Proceedings of the 2007 Winter Simulation Conference
S. G. Henderson, B. Biller, M.-H. Hsieh, J. Shortle, J. D. Tew, and R. R. Barton, eds.

MODELING AND SIMULATION OF GROUP BEHAVIOR IN E-GOVERNMENT IMPLEMENTATION

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ABSTRACT

This study proposes a multi-agent modeling and simulation approach using EGGBM (E-Government Group Behavior Model) to research complex group behavior in E-government implementation. A multi-agent simulation decision system based on Java-REPAST is developed for qualitative validation to show that EGGBM is consistent with common sense. We give an example of EGGBM application to show that EGGBM method can help decision-makers choose appropriate decisions to improve the level of accepting information technology (LAIT) of groups. Finally, we conclude that this approach could provide a new attempt for the research of group behavior in E-government organization.

1 INTRODUCTION

Recently in China, with the accelerating pace of applying information technology in E-government, there have been some thorny issues. In particular, behavioral and psychological problems which are often the most difficult to solve are the key to the success of the reform. According to the recent survey of China Social Science Institute published in March, 2006, nowadays, there are four main obstacles in E-government implementation: Structural Inertia, Group Pressure, Existent Power and Threat of Expertise.

Related to these obstacles, groups in the organization play a decisive role. Psychological and behavioral reaction of groups in the whole process of information is delicate. Individuals are not as a single person, who exists in the circumstance under the influence of groups, and environment and groups have impact on his psychology(P.Robbins, 2002). Therefore, human psychological and behavioral analysis is necessary for proper decision-making in E-government implementation.

The combination of information technology and psychological research, in particular combination with social psychology, has become a new area of research(R. K. S. ROSARIA CONTE, 2001). It has been further studied and will documented that information method such as the Internet have a great impact on people's psychology, creating a new discipline-Internet psychology(Wallace, 2001). In addition to psychological research, some Qualitative Analysis is taken from the perspective of organization and management of groups(Ozcelik, 2005).

CA (Cellular Automata), also a Multi-agent simulation tool, has proven effective to study the behavior of human and simulate migration, change of concept, as well as change of cooperation relationship in human society (Hegselmann R, 1998). In our previous work, we have used CA model to explore the loyalty of individuals to the group(Hu Bin, 2006). Multi-agent simulation is based on characteristics and behavior of individual and establishes individual characteristics and behavior in the model. Individual is mapped as agent, individual characteristics mapped as the attributes, and individual actions mapped as the methods of agent(Macal, 2005). Using agent's autonomy, reasoning, communication and coordination mechanism(A. T. C, 2006; EricPlaton, 2007) to simulate an independent group of the mutual interaction between individuals, results in conclusions towards the structure and function of groups or the overall organization system.

An advantage of using agent-based simulation is that it is necessary to think through one's basic assumptions very clearly in order to create a useful simulation model. Another benefit of simulation is that, in some circumstances, it can give insights into the "emergence" of macro level phenomena from micro level actions(Gilbert Nigel, 2000). Within organization science in particular, and social science more generally, scientists and practitioners are turning to computational analysis to address fundamental socio-technical problems that are so complex and dynamic that they cannot be fully addressed by tradition techniques(Carley, 2002). This has resulted in the emergence of a new scientific discipline that is computational social and organizational science(Carley, 2002).

In this paper, we: (1) analyzed the relationship throughout the E-government implementation by System Dynamic analysis (2) proposed a multi-agent simulation model of

group behavior in application of information technology in governmental organization (EGGBM: E-Government Group Behavior Model); (3) constructed a simulation system using a Java-Repast, and analyzed the management decision-making that is complicatedly performed in actual environment;

In section 2 we propose EGGBM mathematical modeling. Validation is described in section 3. Application of the Model, along with some related discussions and some revelations are introduced in section 4 and 5. Finally, conclusions and prospects for future research work are announced in section 6.

2 EGGBM MODELING

System Dynamic is regarded as an analysis tool to understand the casual relationship of the elements in EGGBM Modeling. Then, agent objects and their attributes are defined to describe individuals in groups, and some agent action rules are regulated to let agents know how to act in the artificial society (John H. Holland, 2006).

