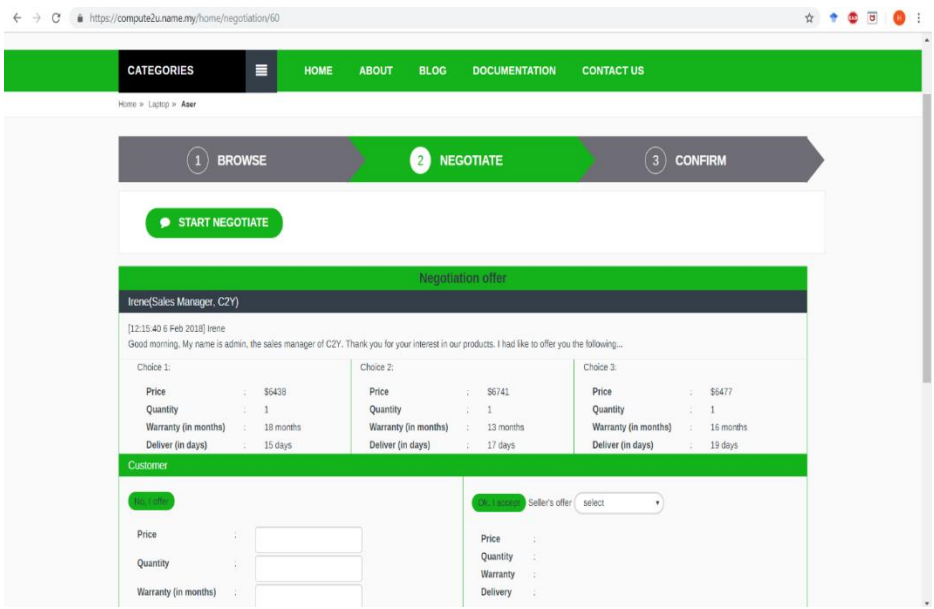

Figure 18. Negotiation page with multiple choices

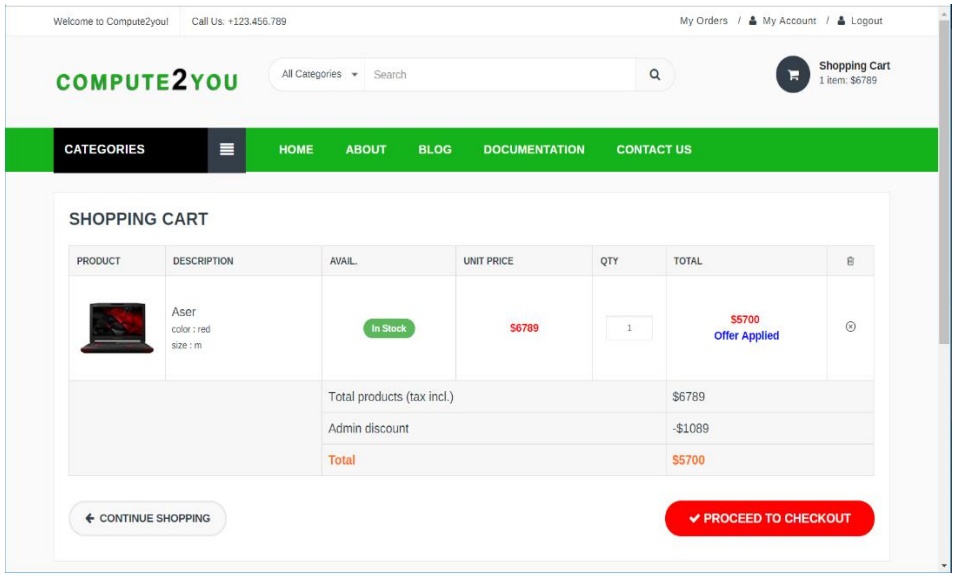

Figure 19. Shopping cart page after negotiation succes

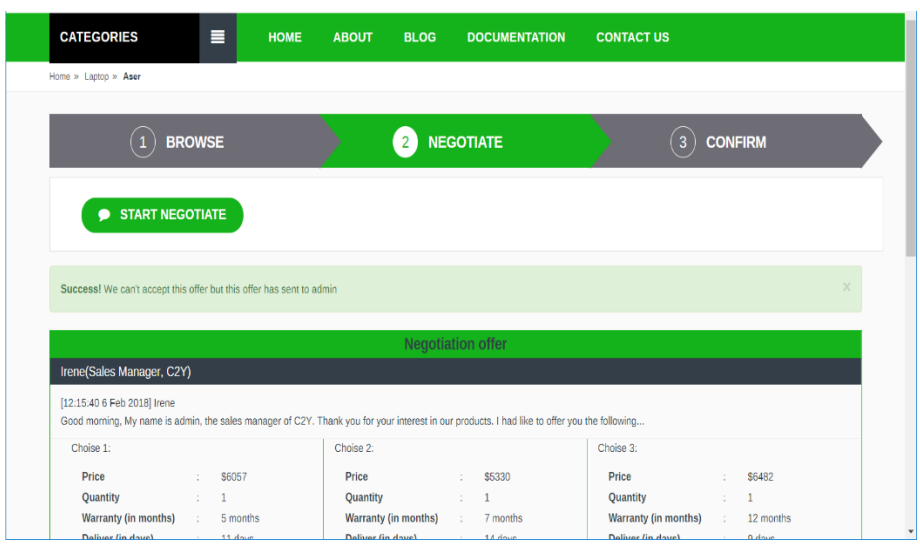

Figure 20. Unsuccessful negotiation and the buyer's offer forward to admininstration by the seller

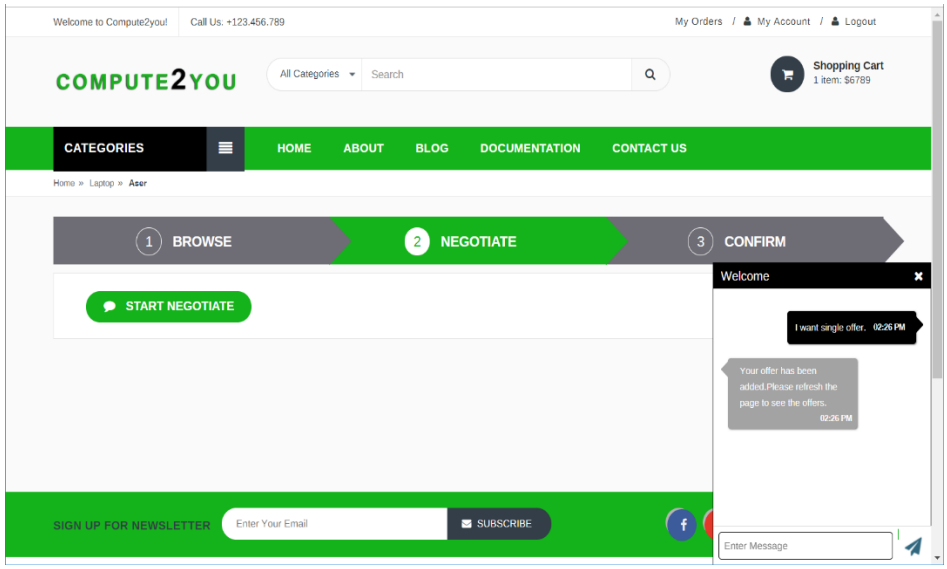

Figure 21. Single option negotiation

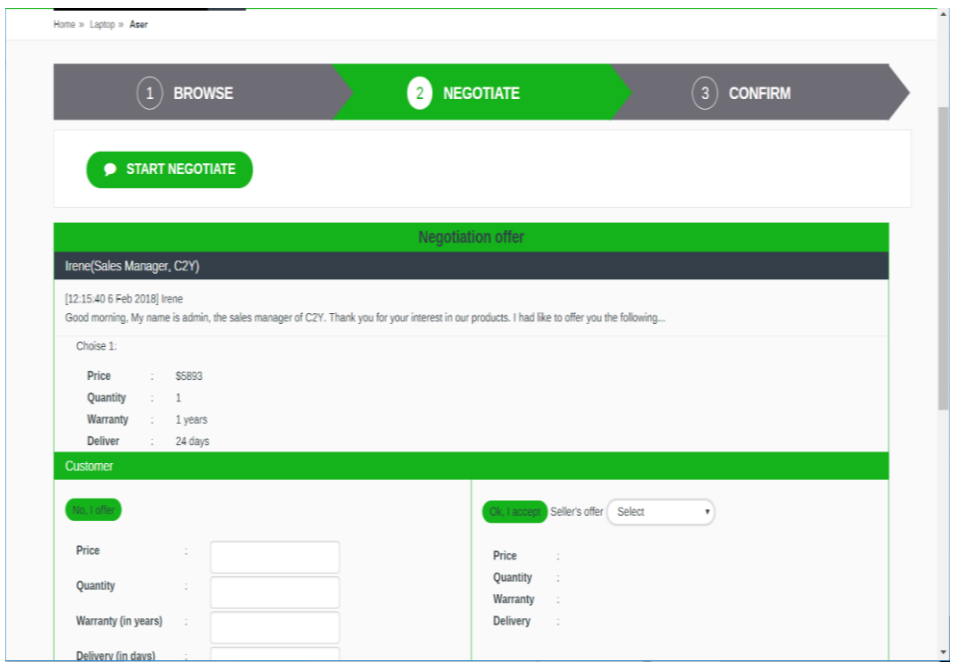

Figure 22. . Negotiation page with Single option

Following is the workflow of the prototype:

