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The Role of Emotion in Elimination of Confrontation and Collaboration Dilemma in Citarum River Basin Problem

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Abstract

The purposes of the current research are to identify, analyze and simulate the dynamics of interaction and conflicts among agents using drama theory in Citarum river basin problem. To accomplish these purposes, we create a simulation model that combine drama theory and emotional state model (PAD model). Drama theory was adopted because it able to describe dilemmas and paradox arising from rational goal seeking behavior. It also provides us with rigorous analytical and computational tools for conflict analysis. Our previous model was able to recognize and solve confrontation dilemmas, i.e., persuasion and rejection dilemma among the agents. In this paper, we propose an enhanced simulation model that is also able to recognize and solve collaboration dilemmas (trust dilemma) among the agents. In order to obtain some fruitful suggestions for encouraging agent's collaboration, we conduct agent-based simulation using SOARS (Spot Oriented Agent Role Simulator).

Keywords: Agent based Simulation, Negotiation, Dilemma, Drama Theory, Emotion.

1. Introduction

Citarum River is one of the largest rivers in the West Java. In the past, Citarum river basin was clean, place where the aristocratic in Bandung make a tour to catch a fish and interacted with their community, but now, the condition was change totally [15]. There are some factors which cause the problem, i.e.; illegal lodging and the population explosion in upper stream, and household waste in down stream. Nowadays, at least 200 tons of household wastes are thrown away into Citarum. Many of industries in down stream do not perform waste treatment before throwing them away into Citarum. Agents in the

Citarum problem have different interests and positions. In negotiation process, agents may change their position and interests; accordingly, the situation is dynamic. There are some impediments (or dilemma) to achieve common position and trustworthy (*i.e.*, collaboration). Behaviors of an agent in the negotiation process depend on his /her dilemma toward another agent and on his/her strategy and emotional state (positive or negative emotion).

Emotional state consists of three dimensions, that is, pleasure, arousal and dominance. Positive emotion means that the agent is willing to participate in negotiation process and compromise. Negative emotion means that the agent is angry or annoyed by another agent. Based on the previous research, agent's positive emotion is very important in order to eliminate confrontation dilemmas among agents in Citarum River basin problem.

Although confrontation could be eliminated in the previous research, collaboration dilemmas (such as trust dilemma) are still remaining. In this research, we add a conceptual model for affiliation related phenomena that are affiliative tendency. It was defined in terms of generalized positive social expectations and associated positive behaviors in social interactions with others (e.g. liking people, enjoying companionship, and being pleasant and agreeable with others).

Each agent has affiliative tendency with another agent, such as tend to cooperate or no. It was emerging a new problem among the agent that is trust. How to eliminate a trust dilemma? This paper will propose an enhanced simulation model of dilemma of conflict and dilemma of collaboration (trust dilemma) among the agents. Then we conduct agent-based simulation by using SOARS (*Spot Oriented Agent Role Simulator*) with hope to obtain some fruitful suggestions for encouraging their collaboration.

Citarum River Basin Problem

Citarum River basin is a region with 6,080 km2 area located in the three provinces, West Java, Banten and Jakarta. The annual precipitation depth is 3,000 mm/year in the mountain and 2,500 mm/year in lowland. Relative humidity is 80% and daily temperature is 25◦C in the lowland and 18◦C in the mountain.

Figure 1. Citarum River Basin Region

Citarum River is connected by artificial channel with 4 rivers to the west, named West Tarum canal (WTC), and 4 rivers to the east, named East Tarum Canal (ETC). The total area of Citarum river basin is 12,000 km2. In the past, Citarum river basin was clean. It was the place where nobles from Bandung make tour to catch a fish and interacted with their people. Now, the condition was change totally [15]. Citarum river is heavily polluted and the flow fluctuation may reach seven hundred times. During rainy season the flow is high as 200 cubic meters per second. Flood always occur in rainy season because, the downstream area of Citarum River is very shallow. In the rainy season, the color of the water is brown because of erosion of barren lands along the riverside. In the dry season, the color of river changed to black and full of household wastes.

Why is the condition of Citarum river basin deteriorating? The first reason is illegal lodging in Citarum river basin. West Java environmental agency reported that more than 54 percent of forest in the Citarum area had been converted during the period of 1983 until 2002. The second reason is population explosion in the upper stream area. Data from the West Java administration shows about 11 million people live in the basin, with over 1,000 companies operating in the area. More than 4.8 million people live in areas of 177,600 ha in the upper stream [10]. The number of housing was jumped by 233 percent between 1983 and 2002, with industrial land use increasing by 868 percent during the same period. The areas of agricultural land had been converted into housing complexes or industrial land, further contributing to the decease in water catchments areas.