2.1 System Dynamic Analysis

System Dynamic is used to analyze EGGBM modeling from the perspective of relationship to link parts of the system(Pearl J. Causality, 2000). System Dynamic depends on the behaviors and characteristics of dynamic internal structure and feedback mechanism (Ogata, 2001). Systems Dynamics (SD) is extremely useful for identifying the important variables and causal linkages in a system and for structuring many aspects of model development. Many ABMS modeling projects has benefited greatly by beginning with a systematic identification and analysis of the important variables in the system and their causal relationships as in SD (Macal, 2005). Vensim software is used to establish a system dynamic map of this model, shown in Figure 1.

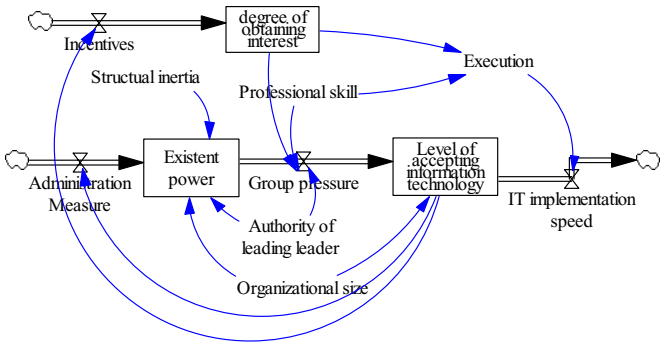

Figure 1: System Dynamic Analysis of EGGBM.

According to the analysis of system dynamic, E-government implementation are regarded as a large system including input, internal structure, output and feedback. Administrative measures and incentive are input. In internal structure, there are human groups in the process of E-government implementation, consisting of many agents. Output is the reaction of group behavior to the E-government implementation. In feedback, the level of accepting information technology influences governmental administrative measures and incentives.

According to the theory of Edward Spraunger (M.Hodgetts, 2002), in governmental organization, the groups are classified under three value classes: economic type, political and social type. For different individuals, different incentives are used to improve the degree of obtaining interest (DOI). The individuals meet the needs to a variety of extent in Social, Esteem and Self-actualization level, which are the highest three levels defined by Maslow's hierarchy of human need theory(P.Robbins, 2002). The organization groups, who have their own power related to their own interests and professional backgrounds, have an impact on the groups around them. Opponents whose interests have not been met will give advocator who satisfy the interests pressure, and lower their level of accepting information technology (LAIT). Conversely, advocator will put pressure on opponents, and urge opponents to accept information technology. They are in the ongoing game for safeguarding their own interests in E-government implementation.

The execution of administrative measures also reduce the power of opponents that influence decision-makers to postpone the implementation of E-government. Structural inertia relates to the distribution of powers inside organization. The more guarded power hierarchy is, the greater the difference between different levels of power. Consequently, it will give way to the bureaucratic organization much more and leads to a greater structural inertia. Meanwhile, the degree of obtaining interest (DOI), the existent power and profession skill all have an impact on the group's pressure to influence the E-government implementation.

2.2 Agent Object

According to System Dynamic analysis of E-government implementation in the above section, this study establishes an agent model illustrated in Figure2, a circle with a number represents an agent, which is an individual in E-government implementation. The agents with red circle are in favor of applying information technology, while agents with blue circle behave against information technology. In addition, there are maybe some green circles that represent neutral agents. The gray-level of the cell occupied by an agent represents the level of accepting information technology (LAIT). Those cells that have not been occupied by agents represent passive elements in the E-government implementation, which may be a process, some workers, some software engineers or others that would not been clearly described in this model. T The defined agents do

not directly influence their level of accepting information technology (LAIT), however, they are affected by the LAIT of their neighbors' cells. Agents would move freely in the world of cell and communicate with other agents. There are also environmental factors, defining which agents depend for survival and is referred to the attributes and policy of governmental organization in this research.

Figure 2: Agent model in Moore neighbors.

As shown in Figure 2, $A_n(i,j)$ represents an agent, and $A_{nL}(i,j)$ represents the agents in its eight Moore neighbor. Each agent has some attributes like the level of accepting information technology (LAIT), existent power of groups (EPG), the degree of obtaining interest (DOI), value type (VT).