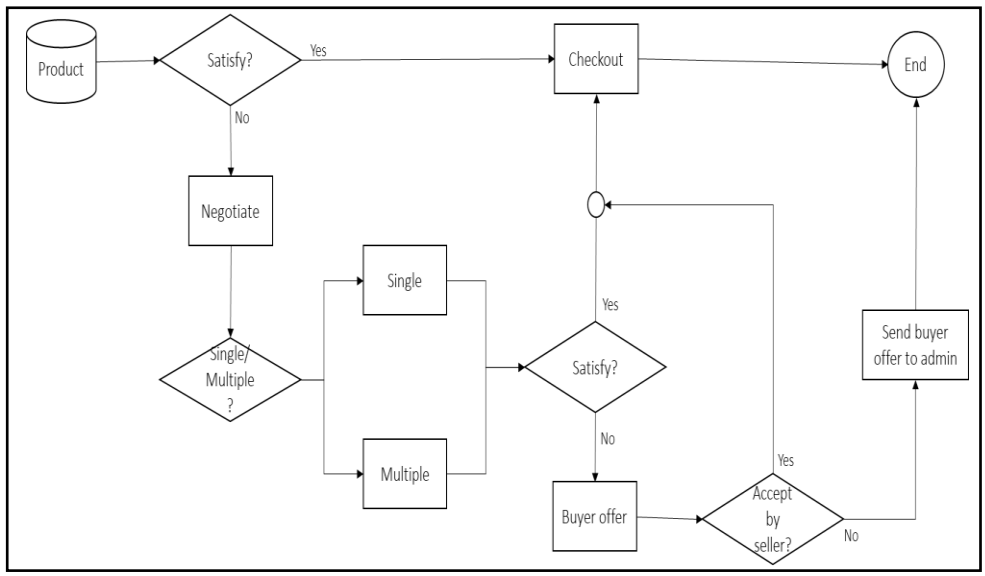

Figure 23. Prototype workflow

4.4 Design

4.4.1 Measure

To empirically validate the design hypotheses and the prototype, we conducted a 1 x 1 factorial within-subject experiment. The human subject to the role of the buyer to interact with the seller negotiation agent using the negotiation offer strategies that be designed. The negotiation offer strategies rules were reinforced by prototype and were applied to all the conditions.

A three-issues negotiation task was adapted by from the negotiation literature review. The task comprised three negotiation issues are: unit price, warranty, and delivery date. There were nine options for unit price, seven option for warranty, and four options for delivery date (table 3). Therefore, the

combination of the value options of the three issues formed a total of 9 x 4 x 3 = 108 alternatives to the final agreement.

Unit price	$6789	$6699	$6499	$6129	$5889	$5589	$5249	$5166	$4689
Warranty	36 months		24 months		18 months		12 months		
Delivery date	7 days				9 days			14 days	

Table 3. Negotiation issues

4.4.2 Material

Negotiation task, negotiation guideline, and questionnaire were developed for the experiments. A negotiation task about the online purchase of laptop with three issues comprising unit price, warranty, and delivery date. The task was simulated from a validated negotiation scenario based on real-world manufacturing contract negotiations, originally developed by Jones 1988, and used in experimental negotiation studies (Yang et al., 2009; Yang et al., 2012). The different of simulated task was used for an individual buyer instead of a buyer that represented a company.

Negotiation guideline is a reference document for the user. The document describes the broad advise (steps by steps) in following negotiation stage procedure. The aim is to streamline particular processes or procedure according to asset routine. The questionnaire, the survey was designed to generate specific responses from the participant based on their evaluation after the experiment conducted. The questionnaires divided into three sections (i) demographic survey, (ii) integrative settlement questions and (iii) social-psychological outcomes questions. We developed Likert scale survey

questions for integrative settlement and social-psychological outcome. By using 5 points of Likert scale survey question are inherently more stable and subject to less random variability than single-item measure (refer table 5).

(Code) Construct	**(Code) Items**
(TA) Trust Ability	**(TA1)** The seller is competent **(TA2)** The seller knows about the product **(TA3)** The seller knows how to match the product/offer according to my preference **(TA4)** The seller knows how to provide excellent service
(TI) Trust Integrity	**(TI1)** Offer made by seller are likely to be reliable **(TI2)** I do not doubt the honesty of seller **(TI3)** I expect the seller will keep promise they make **(TI4)** I expect the offer given by seller is their best judgment
(IAO) Information Accept Offer	**(IAO1)** The seller knows how to ask information **(IAO2)** The seller provides useful information **(IAO3)** Offer made by seller are likely according to my preference
(PNSNP) Perception of negotiation situation - negotiation process	**(PNSNP1)** Do you feel the seller listened to your wishes or preferences? **(PNSNP2)** Did the seller consider your wishes or preferences? **(PNSNP3)** How satisfied are you with the ease of reaching an agreement **(PNSNP4)** Would you characterize the negotiation process as fair
(PNSNO) Perception of negotiation situation -	**(PNSNO1)** Did you feel like forfeited or "lost in this negotiation

(Code) Construct	(Code) Items
negotiation outcome	**(PNSNO2)** How satisfied are you with the result (outcome) of negotiation?
(POO) Perception of opponent - cooperativeness	**(POO1)** Did you feel the seller was helpful during the negotiation? **(POO2)** Did you feel the seller was flexible in making an offer? **(POO3)** How satisfied are you with the seller cooperativeness during the negotiation **(POO4)** What kind of "overall" impression did the seller make on you?
(DFN) Desire for future negotiation	**(DFN1)** If there are needs in future, would you willing to interact (e.g. subscribe newsletter) with the seller in future? **(DSF2)** If there are needs in future, would you willing to negotiate with the seller in future?
(SR) Settlement Ratio	**(SR1)** Did you succeed in negotiation according to your preference or closed to your preference?

Table 4. Constructs and items measurement (Gefen, 2000; Gefen & Straub, 2004; Curhan & Elfenbein, 2006; Yang, Singhal & Xu, 2012)

4.4.3 Participant

We recruit a total of 49 participants (male = 14 and female = 35). These 49 participants likely to represent a diversity of background such as student (undergraduate = 10 and postgraduate = 5), community members = 4, and professional workers = 30. Community members and professional workers responded to email that sent to them. According to Compeau., et. al. (2012) "…is to think critically

about the aim of the study, the context of research, and the potential that they would have on the ability of the authors to meet their aims” .

4.4.4 Procedure

The experiment is divided into three stages of procedures. The three stages are pre-negotiation, during negotiation, and post-negotiation. In the pre-negotiation stage, participants will be briefed about the general instructions and procedure of the experiment. The participant also be given the procedure guideline for their reference

In the second stage, the negotiation stage, the participants will negotiate with the automated negotiation agent until they reach an agreement or until the negotiation is terminated without an agreement, whereby the participants reject the automated negotiation agent's final offer. No time limit was imposed in this stage.

Lastly, the post-negotiation stage occurs upon completion of the negotiation task. During the post-negotiation, the participants are required to complete the questionnaire reflecting on their respond to integrative settlement and their post-negotiation (counterpart’s social psychological outcomes). Demographic information was also collected for control checks

Chapter 5. Data Analysis and Result

5.1 Variable

We identified two dependent variables and eight independent variables. The two dependent variables are integrative settlement and counterpart's social-psychological outcomes. Meanwhile, eight independent variables are trust-ability, trust-integrity, information-better offer, information-accept offer, success rate, negotiation process, negotiation outcome, and cooperativeness. Following the description of each variable (table 5):

5.2 Data Analysis

5.2.1 Demographic Analysis

Demographics is a statistic about the population of particular geography which comprises an array of socioeconomic information such as gender, age, employment status and etc. (French, 2014). In this study, we seek these forty-nine (49) participants likely to represent a diversity of background to align with the participant's objective. Therefore, we did the demographic survey and analysis the input. Figure 22 shows the distribution of the gender of participants. Out of thirty-five (35), participants are female, and the remaining are male.