There are several agents who participate in Citarum river basin problem, i.e. local people in downstream, local people in upstream, textile industries, environmentalist (green), regencies in upper stream and cities in down stream [18]. All of these agents have different interests and have lack of coordination among them.

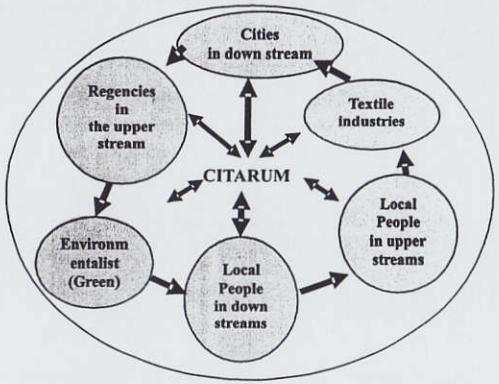


Figure 2. Agents in Citarum River Basin Problem

Each agent in Figure 2 pursues its own purposes. [18]. They have partial proposals for the problem, such as, proposal for stopping deforestation and stopping illegal lodging. Proposal for stopping deforestation makes the up stream regencies unhappy because, there will be no land that can be converted from forest into residence anymore. Proposal for stopping illegal lodging makes local people in upstream unhappy because, they couldn't get money and, the industries will be blamed because of the increasing unemployment rate. In the other hand, the illegal lodging has made people in downstream suffer.

2. Drama Theory

Drama Theory is a metaphor of confrontation process. Its first stage begins when each agent has several frames for the situation called a Scene setting stage. The next stage is called build up, that will result a common reference frame among agents. Based on the common reference, each agent may have dilemmas toward another agent then, he/she will enter the next stage, which is called climax stage. According to Bryant (2003), there are two groups of dilemma in climax stage, Confrontation Dilemma and collaboration dilemma. If agents cannot reach the same position and trust each other after the climax stage then, the negotiation process will return to the build up stage. Otherwise, the negotiation process will generate a resolution, means that the conflict has been resolved. The last stage is dénouement in which agents may conclude the confrontation. It results collaboration or tragedy.

2.1. Drama Theory in Citarum River Basin Problem

The previous paper begins with build up stage of interaction among agents in Citarum riverbasin problem. Common reference frame resulted from the stage is described in Figure 3. The common reference frame consists of agents/participants, their options, positions (proposals), and threat.

OPTIONS OF PARTICIPANTS	THREAT	POSITIONS					
		USR	G	TI	DSP	USP	DSC
Up Stream Regencies (USR)						<	>
Stop deforestation	No	Yes	Yes	*Yes/No*	Yes	No	Yes
Green (G)				>	<	>	<
Protest	Yes	No	No	No	*Yes/No*	No	No
Textile Industries (TI)			>		>		>
Stop un-treatment waste disposal to river	No	*Yes/No*	Yes	No	Yes	*Yes/No*	Yes
Down Stream People (DSP)			<	<		<	<
Stop waste disposal to river	No	*Yes/No*	Yes	*Yes/No*	No	*Yes/No*	Yes
Up Stream People (USP)		>	>		>		>
Stop illegal lodging	No	Yes	Yes	*Yes/No*	Yes	No	Yes
Down Stream Cities (DSC)		>	<	>	<	>	
Strict penalties for illegal waste disposal to river	Yes	*Yes/No*	Yes	No	No	*Yes/No*	No
Maintenance River	No	*Yes/No*	Yes	*Yes/No*	Yes	*Yes/No*	No
Revenue sharing to Up Stream Regencies	No	Yes	*Yes/ No*	*Yes/No*	*Yes/No*	*Yes/No*	No

Figure 3. Common Reference Frame for Citarum River Basin Problem

The agent has at least an option. Position or proposal offered by an agent to another agent is represented a column of each agent. For example, Up Stream Regencies' proposal is represented by a column below "USR". It is a combination of "Yes", "No", and "Yes/No". "Yes" or "No" means respectively that the agent proposes an action to implement (*i.e.*, adopt) or to not implement (*i.e.*, reject). "Yes/No" means that the agent is indifferent with an action to adopt. Therefore, the position of USR means that Up Stream Regencies will adopt "stop deforestation" if Green rejects "protest", Up Stream People will adopt "stop illegal lodging", and Down Stream Cities adopt "revenue sharing to USR"; USR is indifferent with actions of Textile Industries and Down Stream People; and finally, USR is also indifferent with several Down Stream Cities' actions, these are, "strict penalties for illegal waste disposal to river" and "maintenance river".