1) **LAIT**- $S_{(i,j)}(t)$: defined as the state of cell located in (i, j) of grid world in t tick phase. "1" indicates that individuals accept information technology to a very large extent, and their gray color is white, while "0" is very small, and their gray color is black. The $S_{(i,j)L}(t)$ represents LAIT of cells in eight Moore areas.

2) **EGP**- $E_{(i,j)}(t)$: a weight element that represents pressure on individuals around and $E_{(i,j)L}(t)$ is defined as existent power of agents located in Moore area. $0 \le E_{(i,j)}(t), E_{(i,j)L}(t) \le 1$. Different existent power of individuals in governmental organization are $E^{l}_{(i,j)}(l = 1,2,\cdots c)$, where c represents authority level.

3) **DOI**- $P_{(i,j)}(t)$: "-1" represents one who definitely lost interest and "1" represents one who definitely benefits. In fact, this value usually locates between "0" and "1". Define $P_{(i,j)}(t)$ and $P_{(i,j)L}(t)$ as characteristic of agent located in cell (i,j) and characteristics of its eight Moore neighbors respectively. $P_{(i,j)}(t)$ and $P_{(i,j)L}(t) = \{y \mid -1 \le y \le 1\}$.

4) **VT**- $T(i,j)$: "0" is social type, "1" is economic type and "2" represents political type.

Besides attributes of agent in the model, environment factors such as structural inertia, administrative measures and incentives are also included:

1) **Structural Inertia**- In: the larger structural inertia is, the more deep-rooted ideological power organization has. Thus, organization has less flexibility, and it is more difficult to let E-government go on. It takes value between 0 and 1. $0 \le In \le 1$.

2) **Administration Measure**- $PM_{(i,j)}(t)$: "1" shows that managers take complete administrative measures, and "0" shows that they did not take any administrative measures and let governmental organization develop with its nature. $PM_{(i,j)}(t) = \{z \mid 0 \le z \le 1\}$.

3) **Incentives**- $SM_{(i,j)}(t)$, "1" shows managers to take complete incentives, and "0" shows that they did not take any incentives and let them develop with their nature. Define $TypeSM_{(i,j)}(t)$ as the type of Incentives, "0" is social type, "1" is economic type and "2" is political type.umn).

2.3 Actions of Agents

Apart from the definition of variables and states in the EGGBM model, these variables need to be linked and states is transformed by some actions, so as to make the model evolve to produce emergence phenomena.

1) **Action 1:** in governmental organization, a group has different hierarchy. Those who stay at the top hierarchy maintain greater power. Therefore, groups with the greater structural inertia have more difference between powers at different levels. In this study, the level of organization's authority is 3, and the value of c in equation $E^{l}_{(i,j)}(l = 1,2,\cdots c)$ is 3. Only one individual in the first level is leading leader, who holds maximum of power, which is represented by $E^{1}_{(i,j)} = 1$. Therefore, the equation is written as follows:

$$E^{l+1}_{(i,j)} = E^{l} - E^{l} * In \tag{1}$$

2) **Action 2:** administration measure will reduce the existent power of individual. Administration measure will exponentially decay from the beginning point of its execution, as follows:

$$PM_{(i,j)}(t) = \lambda_1(1 - e^{-\alpha_1(t-t_1)}) \tag{2}$$

$$E_{(i,j)}(t) = E_{(i,j)}(t_1) - E_{(i,j)}(t_1)PM_{(i,j)}(t) \tag{3}$$

where t_1 is beginning time when the measure begins to execute.

3) **Action 3:** Incentive will improve DOI of individuals. Social incentive will improve DOI of social individual, political incentive will improve DOI of political individual and economic incentive will improve DOI of economic individual.

$$SM_{(i,j)}(t) = \lambda_2(1 - e^{-\alpha_2(t-t_2)}) \tag{4}$$

$$P_{(i,j)}(t) = P_{(i,j)}(t_2) + |P_{(i,j)}(t_2)| * SM_{(i,j)}(t), \quad \forall TypeSM_{(i,j)}(t) = T(i,j) \tag{5}$$

where t_2 is beginning time when the incentive begins to impose.