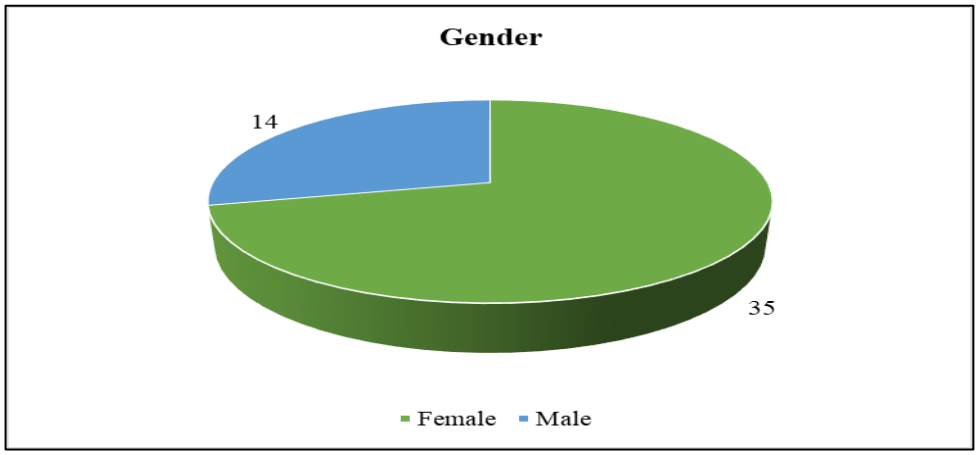

Figure 24. Gender analysis

Figure 23 demonstrations the distribution of participants' age. The biggest distribution is the age of 18 – 24, a total of 17. Followed by a range of 25 -34, a total of 16 and 35 – 44, a total of 11. The second lowest of age distribution is over 45 that only 3 participants and the lowest are the range of 25 – 44, 2 participants.

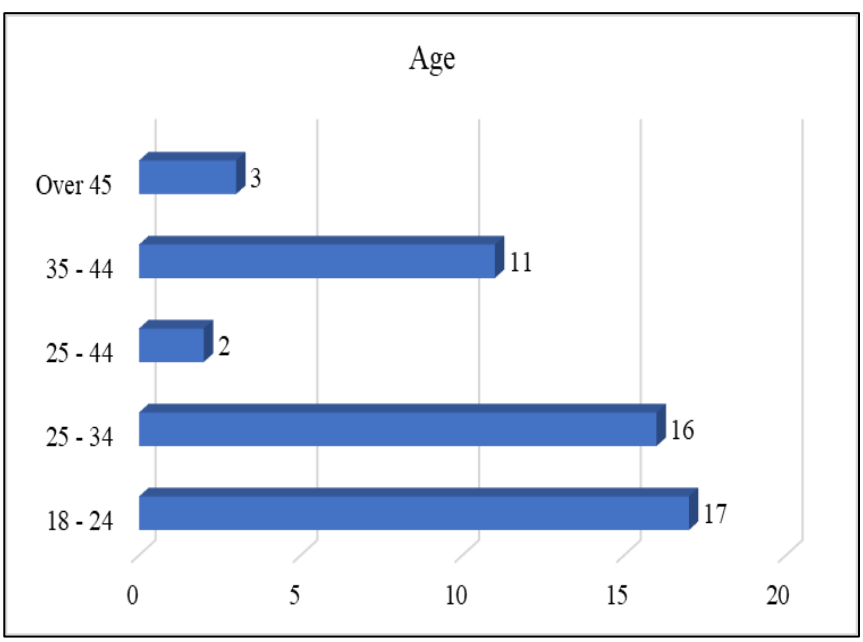

Figure 25. Age analysis

Category	Variable	Symbol	Description
Integrative settlement	Trust – ability	TA	The seller's competence in doing their task
	Trust – integrity	TI	The seller's honesty and able to complete their task
	Information – better offer	IBO	The seller's offer to the buyer based on the buyer's preference
	Information – accept offer	IAO	The seller accepts the offer from the buyer
	Success rate	SR	The percentage of success among a number of attempts (negotiation)
Counterpart's social-psychological outcomes	Negotiation process	PNSNP	The buyer's perception or judgment on the process flow during the negotiation
	Negotiation outcome	PNSNO	The buyer's satisfaction on the result of negotiation

Category	Variable	Symbol	Description
	Cooperativeness	POO	The buyer's perception or judgment on the seller's willingness to do their job
	Desire for future negotiation	DFN	The buyer's desire to continued contact with the seller in future

Table 5. Independent and dependent variable declarati

Figure 16 illustrates the distribution of participants' level of education. 21 participants hold diploma's degree, 19 participants hold bachelor's degree, 5 participants hold master's degree and the remaining are high school certificate holder.

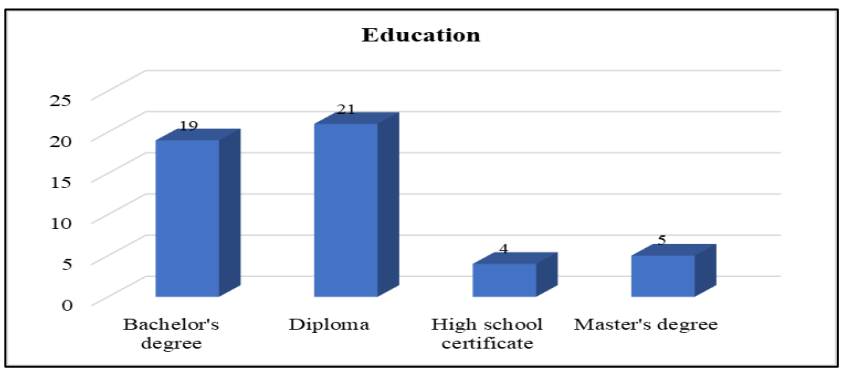

Figure 26. Education analysis

Figure 25 exemplifies the dispersal employment of participants. The highest dispersal is employed full time total of 30. The second highest dispersal is student total of 15. The rest are employed part time total of 2, fresh graduate and self-employed only 1 each.

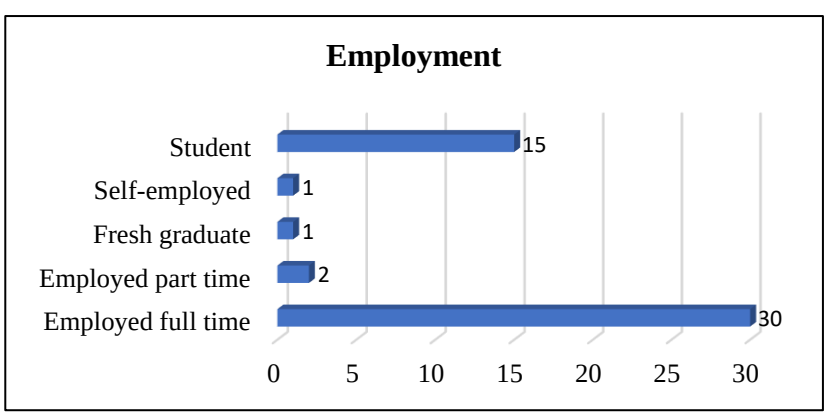

Figure 27. Employment analysis

The final question in demographic survey on “is a participant the e-commerce user?”. 38 participants answered “yes” and 11 “no”. The purpose of this question is to identify the participant is familiar with the online purchase tools.

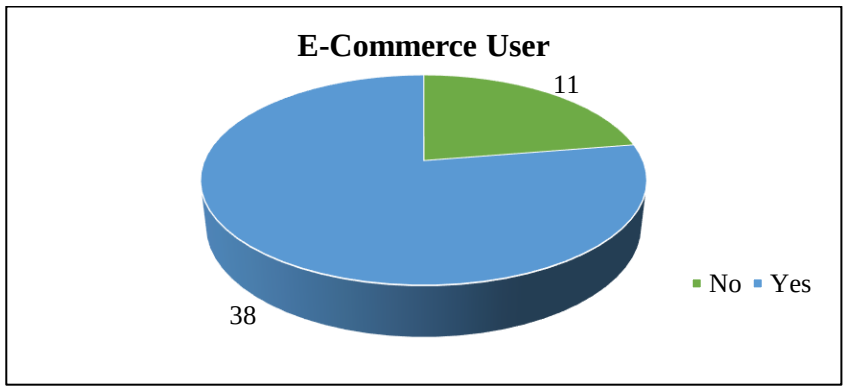

Figure 28. E-Commerce user analysis

5.1.1 Hypothesis testing

Hypothesis testing is the use of statistics to determine the probability that a given hypothesis is true. In this study, we used quantitative analysis to perform hypothesis testing. Quantitative methods emphasize objective measurement and the statistical, mathematical, or numerical analysis data collected through a various channel such as surveys, questionnaire or by manipulating pre-existing statistical data using computational techniques. By using a quantitative method, the research focus is on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon (Babbie, 2015; Muijs, 2010).

We used two analysis technique for our hypothesis testing; (i) structural equation model (SEM) and (ii) independent sample mean T-Test.

For testing the effect of the integrative settlement (H1 – H2), the results were submitted to the structural equation model (SEM) using SmartPLS. The SmartPLS becomes a good alternative when the sample size is small (SEM emphasis the relationship between independent and dependent variable that is made up of a latent variable. It is also known as casual modeling because to test the proposal casual constructs. Detail the H1- H2 results in the result section.

A compare independent sample means T-test was used to analyze our second research model (H4 – H6). The independent sample T-test compares two means of independent group in order to determine whether there is statistical evidence that the associated population means are significantly different. Our experimental design to test H4 – H6 is within-group analysis. Within-group analysis or known as repeated-measure is a type of experiment design that all participants are exposed to every treatment or condition. The significant benefit of this type of experimental design does not require a large pool of participant. Besides, it can help to reduce errors associated with individual differences because each participant serves as his or her own baseline. Please refer to the result section for H4 – H6 results.