Threat is a situation when all agents adopt their fallback. For example, in the threat situation, USR is threatening to reject "stop deforestation". The symbols "<" and ">" represent an agent's preference between his/her position and threat. The symbol "<" means that the agent prefers his/her position to threat. In the opposite, if the agent prefers threat to his/her position, then it is represented with ">". Accordingly, USP in Figure. 3 prefer his/her position to threat.

Since the dilemma of Citarum problem is only persuasion and rejection dilemma (confrontation dilemma) and trust dilemma (collaboration dilemma), for the purpose of simulation we define the dilemma as follow:

a. Confrontation Dilemma
   - Rejection dilemma
     Party 1 has rejection dilemma with respect to party 2, if party 1`s rejection of party 2's position is not credible according to party 2, because party 2 knows that party 1 prefers party 2's position than the threat.
   - Persuasion dilemma
     Party 1 has persuasion dilemma with respect to Party 2, if Party 1 can not persuade Party 2 to accept Party 1`s position because Party 2 prefers treated position than Party 1`s position.

b. Collaboration Dilemma
   - Trust dilemma
     Party 1 has trust dilemma with respect to Party 2, if Party 1 can not believe that Party 2 commit with the common position, because Party 1 knows that there is another scenario preferred by Party 2 than the common position.

2.2 Agent Based Modeling in Drama Theory

The purpose of the previous research is to identify, analyze and simulate dynamics of interaction and conflicts among the stakeholders (or agents) in the Citarum river negotiation process, where they claim their strategies and interests as well as express emotion. To accomplish the purpose, we first model the process in terms of drama theory that is combined with emotional state model (PAD). Drama theory was adopted because it able to describe dilemmas and paradox arising from rational goal seeking behavior. It also provides us with rigorous analytical and computational tools of conflict analysis. Agent-based simulation using SOARS was conducted, in order to obtain some fruitful suggestion for encouraging

collaboration among agents. The simulation result shows that emotion of agents has a crucial and important role to encourage collaboration. If there are more agents who have positive emotion then, there will be less number of dilemmas to achieve collaboration.

The previous study only involves two confrontation dilemmas, i.e., rejection dilemma and persuasion dilemma (for detail see Putro, Utomo Sarjono, et.al. 2007). In this research we adopt the concept of affiliative tendency in order to simulate trust dilemma.

2.2.1. Emotion model

Emotion model that will be used in this paper is the development from emotional negotiation model PAD (Jiang, 2004). Emotional state model (PAD) involves three dimensions, *i.e.*, Pleasure (*rp*). Arousal (*ra*) and Dominance (*rd*).

- Pleasure (*rp*) and displeasure; distinguishes the positive and negative affective quality of emotional states.
- Arousal (*ra*) and nonarousal; refers to a combination of physical activity and mental alertness.
- Dominance (*rd*) and submissiveness" is defined in terms of control versus lack of control.

During negotiation, a more pleasant agent tends to compromise with others. We can reflect this relationship to the payoff system by assuming that pleasure influences the agent to increase the payoff offered to another agent during negotiation process.

The second dimension, ArousalNon-arousal, means to rouse or to stimulate action or to physiological readiness for activity. We can reflect this to the payoff system of negotiation by assuming that this measure influences the effects of P. For example, if an agent is in pleasure status, then this emotion makes the agent increase the evaluation payoff; if the agent is also on arousal, it increases even more. But, if the agent is in displeasure, then arousal will make the agent decrease the payoff more.

The third dimension D: DominanceSubmissiveness. This estimates the degree of the ability of being commanding, controlling, or prevailing over all others, or degree to yield oneself to the authority or will of another.

Each agent has the emotional state [11], *i.e.*:

$$Es_i = \{r_p, r_a, r_d\} \; ; \; r_p, r_a, r_d \in (-1, 1)$$

Alternatively, when the PAD scale scores are standardized, each emotion term can be described succinctly in terms of its payoffs on the pleasure-displeasure, arousal-nonarousal, and dominance-submissiveness axes. The following sample ratings illustrate definitions of various emotion terms when scores on each PAD scale range from -1 to +1. The payoffs have negative meaning if close to -1 and have positive meaning if close to 1.