4) **Action 4:** to every agent $A_n(i,j)$, the force of all the winners of interest (DOI is greater than 0) and the losses (DOI is lower than 0) are considered. LAIT is affected by the side with greater force. The force of those who win interest is defined as GA, and the force of those who lose

interest is defined as LA, as follows:

$$GA = \sum_{k=1}^{m} E_{L(i,j)}(t+1)P_{L(i,j)}(t+1) + E_{(i,j)}(t+1)P_{(i,j)}(t+1), \quad \forall P_{(i,j)}(t+1) > 0, \forall P_{L(i,j)}(t+1) > 0 \tag{6}$$

$$LA = \sum_{k=1}^{m} E_{L(i,j)}(t+1) \mid P_{L(i,j)}(t+1) \mid + E_{(i,j)}(t+1) \times \mid P_{(i,j)}(t+1) \mid, \forall P_{(i,j)}(t+1) < 0, \forall P_{L(i,j)}(t+1) < 0 \tag{7}$$

where m represents the number of agents located in Moore neighbor areas of (i,j) Agent. Define the average of LAIT as $\overline{S} = (\sum_{k=1}^{m} S_{(i,j)L}(t) + S_{(i,j)}(t))/m$, and then LAIT of agent in next time is:

$$S_{(i,j)}(t+1) = S_{(i,j)}(t) + (GA - LA) * \overline{S} / m \tag{8}$$

2.4 Simulation Engine

A simulation engine is used to integrate all the above components including object variables and object actions to drive simulation. The simulation engine runs as follows:

Step 1: Generate the initial attributes including LAIT, EGP, DOI, Value Type, Structural Inertia etc.

Step 2: Calculate the EGP according to initial Structural Inertia according to Action 1.

Step 3: Change the EGP of individuals with the imposing of administration measure according to Action 2.

Step 4: Change the DOI of individuals with influence of Incentive according to Action 3.

Step 5: Change the LAIT when an agent is affected by agents in his neighbors according to Action 4.

Step 6: Move individuals in artificial society randomly.

Step 7: Calculate the mean and variance of LAIT to measure the status of group behavior in E-government.

Then, the process return Step 2 to begin a new iteration in a unit time, which refer to one tick time in this paper.

3 EGGBM VALIDATION

We use REPAST to implement EGGBM. For model validation, a qualitative validation must be used when no recognizable patterns are generated, but for human beings meaningful behavior is expressed by the model, is the Turing Test (Kuppers & Lenhard, 2005). Turing Test will answer "can human beings discriminate between the outcomes of a computer model and the outcomes of the real system the computer is modeling?". Also, the recent relativist/holistic philosophy argues that validation of the internal structure cannot be made entirely objective, formal and quantitative(Barlas, 1996).

We utilize qualitative validation method that extends Turing Test(Dijkum, 1999). In the following sections, we will introduce the conceptual model and validation steps, then a validation experimental example is given to introduce how to design such an experiment to validate, finally analysis is given to complete this in an example of the validating process.

3.1 Conceptual model and its validation steps

The components in EGGBM can be integrated to form a conceptual model of the E-Government Group Behavior. The framework for this model is illustrated in Figure 3.

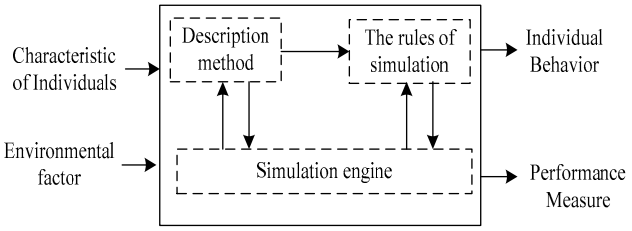

Figure 3. Conceptual Model of Agent-based Simulation with Inputs and Outputs

The first component is the description method. Based on it, values are assigned according to the characteristics of individuals. An environmental change is input and the rules that are second component are triggered. The third component, qualitative simulation engine, drives runs of all these components combined. Specially, the space that individuals move in is artificial society, where individuals communicate to interact with others for accepting information technology. The whole virtual society is simulated in the computer.