For success rate (H3), we used a mathematical formula to calculate the success ratio. The success rate is the fraction of percentage of success among a number of attempts. The formula as following:

$$\frac{Success_n}{Attempt_n} \times 100$$

5.2 Result

5.2.1 Research Model 1: Integrative Settlement

The research model 1 of Figure 8 was analyzed using SmartPLS (v.3.2.8), a partial least square structural equation modeling (PLS-SEM) tool (Ringle, Wende, & Becker, 2015) It is soft modeling approach to SEM with no assumption about data distribution (Vinzi, Trinchera, & Amato, 2010). Therefore, the tool become a good solution for a sample size is small (Bacon, 1999; Hwang, Malhotra, Kim, Tomiuk, & Hong, 2010; Wong, 2010). It is enabling the simulation analysis up to 200 indicator variables, allowing the examination of extensive interactions among moderator and latent predictor variable indicators.

Reliability results indicates that the few of indicators need to be removed due outer loading number lower than recommended threshold value of .70 (cite). Therefore, to ensure the model reliability, we removed items TA2, T12, TI3, T14, IE1 and IS1. Then, we re-analyzed the reliability and the reliability results are given in table 6. The outer loading number and the composite reliability are exceeded to the threshold. In additional, consistent with the guideline of Fornell and Larcker (Fornell & Larcker, 1981), the average variance extracted (AVE) for each measure exceed .50, composite reliability (CR) exceed 0.7 (Gefen, Straub, & Boudreau, 2000), cronbach's alpha exceed 0.7 (Nunnally, 1978). Table 7 reports the discriminant validity of the measure scale result. The element in the matrix diagonals, represents the square roots of the AVEs, are greater in all cases that the off-diagonal elements in their corresponding row and row and column (Fornell & Larcker, 1981). Therefore, it is supporting the discriminant validity of our scale

Latent variable	Indicators	Outer loadings	Composite reliability (CR)	Average variance extracted (AVE)	Cronbach's alpha
Trust Ability	TA1	0.833	0.872	0.694	0.782
	TA3	0.793			
	TA4	0.870			
Trust Integrity	T11	1.000	1.000	1.000	1.0000
Information Accept	IE2	0.906	0.878	0.783	
Offer	IE3	0.864			
Integrative Settlement	IS2	1.000	1.000	1.000	1.000

Table 6. Reliability assessment of the measurement model

Latent Variable	Trust Ability	Trust Integrity	Information Exchange	Integrative Settlement
Trust Ability	**0.833**			
Trust Integrity	0.486	**1.000**		
Information Exchange	0.300	0.355	**0.885**	
Integrative settlement	0.551	0.292	0.422	**1.000**

Table 7. Discriminant validity (intercorrelations) of latent variable

We tested convergent validity by extracting the factor cross loadings of all indicators to their respective latent constructs. Table 8 shown the result of convergent validity. The result indicate that all items loaded: on their respective construct from a lower bound .70 to an upper 1.000, that greater that acceptable threshold of 0.5, thus convergent validity of these indicators as representing distinct latent construct is confirmed.

	Trust Ability	Trust Integrity	Exchange Information	Integrative Settlement
TA1	**0.833**	0.443	0.264	0.481
TA3	**0.793**	0.325	0.169	0.361
TA4	**0.870**	0.430	0.297	0.512
TI1	0.486	**1.000**	0.335	0.292

	Trust Ability	Trust Integrity	Exchange Information	Integrative Settlement
IE2	0.238	0.298	**0.906**	0.403
IE3	0.300	0.296	**0.864**	0.339
IS2	0.551	0.292	0.422	**1.000**

Table 8. Convergent validity - factor loadings (bolded) and cross loadings

Table 7 presents the hypothesis testing and the outcome on the relationship between trust and information exchange towards integrative settlement. One of the two trust's element, that is ability has statistically significant relationship towards integrative settlement with the path coefficient = 0.483 (standard beta (sample mean) = 0.505, standard deviation = 0.145 and t-value = 3.331). However, another element of trust, ability was founded that the relationship between ability towards to integrative settlement. The second variable that we manipulated to test its relationship with integrative settlement is information exchange. The finding shows that information exchange has statistically significant relationship towards integrative settlement with the result of path coefficient = 0.290 (standard beta (sample mean) = 0.288, standard deviation = 0.128 and t-value = 2.273). Figure 28 shows the result of measurement model.

Hypothesis	Relationship	Std Beta	Std Error	t-value	Decision	95% CI LL	95% CI UL
H1a	Trust Ability -> Integrative Settlement	0.505	0.145	3.331**	Significant	0.246	0.723
H1b	Trust Integrity -> Integrative Settlement	-0.074	0.149	0.269	Not Significant	-0.321	0.723
H2	Information Exchange -> Integrative Settlement	0.288	0.128	2.273**	Significant	0.089	0.501

n = 49, **p < .001

Table 9. Description statistic and hypothesis testing

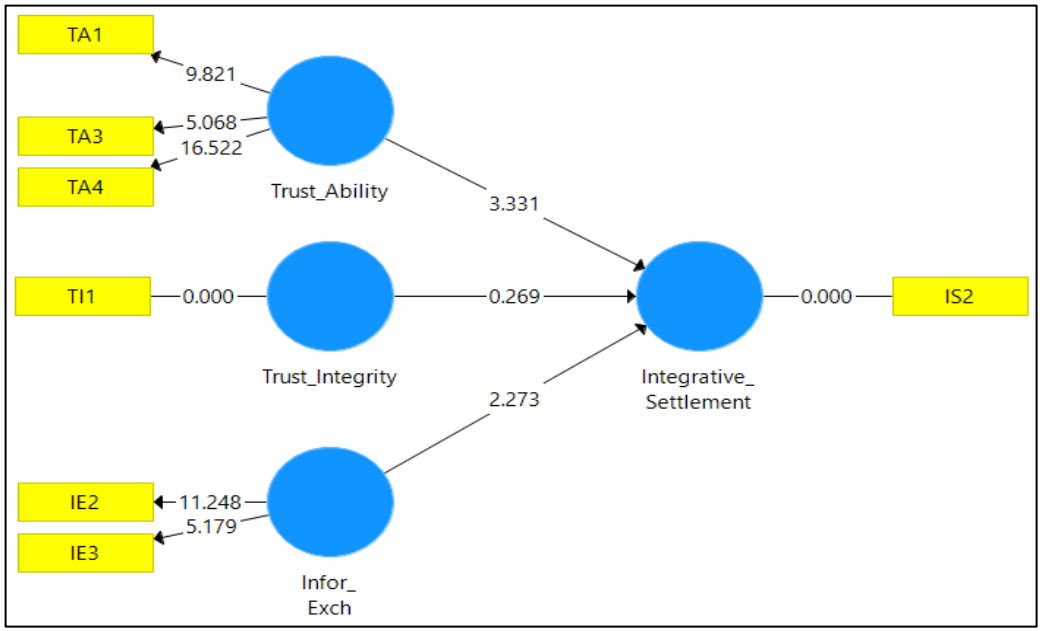

Figure 29. Measurement model result

5.2.2 Research Model 2: Counterparts' Social Psychological Outcome

We checked the reliability analysis of the subjective independent variable before hypotheses testing analysis. We analyzed the question using SPSS reliability analyze, Cronbach's Alpha. Cronbach's Alpha is commonly used to assess the internal consistency of a questionnaire that made up of multiple Likert-type scales and items. The result from the reliability analysis, Cronbach's Alpha shown current score α = .808. However, we analyze each of the items in the independent variable and found three items' score α > .808. The items are PNSNO1 and DSF1 under MESOArgN treatment; and PSNNO1 under treatment SOArgN. Therefore, we ignore four items for further hypotheses analysis. The remaining items have acceptable reliability with a Cronbach's alpha =<.0875 (please refer to table 6).

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MPNSNP1	72.51	49.088	0.291	0.804
MPNSNP2	72.41	48.830	0.306	0.803
MPNSNP3	72.35	49.940	0.257	0.805
MPNSNP4	72.59	50.205	0.188	0.808
*MPNSNO1	73.63	51.862	-0.034	0.826
MPNSNO2	72.59	48.288	0.409	0.799
MPOO1	72.65	48.648	0.338	0.802
MPOO2	72.53	47.963	0.388	0.799

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MPOO3	72.61	47.534	0.442	0.797
MPOO4	72.47	48.546	0.441	0.798
*MDSF1	72.80	50.124	0.123	0.814
MDSF2	72.41	47.830	0.392	0.799
SPNSNP1	73.53	46.046	0.567	0.790
SPNSNP2	73.53	46.546	0.567	0.791
SPNSNP3	73.45	48.461	0.428	0.798
SPNSNP4	73.53	46.838	0.534	0.792
*SPNSNO1	72.86	56.917	-0.469	0.838
SPNSNO2	73.51	46.963	0.633	0.790
SPOO1	73.55	46.586	0.588	0.790
SPOO2	73.57	47.125	0.447	0.796
SPOO3	73.47	46.379	0.644	0.788
SPOO4	73.55	47.836	0.542	0.794
SDSF1	73.61	46.867	0.430	0.797
SDSF2	73.45	47.044	0.376	0.800

Table 10. Cronbach's alpha data analysis

* the items in questionnaire been ignored for further analysis

The normality tests, Levene's Equality of Variance test also was conducted concurrently with the t-test analysis. A Levene's test verified that equality of variance in the samples (homogeneity of variance, $p > .05$) (Martin

& Bridgmon, 2012), refer to table 10. Therefore, the t-test result is enough for these hypotheses testing as the sample is a normal distribution.