In Mehrabian (1995), angry is coded by {-.51, .59, .25}, bored is {-.65, -.62, -.33}, curious is {.22, .62, -.01}, dignified is {.55, .22, .61}, elated is {.50, .42, .23}, hungry is {-.44, .14, -.21}, inhibited is {-.54, -.04, -

.41}, loved is {.87, .54, -.18}, puzzled is {-.41, .48, -.33}, sleepy is {.20, -.70, -.44}, unconcerned is {-.13, -.41, .08}, and violent is {-.50, .62, .38}.

For each agent i have the function of emotional state, which is [11]:

$$Se_i(r_p, r_a, r_d) = r_p.(1 + r_a) - r_d$$

For example: if an agent has emotional state defined as {−0.51, 0.59, 0.25}, then function of emotional state is

$$Se_i(r_p, r_a, r_d) = -0.51.(1 + 0.59) - 0.25 = -1.0609 \quad (1)$$

2.2.2. The Dynamics of Pleasure, Arousal and Dominance

Pleasure, arousal and dominance of an agent is not static, it can vary depend on the stimulus that are accepted by an agent. Stimulus can be divided into two kind, pleasant and unpleasant (Bradley *et. al.*, 2001). In this paper unpleasant stimulus is refer to negative emotion that is given by agent j to agent i and pleasant stimulus is refer to positive emotion that is given by agent j to agent i. According to Bradley *et.al* (2001) and Barteneva *et.al* (2006) unpleasant stimulus will decrease pleasure and dominance of agent i while pleasant stimulus will increase both of these variables. Arousal of agent i will increase when an agent i receive negative or positive emotion from agent j. The dynamics of emotion variables can be simply described in the figures below.

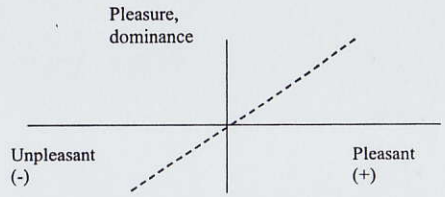


Figure 4. The dynamic of emotion variable: pleasure and dominance

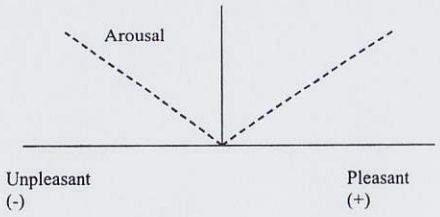


Figure 5. The dynamic of emotion variable: arousal

Each PAD dimension has maximum value of 1 and minimum value of -1, while emotional state has maximum value of 3 and minimum value of -3. So, the value of each PAD dimension of agent *i* to agent j can be described as a function of emotional state of agent j to agent *i*.

$$rp_{ij} = \frac{S_{eji}}{3}$$

$$rd_{ij} = \frac{S_{eji}}{3}$$

$$ra_{ij} = \frac{S_{eji}}{3} \quad \text{for } S_{Eji} > 0$$

$$ra_{ij} = \frac{-S_{eji}}{3} \quad \text{for } S_{Eji} < 0 \quad (2)$$

Which:
rp_{ij} = pleasure of agent *i* to agent *j*
rd_{ij} = dominance of agent *i* to agent *j*
ra_{ij} = arousal of agent *i* to agent
S_{Eji} = emotional state of agent *j* to agent *i*

2.2.3 Affiliative Tendency

Affiliative tendency was defined in terms of generalized positive social expectations and associated positive behaviors in social interactions with others (e.g liking people, enjoying companionship, and being pleasant and agreeable with others). An individual's emotional states are inferred from averages of his or her emotional states across representative samples of everyday situation. Affiliative persons were found to be exuberant (pleasant, arousable, dominant) when the corresponding scales were analyzed in terms of trait pleasure, trait arousability and trait dominance. Thus, Mehrabian [13] proposed that emotional traits could also be described in terms of the pleasure-displeasure, arousal-nonarousal, and dominance-submissiveness dimensions.

Based on Mehrabian, affiliative tendency scales were defined as follows [13]:

$$Affiliation_{ij} = 0.46rp_{ij} + 0.24ra_{ij} + 0.3rd_{ij} \quad (3)$$

Mehrabian [13] constructed his scale to be an almost exclusive measure of positive interpersonal orientation (i.e., generalized expectations, behaviors, and attitudes) and to be free of interpersonal control or dominance elements.