As stated in (Dijkum C, 1999), methods of validation are classified into two types: quantitative (or basic) validation and qualitative validation. For our purposes, the qualitative method is clearly the most appropriate. There is no full-proof method for determining the validity of qualitative simulation. We can, however, conduct a reasonable assessment via the following:

First: Isolate an example.

Second: Design a sampling of varying inputs, each a differing combination of individual characteristics, task characteristics and changes of policy.

Third: Run a simulation of each to yield a corresponding output.

Fourth: Assess process of input to output according to common managerial sense. If these are consistent, then the proposed method is valid. Otherwise, it is not.

In this study, three sets of experiment are designed to validate EGGBM. Firstly interest loss-winner validation experiment is designed to inspect that how the final LAIT will be changed by a variety of number of interest winners and interest losses. Secondly, structural inertia validation experiment is proposed to validate the structural inertia. Thirdly, incentive validation experiment is given to see

what impact of different type of incentive on individuals with different value types. In each experiment, first, programs with combination of parameters are planned. We use *Extreme Condition Tests* for extreme combination of parameters (Sargent, 2004). Secondly, statistical curve of the mean and variance of LAIT will be described. Finally, results are analyzed to decide if it is valid.

3.2 Example of designs for experiment

This experiment includes two groups, putting some administrative measures but without incentives. The first group has three experimental programs of 1, 2, 3, where structural inertia will be unchanged, however, administrative measures will change the attenuation value(*Alpha*) as 0.1, 5, and 50. It is anticipated that if administrative measures will have the right impact on LAIT of groups. For the second group of the study, the programs 4,5,6,7 maintain to be unchanged attenuation of administrative measures, and adjust the structural inertia(*Inertia*) as 0.01, 0.5, 0.8 and 1 respectively. It identifies how LAIT of groups changes in the process of government IT application.

Table 1. Experimental designs.

Program	1	2	3	4	5	6	7
Inertia	*0.5*	*0.5*	*0.5*	*0.0.1*	*0.5*	*0.8*	*1*
Alpha	*0.1*	*5*	*50*	*5*	*5*	*5*	*5*

3.3 Qualitative simulation and analysis

We can see that these programs 1, 2, 3 all imposed administrative measures, and increased attenuation index in turn. As shown in Figure 4, the mean LAIT of the three programs attend maximum at the time of about tick=38. However, the program 1 has the fastest attenuation of LAIT, and reaches the final stable value 0.7 at tick=223. The program 2 reaches a stable value of about 0.65 at tick=371. The program 3 maintains the stability of value 1, which is the highest level value of accepting information(LAIT) and starts from the beginning of the programs.

These are identical to the reality of the situation. Firstly, in program 1, imposing administrative measures on the group (MAS) will reduce the existent power of interest losses (information opponents). Interest losses dare not oppose information technology and act on accepting information technology, thus this entire group will improve LAIT. Secondly, in program 2, this is because administrative measure tends to be more effective after it starts implementation everybody is more scared, fearing to punishment due to no fault of their own. However, it lasts for a long time, the administrative measures will be gradually psychologically adapted, and countermeasure is found in group behavior. At that time, it is not very effective and might go to be attenuation. Thus, the interest losses again begin to oppose information and LAIT of groups would have some decline. The faster the attenuation of administrative measures is, the faster LAIT declines, however, it tends to be a state of balance and stability in the end. Thirdly, in program 3, the administrative measure cannot lower and maintain the maximum 1, so opponents will be suppressed and the LAIT will maintain the maximum 1. These all fit the common sense.

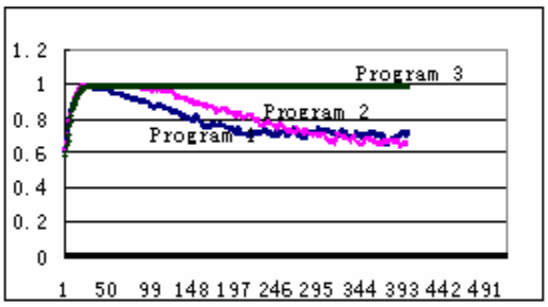

Figure 4: the mean of LAIT of Program 1, 2, 3

From the results of group 2, the program 4, 5, 6, 7 all have administrative measures imposed, holding the same attenuation, and structural inertia increases in turn. As shown in Figure 5, the mean LAIT of the program 4, 5, 6 have all already reached the maximum "1", however, the smaller structural inertia is, the quicker it reaches the maximum. The three programs attend maximum at tick=22, tick=26 and tick=60 respectively. This is in line with common sense. As mentioned in section 2.1 of the mathematical modeling, the greater the structural inertia is, the more conservative organization behaves. Therefore, it is more difficult to change the behavior of the organization. In this condition, carrying out information technology faces much more obstacles.