An independent t-test was run of the data with a 95% confidence interval (CI) for the offer strategies (MESOArgN and SOArgN) mean different. This test to investigate the effects of offer strategies on the counterpart's social-psychological outcomes. It was found, after two interventions, the offer strategy MESOArgN were significantly higher than SOArgN (refer to table 9). The human negotiators had great satisfaction with the negotiation process (H4a) when agent negotiator using MESOArgN strategy versus SOArgN strategy ($t = 9.808$ and $p < .001$). The result of H4b ($t = 6.968$ and p-value $< .001$) also confirmed that the human negotiator has a greater satisfaction with the negotiation outcome when the agent negotiator used MESOArgN versus SOArgN as a negotiation offer strategy.

According to negotiation and marketing literature, the negotiators satisfied with the process and, outcome and have a positive evaluation towards their counterpart's cooperativeness may lead for a desire for future negotiation (Crosby, Evans, & Cowles, 1990; Yang et al., 2012). The finding shows H5 ($t = 8.821$ and p-value $< .001$) is statistically significant that human negotiator has higher perceived cooperativeness towards agent negotiator when the agent negotiator using MESOArgN strategy. As a result of H6 ($t = 6.235$ and p-value $< .001$) shows that human negotiator's satisfaction with the negotiation process, negotiation outcome, and cooperativeness with agent negotiator is highly encouraging connection with the desire for future negotiation. Table 9 shows a summary of the t-test finding.

Overall, among forty-nine (49) participants agent-human negotiation, thirty-nine (39) negotiation reached an integrative settlement and

ten negotiations ended with no settlement for MESOArgN strategy. Meanwhile, twenty-nine (29) agent-human negotiation reached the settlement and twenty (20) ended with no settlement for SOArgN strategy. Table 12 shows that the success rate is higher 79.59% when the agent used the MESOArgN strategy compare to SOArgN, the success rate is 59.18% (refer to table 7). Therefore, we concluded the H3 is statistically significant.

In addition, all abovementioned hypotheses testing, we added one questions on human negotiator's preference. The result shown forty-six (46) out of forty-nine (49) choose MESOArgN and the remaining choose SOArgN. We seek an explanation to participants that selected SOArgN as their preference as a negotiation strategy. Their response, it is difficult to select if given the multiple choices at simultaneous compared with the single option. Rather than select one of the options given, they prefer to have a negotiation on the single item till reach an agreement or settlement.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
PNSNP1	Equal variances assumed	.670	.415	9.808	96	.000	1.04592	.10664	.83425	1.25759
	Equal variances not assumed			9.808	93.894	.000	1.04592	.10664	.83419	1.25765
PNSNO1	Equal variances assumed	1.099	.297	7.487	96	.000	.91837	.12266	.67489	1.16185
	Equal variances not assumed			7.487	95.128	.000	.91837	.12266	.67486	1.16188
POO1	Equal variances assumed	.095	.759	8.821	96	.000	.96939	.10989	.75125	1.18752
	Equal variances not assumed			8.821	95.740	.000	.96939	.10989	.75125	1.18753
DSF1	Equal variances assumed	.783	.378	7.226	96	.000	1.12245	.15534	.81410	1.43080

	Equal variances not assumed			7.226	94.917	.000	1.12245	.15534	.81406	1.43084

Table 11. Independent samples test result

Hypothesis	Independent Variable	Mean (Standard Deviation)		t(df)	Sig. (2-tailed)	Decision
		MESOArgN	**SOArgN**			
H3a	Negotiation process	3.7602 (0.48670)	2.7143 (0.56596)	9.808**	.000*	Significant
H3b	Negotiation outcome	3.6327 (0.63554)	2.7143 (0.57735)	6.968**	.000*	Significant
H4	Cooperativeness	3.6582	2.6888	8.821**	.000*	Significant

Hypothesis	Independent Variable	Mean (Standard Deviation)		t(df)	Sig. (2-tailed)	Decision
		(0.52958)	(0.55792)			
H5	Desire for future negotiation	3.8163 (0.72668)	2.6936 (0.80891)	6.235**	.000*	Significant

Notes n = 49, *p < 0.05, **p < .001

Table 12. Descriptive Statistic and T-Test result of social-psychological perspective

Hypothesis	Variable	Ratio (percentage %)	
H6	Settlement ratio	MESOArgN = 79.59	SOArGN = 59.18
n = 49			

Table 13. Settlement ratio (success rate) result

Chapter 6. Discussion

6.1 Finding

McAllister (1995), defined trust as “an individual’s belief and willingness to acct on the basis of the words, actions, and the decision of another” (McAllister, 1995). Trust is important in communication between human and agent. The meaning of trust in automation is the expectation of ability or competence of the agent or system to perform their routine tasks (Muir, 1994). It has direct affect willingness of human to accept the input or output such as produced information, suggestion, and decision from the agent (Freedy, DeVisser, Weltman, & Coeyman, 2007; Hancock et al., 2011; Muir, 1994). As suggested by Walton & Mckersie, (1965) and Freedy et al. (2007), we found that element of trust, specifically the ability (Hypothesis 1a) had a positive influence effect on the integrative settlement. Besides the ability, trust is collected several of beliefs includes integrity or honesty (Gefen & Straub, 2004). In our experiment, we found that the integrity (Hypothesis 2a) did not have positive influence effect on the integrative settlement. This is might cause of the human’s dilemma of trust, that has to do with the degree to which negotiator should believe the other party (Y. Yang, Falcão, Delicado, & Ortony, 2013). Trusting anything can prompt misuse or exploitation while trusting nothing makes it difficult to accomplish an agreement (Y. Yang et al., 2013). In other words, the less the human's trust in software agent, they will intervene the process to reach an agreement (De Visser, Parasuraman, Freedy, Freedy, & Weltman, 2006; Hancock et al., 2011; Steinfeld et al., 2006).

Information exchange was significant and positive influence effect on the integrative settlement was supporting Hypothesis 2. In the integrative bargaining

model by Walton and Mckersie (1991), information exchange is essential in order to make a precise judgment and reach an integrative settlement (Walton & McKersie, 1991). Additionally, according to Walton and Mckersie (1991) "When information is low, the result will be less adequate definition of the problem; fewer alternatives will be generated; and the potential consequences of these alternatives will be generated; and the potential consequences of these alternatives will be less explored…the parties will produce relatively low-grade solutions". Thus, the more information the human negotiators shared, the chances to reach an integrative settlement is higher (Butler Jr, 1999; Thompson, 1991).

Other than significant positive influence on the integrative settlement aspects, the MESOArgN offer strategy was shown to significantly has a positive influence on the counterpart's social-psychological outcome. We tested four hypotheses (negotiation situation-process and outcome, opponent and desire for future negotiation) related to counterpart's social-psychological outcomes. The result of experiment confirmed that the proposed negotiation strategy – MESOArgN enhance the persuasiveness of an offer. Besides that, the experiment results also confirmed that the counterpart's satisfaction is higher compared with SOArgN. Negotiators who make multiple equivalent simultaneous offers discover more integrative solutions, attain more profitable results, and counterpart's favorable because of flexibility that comes with choices (Hyder, Prietula, & Weingart, 2000). Besides that, as expected the settlement ratio (Hypothesis 6) of MESOArgN offer strategy is higher than SOArgN offer strategy. Based on the experiment result, we feel there is an opportunity to employ MESOArgN strategy for human-agent negotiation into the real-world e-commerce facilitating a small size online transaction.

6.2 Implication

The experiment results have implications for negotiation theories, technological advancement, and the practice in electronic marketplaces. The first implication for negotiation theories is understanding of multi-issue negotiations and the importance of information exchange to reach a win-win situation. The approach of multi-issue negotiations is to pack all the issues and discuss them concurrently as a complete package (Shaheen S Fatima, Wooldridge, & Jennings, 2004). This situation could be complicated as overflow information. Therefore, it is crucial for both parties to trust each other's so they freedom to behave spontaneously without fear (Walton & McKersie, 1991) such sharing and exchange the information on their interest or preference.

This study presents an artifact for a software agent in agent-human negotiation. The objective is to reach a win-win situation for both parties. We deployed the artifact based on the design science research method, that is fundamentally a problem-solving paradigm (Hevner et al., 2004). In design science, the IS research cycle creates and evaluate IT artifact (Hevner et al., 2004). According to Thompson (1991), a good negotiation strategy should be effective with the most uncooperative negotiators (L. Thompson, 2005). Therefore, an evaluation of the artifact, we highlight the importance of evaluating the effects of an agent in negotiation with a real human to ensure that the human feels satisfied with the process and outcome.