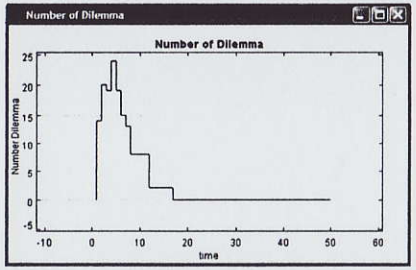
Within the present theoretical perspective, then, it is important to conceptualize and measure affiliative tendency as pure generalized interpersonal positiveness without either an inclination to want to dominate and control others or to be dominated and controlled by others.

3. Model of Negotiation in Citarum River Basin Problem

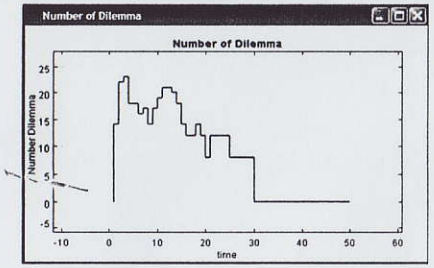
In negotiation process, every agent bargains to others based on his/her emotional state (positive or negative emotion). Positive emotional state is more conducive to a person acting in a friendly and sociable manner with others; conversely, a negative emotional state tends to heighten chances that the individual will be unfriendly, inconsiderate, or even rude to others.

In this model, negotiation process involves bargaining strategy and emotional state of each agent and also affiliative tendency for each agent. The payoff offered by an agent to another agent is determined by the strategy and emotional state of the agent. Strategy will determine how much he/she plans to offer to another agent. The emotional state influences how much the agent will really offer to another agent. Affiliative tendency influences how much the desire of each agent to cooperate with another, so it shows a trust of each agent to another agent. The objective of this negotiation process is to bring another agent to change his/her mind over one or some conflicting options. Negotiation will proceed at each time.

Negotiation process will reduce the number of confrontation dilemma (rejection and persuasion dilemma). If there is no confrontation dilemma, then we move to collaboration stage. Experiments in the previous research show the more agents who have positive emotion then could bring the conflict situation into collaboration stage. Figure 6 shows our previous experiment.

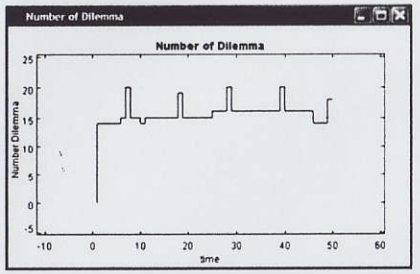


(a): All dilemmas eliminated at time 17

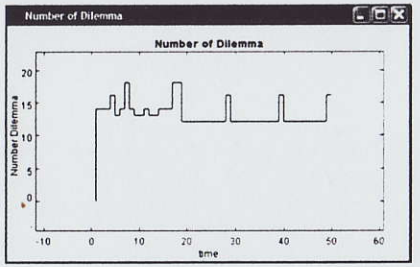


(b): All dilemmas eliminated at time 30

Figure 6. The number of dilemma i Citarum River basin Problem



(c): Dilemmas retained



(d): Dilemmas retained

Figure 6. The number of dilemma i Citarum River basin Problem

In figure 6(a), whole of agent has positive emotion. USR is curious (i.e., having a strong desire to know about something) coded by {.22, .62, -.01}, G is loved (i.e., strong feeling of deep affection for someone or something) coded by {.87, .54, -.18}, TI is elated (i.e., a feeling of great happiness and excitement) coded by {.50, .42, .23}, USP is dignified (i.e., calm, serious and deserving respect) coded by{.55, .22, .61}, DSP is sleepy (i.e., quiet and where nothing much happens) coded by {.20, -.70, -.44}and DSC is dignified (i.e., calm, serious and deserving respect) coded by{.55, .22, .61}.

Table 1. Parameter in Scenario 1

	USR (Curious)	G (Loved)	TI (Elated)	DSP (Sleepy)	USP (Dignified)	DSC (Dignified)
r_p	0.22	0.87	0.5	0.2	0.55	0.55
r_a	0.62	0.54	0.42	-0.7	0.22	0.22
r_d	-0.01	-0.18	0.23	-0.44	0.61	0.61
$Se_i(r_p,r_a,r_d)$	0.3364	1.5198	0.48	0.5	0.0610	0.0610

In figure 6(b), a number agent who has positive emotion is more than negative emotion. USR, USP, DSP, DSC and TI has positive emotion, meanwhile G has negative emotion. USR and DSC is elated (i.e., a feeling of great happiness and excitement) coded by {.50, .42, .23}, USP and DSP is loved (i.e., strong feeling of deep affection for someone or something) coded by {.87, .54, -.18} and TI is dignified (i.e., calm, serious and deserving respect) coded by {.55, .22, .61}. G is angry (i.e., having strong feelings about something that you dislike very much or about an unfair situation).