The program 7 holds large structural inertia of value 1, thus LAIT cannot attend the maximum. On the contrary, it declines. It is because, at that time, the power of the leading leader is over-concentration, all will say yes when the leading leader say yes, vice versa. The leader is just an interest loss (random distribution) now, therefore, he would make the people who originally win interest (in favor, but don't have existed power and cannot be leading) drop LAIT. Interest winners will consequently affect LAIT of

other individuals throughout the organization and let LAIT of groups decline. This is in line with actual knowledge.

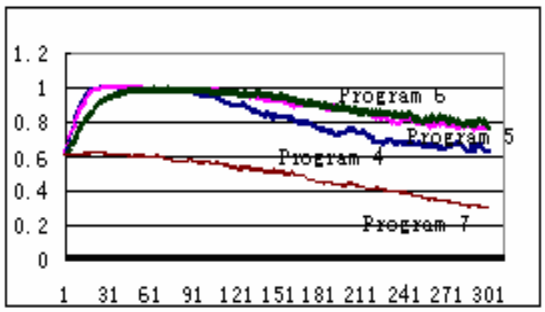

Figure 5: the mean of LAIT of program 4, 5, 6, 7

In addition, using the same method as the above experimental design, we also design interest loss-winner validation experiment and incentive validation experiment. In short, from the three analysis of the experiments, it is qualitatively drawn that Repast-based EGGBM simulation model is consistent with common sense, and is used to reflect group behavior and information environment in the actual process of government information.

4 AN EXAMPLE OF EGGBM APPLICATION

For simulation application of EGGBM, we assume that we have identified some of the parameters in governmental organization by an investigation of statistical analysis, the degree of interests and value type of 90 officials have been understood through Allport-Vernon-Lindzey Study of Value (M.Hodgetts, 2002). We can use information input interface to input value types and the degree of interests(DOI) for each agent. The next task is to seek help from simulation. We try to find a combination of administration and incentive with the lowest cost when LAIT of group arrive at maximum at tick=200 and maintain the value near the maximum 1. Now, we design 12 programs with initial "1" strength of administrative measures, and compare the impact of different types of incentives and intensity on the final LAIT of groups. The parameters are shown in Table 2.

Simulation results are shown in Figure 6. In this experiment, we acquire 20 data which are closest to the tick value 200, and the average LAIT will be calculated according to the above 20 data. We run three times randomly of 12 programs respectively for sampling and get the average value of each program. Program 6 is the best, of which LAIT value is closest to the maximum 1, thus social incentives with the intensity 0.8 is the most appropriate to this group of 90 individuals.

Table 2. Parameters setup of application example.

Political P	**1** : 1	**2** : 0.8	**3** : 0.6	**4** : 0.4
Social S	**5** : 1	**6** : 0.8	**7** : 0.6	**8** : 0.4
Economic E	**9** : 1	**10** : 0.8	**11** : 0.6	**12** : 0.4

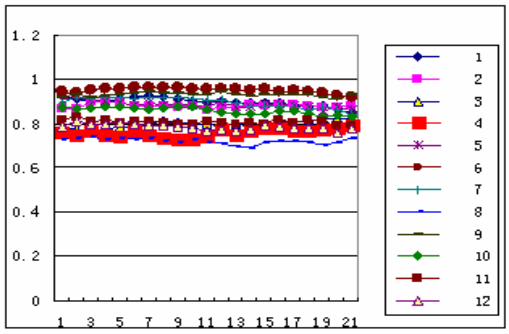

Figure 6: The mean of LAIT of application experiment.