Lastly, the implication of this study, the artifact potentially to be deployed in real-world e-commerce for the small business online transaction. The negotiation strategy that we configured into agent is based on more realistic assumptions of negotiation setting. Previous studies, the negotiation strategy based on negotiation history data that be manipulated using several mathematical and computing

techniques such as probability and machine-learning (Faratin et al., 1998; Lau et al., 2008; J. R. Oliver, 1996; Zeng & Sycara, 1998). Hence, the artifact can be used in open market, where involve many to many relationships between seller and buyer that the prior negotiation knowledge or negotiation history data with the counterpart is not available to the agent.

6.3 Limitation and Future Research

Despite the significant implication, several limitation issues need to be highlighted and open avenues for future research. Firstly, the proportion category of participant is not equal. Related to this limitation is the possible sample bias, the selection of a sample of other categories, student and community member. Consequences, the possible finding of this study only focused on one category. In the future, it would be better to have an equal proportion category of participant, hence the finding will be comprehensive and convincing.

Secondly, this study does not include economic perspective as one of measurement. Economic perspective can be measured using contemporary economic models of negotiation that emphasis on the prediction of optimal joint outcome. The economist, game theorist and applied mathematicians frequently examine “utility” (an economic sense of satisfaction received by negotiators from the agreement) (Yang et al., 2012).

Lastly, limitation communication on the chatbot. In this study, we emphasize the importance of exchange information between both negotiators. The exchange information occurs during the negotiation and after negotiation, whereby the proposed offer by buyer send to admin of the webpage for their future analysis. This

open to new future research that implements an advanced Artificial Intelligent (AI) technology into the chatbot. The communication between buyer and seller could be established before the negotiation stage start. Therefore, the information about the buyer's interest or preference can be directly obtained. As the implication, it provides a chance for the seller to explore the buyer's interest or preference at a faster speed based on the preliminary information given at an early stage.

6.4 Conclusion

Negotiation is a fundamental element of organizations' social lives. It is a method for addressing problems and reaching a conclusion that benefits everyone engaged in the discussion. Negotiation can be divided into two categories; distribution negotiation and integrative negotiation. In this study, we focused on the integration negotiation, whereby take all parties' wants, needs, fears and concerns into the equation.

This study proposes a new offer strategy that combines two elements in negotiation; (i) tactic - multiple equivalent simultaneous offer, and (ii) strategy - argumentation-based negotiation for an automated negotiation agent to reach an integrative settlement (win-win situation). Using a new offer strategy, we attempted to answer the questions (1) "Is the approach of MESOArgN strategy enhance the persuasiveness of an offer?" and (2) "Will the approach of MESOArgN strategy enhance the negotiation outcome?". Whereas the study on negotiation strategy is not new to the negotiation field. Two factors model of negotiation measurements that emerged; (i) integrative settlement and (ii) social-psychological outcome.

We developed the prototype that configured the proposed offer strategy for hypotheses testing purposes. The prototype is an e-commerce namely Compute2u, that embarks software agent technology as a buyer. We programmed and configured the proposed offer strategy into the software agent – automated negotiation agent to negotiate with human. There are three main issues to be negotiated between agent and human. The issues are price, warranty and delivery date. We also configured nine options for unit price, seven options for warranty and four options for delivery for hypotheses testing purposes. The combination of the value options for these three issues formed a total one hundred eight alternatives.

Embarks the software agent technology (automated negotiation agent) into e-commerce is not envisioned to replace human, nonetheless as an efficient decision support instrument for negotiations with human (Lin et al., 2008). Hence, such an agent can be used as mediators for the negotiation processes and reach the agreeable settlement, aimed to have a better negotiation.

Bibliography

Alfredson, T., & Cungu, A. (2008). Negotiation theory and practice: A review of the literature. *Esaypol On Line Resource Materials for policymaking*.

An, B., & Lesser, V. (2012). Yushu: a heuristic-based agent for automated negotiating competition. In *New Trends in Agent-Based Complex Automated Negotiations* (pp. 145-149): Springer.

Babbie, E. R. (2015). *The practice of social research*: Nelson Education.

Bacon, L. D. (1999). *Using LISREL and PLS to measure customer satisfaction.* Paper presented at the Sawtooth Software Conference Proceedings.

Bui, T., & Shakun, M. F. (2003). *Negotiation support systems.* Paper presented at the System Sciences, 2003. Proceedings of the 36th Annual Hawaii International Conference on.

Butler Jr, J. K. (1999). Trust expectations, information sharing, climate of trust, and negotiation effectiveness and efficiency. *Group & Organization Management, 24*(2), 217-238.

Carnevale, P. J., & Pruitt, D. G. (1992). Negotiation and mediation. *Annual review of psychology, 43*(1), 531-582.

Carroll, J. S., & Payne, J. W. (1991). An information processing approach to two-party negotiations. *Research on negotiation in organizations, 3*, 3-34.

Crosby, L. A., Evans, K. R., & Cowles, D. (1990). Relationship quality in services selling: an interpersonal influence perspective. *Journal of marketing, 54*(3), 68-81.

Curhan, J. R., Elfenbein, H. A., & Xu, H. (2006). What do people value when they negotiate? Mapping the domain of subjective value in negotiation. *Journal of personality and social psychology, 91*(3), 493.

De Visser, E., Parasuraman, R., Freedy, A., Freedy, E., & Weltman, G. (2006). *A comprehensive methodology for assessing human-robot team performance*

for use in training and simulation. Paper presented at the Proceedings of the Human Factors and Ergonomics Society Annual Meeting.

Ehlert, P. (2001). Intelligent driving agents: The agent approach to tactical driving in autonomous vehicles and traffic simulation.

Faratin, P., Sierra, C., & Jennings, N. R. (1998). Negotiation decision functions for autonomous agents. *Robotics and Autonomous Systems, 24*(3-4), 159-182.

Faratin, P., Sierra, C., & Jennings, N. R. (2002). Using similarity criteria to make issue trade-offs in automated negotiations. *Artificial Intelligence, 142*(2), 205-237.

Fatima, S. S., & Wooldridge, M. (2001). *Adaptive task resources allocation in multi-agent systems.* Paper presented at the Proceedings of the fifth international conference on Autonomous agents.

Fatima, S. S., Wooldridge, M., & Jennings, N. R. (2004). An agenda-based framework for multi-issue negotiation. *Artificial Intelligence, 152*(1), 1-45.

Fisher, R., & Ury, W. (1983). Getting to Yes Negotiating Agreement Without Giving In. 1983. *Google Scholar*.

Fisher, R., Ury, W. L., & Patton, B. (2011). *Getting to yes: Negotiating agreement without giving in*: Penguin.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50.

Freedy, A., DeVisser, E., Weltman, G., & Coeyman, N. (2007). *Measurement of trust in human-robot collaboration.* Paper presented at the 2007 International Symposium on Collaborative Technologies and Systems.

Fukuta, N., Ito, T., Zhang, M., Fujita, K., & Robu, V. (2016). *Recent Advances in Agent-based Complex Automated Negotiation* (Vol. 638): Springer.

Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the association for information systems, 4*(1), 7.

Gefen, D., & Straub, D. W. (2004). Consumer trust in B2C e-Commerce and the importance of social presence: experiments in e-Products and e-Services. *Omega, 32*(6), 407-424.

Hancock, P. A., Billings, D. R., Schaefer, K. E., Chen, J. Y., De Visser, E. J., & Parasuraman, R. (2011). A meta-analysis of factors affecting trust in human-robot interaction. *Human factors, 53*(5), 517-527.

Hevner, March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS quarterly, 28*(1), 75-105.

Hewitt, C. (1977). Viewing control structures as patterns of passing messages. *Artificial Intelligence, 8*(3), 323-364.

Hill, J., Ford, W. R., & Farreras, I. G. (2015). Real conversations with artificial intelligence: A comparison between human–human online conversations and human–chatbot conversations. *Computers in Human Behavior, 49*, 245-250.

Huang, C.-C., Liang, W.-Y., Lai, Y.-H., & Lin, Y.-C. (2010). The agent-based negotiation process for B2C e-commerce. *Expert Systems with Applications, 37*(1), 348-359.

Husted Medvec, V., Leonardelli, G. J., Galinsky, A. D., & Claussen-Schulz, A. (2005). *Choice and achievement at the bargaining table: The distributive, integrative, and interpersonal advantages of making multiple equivalent simultaneous offers.* Paper presented at the IACM 18th Annual Conference.

Hwang, H., Malhotra, N. K., Kim, Y., Tomiuk, M. A., & Hong, S. (2010). A comparative study on parameter recovery of three approaches to structural equation modeling. *Journal of Marketing Research, 47*(4), 699-712.

Hyder, E. B., Prietula, M. J., & Weingart, L. R. (2000). Getting to best: Efficiency versus optimality in negotiation. *Cognitive Science, 24*(2), 169-204.

Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing? *Journal of personality and social psychology, 79*(6), 995.

Janca. (1995). Pragmatic application of information agents: Bis strategic decisions. *Norwell, United States*.

Janca, P. (1995). Pragmatic application of information agents. *BIS Strategic Report*.

Jarke, M., Jelassi, M. T., & Shakun, M. F. (1987). MEDIATOR: Towards a negotiation support system. *European Journal of Operational Research, 31*(3), 314-334.

Jelassi, M. T., & Foroughi, A. (1989). Negotiation support systems: An overview of design issues and existing software. *Decision Support Systems, 5*(2), 167-181.

Jennings, N. R., Faratin, P., Lomuscio, A. R., Parsons, S., Wooldridge, M. J., & Sierra, C. (2001). Automated Negotiation: Prospects, Methods and Challenges. *Group Decision and Negotiation, 10*(2), 199-215. doi:10.1023/a:1008746126376

Jennings, N. R., & Wooldridge, M. (1995). Applying agent technology. *Applied Artificial Intelligence an International Journal, 9*(4), 357-369.

Jennings, N. R., & Wooldridge, M. J. (1996). Software agents. *IEE review*, 17-20.

Johnson, N. A., & Cooper, R. B. (2009). Power and concession in computer-mediated negotiations: An examination of first offers. *Mis Quarterly, 33*(1), 147-170.

Jonker, C. M., & Treur, J. (1999). *Formal analysis of models for the dynamics of trust based on experiences.* Paper presented at the European Workshop on Modelling Autonomous Agents in a Multi-Agent World.

Kersten, G., & Lai, H. (2010). Electronic Negotiations: Foundations, Systems, and Processes. In M. D. Kilgour & C. Eden (Eds.), *Handbook of Group Decision and Negotiation* (pp. 361-392). Dordrecht: Springer Netherlands.

Lau, R. Y., Wong, O., Li, Y., & Ma, L. C. (2008). Mining trading partners' preferences for efficient multi-issue bargaining in e-business. *Journal of Management Information Systems, 25*(1), 79-104.

Lee, C.-F., & Chang, P.-L. (2008). Evaluations of tactics for automated negotiations. *Group Decision and Negotiation, 17*(6), 515.

Leitão, P., & Karnouskos, S. (2015). *Industrial Agents: Emerging Applications of Software Agents in Industry*: Morgan Kaufmann.

Lewicki, R. J., & Litterer, J. A. (1985). Negotiation. Homewood, IL: Richard D. Irwin. *Inc. LewickiNegotiation1985*.

Lewicki, R. J., Weiss, S. E., & Lewin, D. (1992). Models of conflict, negotiation and third party intervention: A review and synthesis. *Journal of organizational behavior, 13*(3), 209-252.

Lim, L.-H., & Benbasat, I. (1992). A theoretical perspective of negotiation support systems. *Journal of Management Information Systems, 9*(3), 27-44.

Lin, R., & Kraus, S. (2010). Can automated agents proficiently negotiate with humans? *Communications of the ACM, 53*(1), 78-88.

Lin, R., Kraus, S., Wilkenfeld, J., & Barry, J. (2008). Negotiating with bounded rational agents in environments with incomplete information using an automated agent. *Artificial Intelligence, 172*(6-7), 823-851.

Lomuscio, A. R., Wooldridge, M., & Jennings, N. R. (2003). A Classification Scheme for Negotiation in Electronic Commerce. *Group Decision and Negotiation, 12*(1), 31-56. doi:10.1023/a:1022232410606

Lopes, F., Coelho, H., Benazzouz, Y., Boyle, D., Cardoso, H. L., Dai, T., . . . Dimopoulos, Y. (2014). *Negotiation and Argumentation in Multi-agent Systems: Fundamentals, Theories, Systems and Applications*.

Maes, P., Guttman, R. H., & Moukas, A. G. (1999). Agents that buy and sell. *Communications of the ACM, 42*(3), 81-ff.

Martin, W. E., & Bridgmon, K. D. (2012). *Quantitative and statistical research methods: From hypothesis to results* (Vol. 42): John Wiley & Sons.

McAllister, D. J. (1995). Affect-and cognition-based trust as foundations for interpersonal cooperation in organizations. *Academy of management journal, 38*(1), 24-59.

Minghua, H., Jennings, N. R., & Ho-Fung, L. (2003). On agent-mediated electronic commerce. *IEEE Transactions on Knowledge and Data Engineering, 15*(4), 985-1003. doi:10.1109/TKDE.2003.1209014

Mostafa, S. A., Ahmad, M. S., Mustapha, A., & Mohammed, M. A. (2017). A concise overview of software agent research, modeling, and development. *Software Engineering, 5*(1), 8-25.

Muijs, D. (2010). *Doing quantitative research in education with SPSS*: Sage.

Muir, B. M. (1994). Trust in automation: Part I. Theoretical issues in the study of trust and human intervention in automated systems. *Ergonomics, 37*(11), 1905-1922.

Nunnally, J. (1978). Psychometric methods. In: New York: McGraw-Hill.

Nwana, H. S. (1996). Software agents: An overview. *The knowledge engineering review, 11*(3), 205-244.

Nwana, H. S., & Ndumu, D. T. (1998). A brief introduction to software agent technology. In *Agent technology* (pp. 29-47): Springer.

Ogilvie, R. G. (2016). *An Essay on the Nature of Visual Perception.*

Oliver, J. R. (1996). A machine-learning approach to automated negotiation and prospects for electronic commerce. *Journal of Management Information Systems, 13*(3), 83-112.

Oliver, R. L., Balakrishnan, P. S., & Barry, B. (1994). Outcome satisfaction in negotiation: A test of expectancy disconfirmation. *Organizational Behavior and Human Decision Processes, 60*(2), 252-275.

Patton, C., & Balakrishnan, P. S. (2012). Negotiating when outnumbered: agenda strategies for bargaining with buying teams. *International Journal of Research in Marketing, 29*(3), 280-291.

Pruit, G., & Rubin, S. (1986). Social Conflict Escalation and Settlement. *GD Fruit, SZ Rubin*.

Pruitt, D. (1981). Negotiation Behavior.

Rahim, M. A. (1990). *Theory and research in conflict management*: Greenwood Publishing Group.

Rahwan, I., Ramchurn, S. D., Jennings, N. R., Mcburney, P., Parsons, S., & Sonenberg, L. (2003). Argumentation-based negotiation. *The knowledge engineering review, 18*(04), 343-375.

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). SmartPLS 3. *Boenningstedt: SmartPLS GmbH*.

Rosenschein, J. S., & Zlotkin, G. (1994). *Rules of encounter: designing conventions for automated negotiation among computers*.

Selker, T. (1994). COACH: a teaching agent that learns. *Communications of the ACM, 37*(7), 92-99.

Sherif, M., & Hovland, C. I. (1961). Social judgment: Assimilation and contrast effects in communication and attitude change.

Siero, F. W., & Doosje, B. J. (1993). Attitude change following persuasive communication: Integrating social judgment theory and the elaboration likelihood model. *European journal of social psychology, 23*(5), 541-554.

Sierra, C., Jennings, N. R., Noriega, P., & Parsons, S. (1997). *A framework for argumentation-based negotiation*. Paper presented at the International Workshop on Agent Theories, Architectures, and Languages.

Smith, D. C., Cypher, A., & Spohrer, J. (1994). KidSim: programming agents without a programming language. *Communications of the ACM, 37*(7), 54-67.

Soh, L.-K., Tsatsoulis, C., & Sevay, H. (2003). A satisficing, negotiated, and learning coalition formation architecture. In *Distributed Sensor Networks* (pp. 109-138): Springer.

Steinfeld, A., Fong, T., Kaber, D., Lewis, M., Scholtz, J., Schultz, A., & Goodrich, M. (2006). *Common metrics for human-robot interaction.* Paper presented at the Proceedings of the 1st ACM SIGCHI/SIGART conference on Human-robot interaction.

Sussman, S. W., & Siegal, W. S. (2003). Informational influence in organizations: An integrated approach to knowledge adoption. *Information systems research, 14*(1), 47-65.

Thompson. (1990). Negotiation behavior and outcomes: Empirical evidence and theoretical issues. *Psychological bulletin, 108*(3), 515.

Thompson. (1991). Information exchange in negotiation. *Journal of Experimental Social Psychology, 27*(2), 161-179.

Thompson, L. (2005). *The mind and heart of the negotiator*: Pearson/Prentice Hall Upper Saddle River, NJ.

Tripp, T. M., & Sondak, H. (1992). An evaluation of dependent variables in experimental negotiation studies: Impasse rates and Pareto efficiency. *Organizational Behavior and Human Decision Processes, 51*(2), 273-295.

Van Eemeren, F. H., & Grootendorst, R. (2004). *A systematic theory of argumentation: The pragma-dialectical approach* (Vol. 14): Cambridge University Press.

Vetschera, R. (2013). Negotiation processes: an integrated perspective. *EURO Journal on Decision Processes, 1*(1-2), 135-164.