Table 2. Parameter in Scenario 2

	USR (Elated)	G (Angry)	TI (Dignified)	DSP (Loved)	USP (Loved)	DSC (Elated)
r_p	0.5	-0.5	0.55	0.87	0.87	0.5
r_a	0.42	0.59	0.22	0.54	0.54	0.42
r_d	0.23	0.25	0.61	-0.18	-0.18	0.23
$Se_i(r_p,r_a,r_d)$	0.48	-1.045	0.061	1.5198	1.5198	0.48

In figure 6(c), whole of agent has negative emotion. USR, DSC and G is unconcerned (i.e., not worried, because you feel it does not affect you or is not important) coded by {-.13, -.41, .08}, USP and DSP is angry (i.e., having strong feelings about something that you dislike very much or about an unfair situation) coded by {-.50, .59, .25}and TI is hungry (i.e., having or showing a strong desire for something) coded by {-.44, .14, .08}.

Table 3. Parameter in Scenario 3

	USR (Unconcerned)	G (Unconcerned)	TI (Hungry)	DSP (Angry)	USP (Angry)	DSC (Unconcerned)
r_p	-0.13	-0.13	-0.44	-0.5	-0.5	-0.13
r_a	-0.41	-0.41	0.14	0.59	0.59	-0.41
r_d	0.08	0.08	-0.21	0.25	0.25	0.08
$r_p,r_a,r_d)$	-0.1567	-0.1567	-0.2916	-1.045	-1.045	-0.1567

In figure 6 (d), a number agent who has negative emotion is more than positive emotion. USR, USP, DSP, and DSC has negative emotion, meanwhile TI and G has positive emotion. TI and G is elated (i.e., a feeling of great happiness and excitement) coded by {.50, .42, .23}, USP and DSP is angry (i.e., having strong feelings about something that you dislike very much or about an unfair situation) coded by {-.50, .59, .25}. USR and DSC is unconcerned (i.e., not worried, because you feel it does not affect you or is not important) coded by {-.13, -.41, .08}.

Table 3. Parameter in Scenario 3

	USR (Unconcerned)	G (Elated)	TI (Elated)	DSP (Angry)	USP (Angry)	DSC (Unconcerned)
r_p	-0.13	0.5	0.5	-0.5	-0.5	-0.13
r_a	-0.41	0.42	0.42	0.59	0.59	-0.41
r_d	0.08	0.23	0.23	0.25	0.25	0.08
$r_p,r_a,r_d)$	-0.1567	0.48	0.48	-1.045	-1.045	-0.1567

As we can see at figure 6 (a) and (b), all dilemmas can be eliminated but if all agents have positive emotion, the time to eliminate all dilemmas shorter then if there is one agent with negative emotion. At figure 6 (c) and (d), the dilemmas can not be eliminated. In the both scenarios, agent with negative emotion dominated negotiation process. In the previous research we concluded that the role of positive emotion of all agents is the important thing to be considered in negotiation process that brings the process to collaboration stage.

The first and the second scenario above are in collaboration stage, but during negotiation process, affiliative tendency of agent will influence commitment of each agent to do their agreement. Affiliative tendency for each agent is counted by equation (3) during negotiation process. Based on this equation,

the value of affiliative tendency is in range [-1.0,1.0]. The more positive of affiliative tendency value. the more serious of agent to commit through the collaboration.

3.1. Modeling to Eliminate Trust Dilemma

To eliminate trust dilemma in collaboration stage, we use affiliative tendency value. First, we calculate probability for each agent based on the following equation.

$$\Pr ob(i) = \frac{V_{\max} - aff_i}{V_{\max} - V_{\min}} \quad (4)$$

Where:
V_{max} is maximum value of affiliative tendency (1.0)
V_{min} is minimum value of affiliative tendency (-1.0)
aff_i is affiliative tendency for agent i

Based on norm game [4], agent i will attempt to cheat the commitment if $\Pr ob(i) < rand$. where rand is random value which generated from uniform distribution in range [0,1]. For each agent j ($j \neq i$) will attempt to punish agent i if $\Pr ob(j) > rand$. If agent i cheat, then agent i's payoff will increase 1 % from the current payoff. While another agent will decreasing the payoff 1% from the current payoff. If agent i cheat and agent j punish, then payoff of agent i will decrease 10% from the current payoff.