Vinzi, V. E., Trinchera, L., & Amato, S. (2010). PLS path modeling: from foundations to recent developments and open issues for model assessment and improvement. In *Handbook of partial least squares* (pp. 47-82): Springer.

Walton, R. E., & McKersie, R. B. (1991). *A behavioral theory of labor negotiations: An analysis of a social interaction system*: Cornell University Press.

Wong, K. (2010). Handling small survey sample size and skewed dataset with partial least square path modelling. *Vue: the magazine of the Marketing Research and Intelligence Association, 20*, 20-23.

Wooldridge, M. (2001). Agent-Oriented Software Engineering: The State of the Art.

Wooldridge, M., & Jennings, N. R. (1995). Intelligent agents: Theory and practice. *The knowledge engineering review, 10*(02), 115-152.

Yang, Singhal, & Xu. (2009). Offer with choices and accept with delay: a win-win strategy model for agent based automated negotiation. *ICIS 2009 Proceedings*, 180.

Yang, Singhal, S., & Xu, Y. (2012). Alternate strategies for a win-win seeking agent in agent-human negotiations. *Journal of Management Information Systems, 29*(3), 223-256.

Yang, Y., Falcão, H., Delicado, N., & Ortony, A. (2013). Reducing mistrust in agent-human negotiations. *IEEE Intelligent Systems, 29*(2), 36-43.

Yinping, Y., & Singhal, S. (2009). *Designing an intelligent agent that negotiates tactfully with human counterparts: a conceptual analysis and modeling framework.* Paper presented at the System Sciences, 2009. HICSS'09. 42nd Hawaii International Conference on.

Zeng, D., & Sycara, K. (1998). Bayesian learning in negotiation. *International Journal of Human-Computer Studies, 48*(1), 125-141.

Appendix A

SmartPLS Result

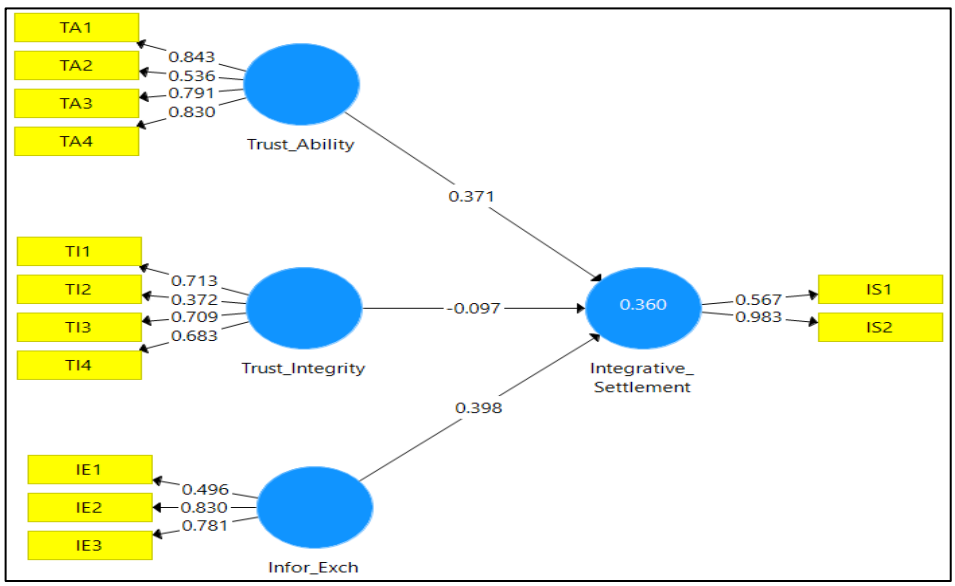

Figure 30. SmartPLS - realibility test initial result

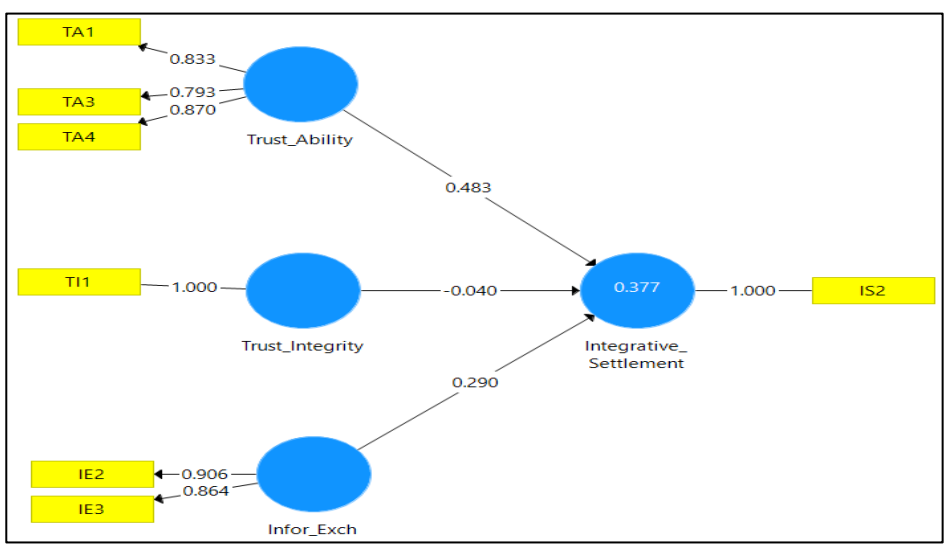

Figure 31. SmartPLS -realibility test after remove unreliability question

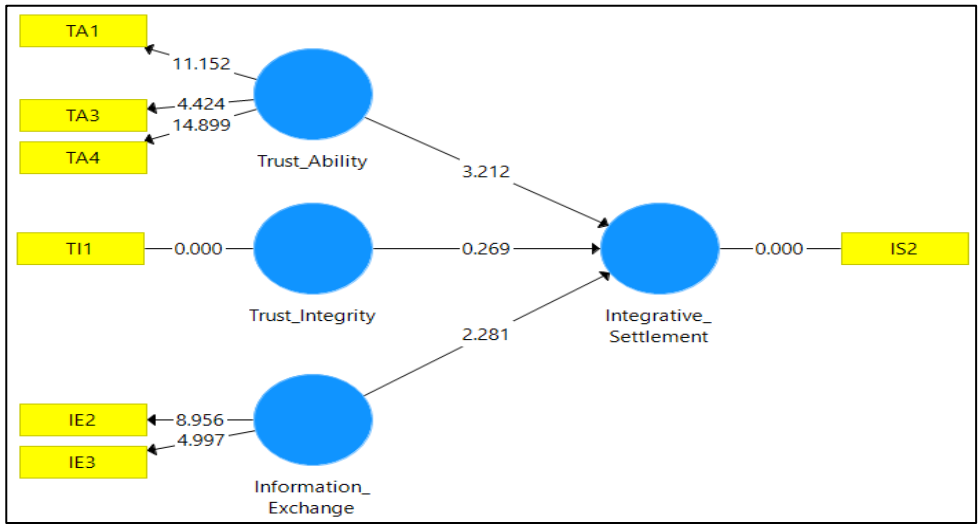

Figure 32. SmartPLS - bootstraping result

Abstract in Korean

자동 협상은 전자 시장 (e-market) 분야에서 점점 더 많은 관심을 끌고 있다. 대부분 자동 협상에 대한 연구는 배포 협상에 (zero sum) 중점을 두었으며, 그 효과는 소프트웨어 에이전트간 상호 작용 간의 단일 문제 협상에서만 설명했다. 이 연구에서는 자동화된 협상 에이전트에 대한 통합 협상의 제안 전략 모델을 제안하고 소프트웨어 에이전트대 인간 상호 작용에 중점을 둔다. 우리의 제안 전략 모델은 통합 협상 모델을 기반으로하며, 협상가 간의 정보 교환의 중요성을 강조하고 도움이되는 패키지 제공을 포함하여 다중 문제 협상은 통합적 결과 (win-win)를 달성할수 있다. 이 모델을 개발하면서 우리는 통합 (win - win) 협상 결과를 달성하기 위한 제안 전략으로 여러 동등한 동시 제안의 (multiple equivalent simultaneous offers) 논쟁 기반 협상 (argumentation-based negotiation) 전략과 협상 전술을 통합하고 있다. 그 제안 전략을 평가하기 위해 에이전트 협상을 전개하고 3 가지 문제의 온라인 구매 작업에 대한 49 명 인간 에이전트 협상을 실시했다. 실험 결과는 에이전트 협상을 가진 제안된 전략은 협상 결과의 제안 그리고 성과의 설득력을 향상할 수 있다는 것을 나타낸다 (협상 프로세스, opponent - agent 및 마래의 협상 욕망에 대한 인간 상대방의 인식). 이 연구 결과는

제안된 설계의 효과를 확인하고 혁신적인 전자 상거래 (e-commerce) 거래를 무효화한다.

키워드 : 자동 협상, 소프트웨어 에이전트, 통합 협상, 논쟁 기반 협상, 여러 동등한 동시 제안, 제안 전략

학번: 2014-31420