4. Simulation Using SOARS and Result

In order to simulate this problem, we use SOARS to look the initial frame for Citarum river basin problem. We describe an initial frame in figure 3. There are so many dilemmas in our common frame. Based on the previous research [19], we can eliminate the dilemma of conflict. In this simulation, we assume that bargaining strategy of agent was same, that is $'1' = s \quad S^{1}$. The purpose is to look the effect of emotional state from each agent and to look the affiliative tendency from each agent. We assume that if the number of emotion function payoff is positive, then agent will have a behavior that like to compromise and will not compromise if the emotion function payoff is negative.

In this simulation, we make two experiments (2 scenarios) based on the first and the second scenario in the previous section. We use these scenarios because these scenarios brought the conflict to the collaboration stage (i.e. all dilemmas of conflict can be eliminated). Parameter in this scenario is emotional state, i.e. $Es_i = \{r_p, r_a, r_d\}$, where $r_p, r_a, r_d \in (-1, 1)$. The payoffs have negative meaning if close to -1 and have positive meaning if close to 1. For each agent i have the function of emotional state, that is $Se_i(r_p, r_a, r_d) = r_p.(1 + r_a) - r_d$

4.1. First Scenario

In this scenario, whole of agent has positive emotion. USR is curious (i.e., having a strong desire to know about something) coded by {.22, .62, -.01}, G is loved (i.e., strong feeling of deep affection for someone or something) coded by {.87, .54, -.18}, TI is elated (i.e., a feeling of great happiness and excitement) coded by {.50, .42, .23}, USP is dignified (i.e., calm, serious and deserving respect) coded by{.55, .22, .61}, DSP is sleepy (i.e., quiet and where nothing much happens) coded by {.20, -.70, -.44}and DSC is dignified (i.e., calm, serious and deserving respect) coded by{.55, .22, .61}. In this scenario, we use the parameters as described at table 1.

The probability of affiliative tendency in this scenario could be seen in following figure.

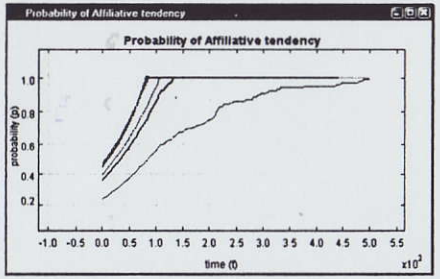


Figure. 7. Probability of Affiliative tendency in Scenario 1

From the above figure could be seen that probability for each agent is close to 1, it means that no one agent will cheat the commitment, because affiliative tendency is positive and the value is large. Each agent will avoid cheating because the other agent can punish him/her.

4.2. Second Scenario

In this scenario, a number agent who has positive emotion is more than negative emotion. USR, USP, DSP, DSC and TI has positive emotion, meanwhile G has negative emotion. USR and DSC is elated (i.e., a feeling of great happiness and excitement) coded by {.50, .42, .23}, USP and DSP is loved (i.e., strong feeling of deep affection for someone or something) coded by {.87, .54, -.18}and TI is dignified (i.e., calm, serious and deserving respect) coded by {.55, .22, .61}. G is angry (i.e., having strong feelings about something that you dislike very much or about an unfair situation). In this scenario, we use the parameters as described at table 2, i.e.

The probability of affiliative tendency in this scenario could be seen in following figure.

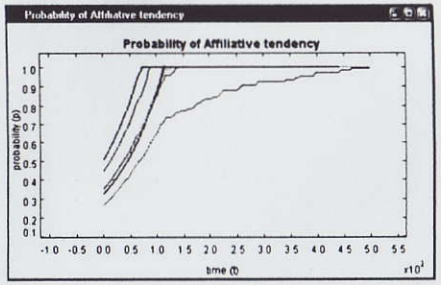


Fig. 8. Probability of Affiliative tendency in Scenario 2

From the above figure could be seen that probability for each agent is close to 1, this result consistent with the first scenario.

An agent with high initial affiliative tendency will reach affiliative tendency to 1 more faster then an agent with low initial affiliative tendency. In the first scenario, DSP (red), USR (black), and USP (orange) has high initial affiliative tendency and reached affiliative tendency to 1 more faster then the other agents. This situation occur again in the second scenario with DSC (blue) has high initial affiliative tendency and reached affiliative tendency to 1 more faster then the other agents. This situation can be interpreting that in the positive emotion circumstance an agent with high initial affiliative tendency will maintain commitment to cooperate. He/she can punish another agent who do cheating (break the commitment). As we can see from the second scenario, G (dark green) with negative emotion (angry) has low initial affiliative tendency so G has higher probability to do cheating (break the commitment). But this situation would not occur because the other agent who has high initial affiliative tendency will have higher probability to punish the agent.

5. Conclusion

From the result of simulation, we show how the emotional states and affiliative tendency of agents affect in negotiations process. In the collaboration stage, to maintain the commitment, each agent must be willing to punish the other agent who attempt to cheat. In our simulation, the effect of positive emotional state of agent and affiliative tendency is important to maintain collaboration. So the suggestion for this problem is each agent must have a positive emotion which consists of three dimensional and positive affiliative tendencies, so the collaboration will happened.

References

Bryant, J. (2003). *The Six dilemmas of Collaboration*, John Wiley.

Barteneva, D., Lau,N., Reis, P.L. (2006), "Implementation of Emotional Behaviors in Multi Agent System Using Fuzzy Logic and Temperamental Decision Mechanism", *Proceeding of Fourth European Workshop on Multi Agent Systems*, 11 pages.

Axelrod, R. (1997). *The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration*, Princeton University Press, Princeton, New Jersey.

Bradley, M.M., Codispoti , M., Sabatinelli, D. dan Lang, P.J. (2001). "Emotion and Motivation II: Sex Differences in Picture Processing", *Emotion*, Vol.1, No.3, 300-319.

"DAS Citarum Menanti Badan Otorita", *Kompas Online*, 6 October 2003.

Howard, N. (1996). "Negotiation as Drama: How "Games" Become Dramatic", *International Negotiation*, No. 1, 125-152.

Howard, N., Bennet, P., Bryant, J. and Bradley, M. (1993). "Manifesto for a Theory of Drama and Irrational Choice", *Systems Practice*, Vol. 6, No. 4, 429-434.

Howard, N. (1994a). "Drama Theory and its Relation to Game Theory: Part One", *Group Decision and Negotiation*, No. 3, 187-206.

Howard, N. (1994b)."Drama Theory and its Relation to Game Theory: Part Two", *Group Decision and Negotiation*, No. 3, 207-235.

Idrus, H. Water Quality Management for the Citarum River basin, *Jasa Tirta II Public Corporation*.

Jiang, H., Vidal, J.M. and Huhns, M.N. (2004). *Incorporating Emotions into Automated Negotiation*. University of South Carolina, Columbia.

Maulana, F. (2004). "Menyelamatkan Hutan Tatar Sunda", *Kompas Online*, 12 Mei 2004.

Mehrabian, A. (1976). "Questionnaire measures of affiliative tendency and sensitivity to rejection". *Psychological Reports*, Vol. 38, 199-209.

Mehrabian, A. (1997). "Analysis of Affiliation Related Traits in Term of PAD Temperament Model". *The Journal of Psychology*, Vol.131, 101-117.

"Pendangkalan Citarum Mencapai Empat Meter", *Pikiran Rakyat*, 21 December 2004.

Putro, U.S. (2000). "Adaptive Learning of Hypergame Situations Using a Genetic Algorithm", *IEEE Transactions on Systems, Man, and Cybernetics*, Vol. 30, No. 5, 562-572.

Putro, U.S. et al., (2005). "Agent Based Modeling and Simulation of Knowledge Management", *Proceeding IFSR*.

Putro, U.S. et.al. (2005). "Drama Theory sebagai Model dari Dinamika Konflik dalam Permasalahan DAS Citarum", *Jurnal Manajemen Teknologi*, Vol. 4, No. 2. 88-104.

Putro, U.S. et.al. (2007). "Role of Emotion in Negotiation Process: An Application of Drama Theory in Citarum River Basin Problem", *International Society of System Science*.

Sungkono, E (2005)."Citarum", *Pikiran Rakyat*, 17 April 2005.

Umar, S. (2005). "Meminimalisasi Banjir Citarum", *Pikiran Rakyat*, 18 March 2005.