5 DISCUSSIONS AND REVELATIONS

In this section, the impact of the initial LAIT on the future LAIT are studied. The experiment is designed as follows: we assume that the number of interest winners maintains 50, while the total number of agent is 100. There are not administrative measures and incentives imposed, and the mean and variance of LAIT have different combinations as follows: (0.6, 0.2), (0.6, 0) and (0, 0.2).

From the above, we can draw some conclusions as follows. In the absence of any administrative measures and any incentives, whether the initial LAIT of groups and the distribution of information technology is, whether the combination of mean and variance change, the final LAIT will always tend to be a stable value, and the mean values tend to a stabilized value 0.6, 0.6 and 0.6 respectively, and the variance of LAIT are close to 0.4, 0.4 and 0.4 respectively. Furthermore, agents have existent power and degree of interest that is randomly distributed. As shown in Figure 7, it is found that in the experiment with the combination of the mean and variance (0.6, 0.2) interest winners once get a great win, therefore, the mean of LAIT increases to 1 once. However over time, at the time of tick=260, the mean of LAIT is still in a position around the same value as the start value of 0.6 and tends to be stable.

This leads to a discovery that the initial LAIT of groups has little effect on the future LAIT. The key is to take different administration measures and incentives in E-government implementation, and the interaction in organization have a great impact on LAIT of groups.

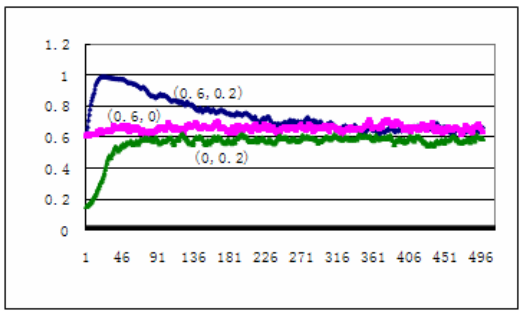

Figure 7: The mean of LAIT.

This analysis has also given us a revelation that in the E-government implementation, the government would not frustrate just because of low initial level in application of information technology and low initial LAIT. They should seize the future, take reasonable incentive and administrative measures, and effectively make decision among some other important aspects of information technology including software developers, equipment procurement, and staff training. These aspects are all parts of E-government implementation, which is a large system. Only if a systematic consideration of these factors is made, information technology is successfully accepted by governmental organization and its speed can eventually accelerate.

In addition, we understand that the last LAIT is always inclined to be a stable value, no matter how the parameters of model adjust. On the surface, this result is not easily expected. In fact, under the principle of organizational behavior (P.Robbins, 2002), internal or external environment will change. Under this influence, groups always make fluctuations of behavior and mood, which gradually reaches steady state equilibrium. The process of accepting information technology for groups is also a process tending to a final equilibrium. The above phenomenon can also be concluded according to the "social exchange theory"(Blau P, 1964), people are motivated by a desire for social status and respect as much as they are motivated by gains that are material and/or monetary. This duality manifests in behavior. Consider, as an example, the inclination to act according to what is in the group's best interests as opposed to one's own. From the group's point of view, one should be loyal and do what is in the best interests of the group. The individual, however, considers their own best interests to be as important and will weigh them accordingly(Prien R L, 1995) when considering the benefits vs. the costs of behaving loyally. The evolution of the group will therefore depend largely upon these personal evaluations. This manifests via process of equilibrium-oscillation-equilibrium.

It also reveals that in E-government implementation, there is usually a lot of resistance. There is struggle between groups of different interests. However, this system will always tend to be stable, and may tend to a state of rejecting information technology or a state of accepting information technology. At that time, as decision-makers, they cannot expect what happened in the internal groups themselves as time goes on, and blindly regard that people will accept information technology because they will be accustomed to it, and thus they will remain without reform. Unfortunately, like this, "never change means to be dead" dangerous phase would last for a long period and E-government implementation would never be pushed. It tells us that decision-makers must exactly see the current state of accepting information technology, and adopt appropriate incentive and administration measure.

6 CONCLUSIONS AND FURTHER WORK

In this paper, group behavior in the process of E-government implementation has been in-depth analyzed. We use System Dynamic as a tool to think from perspective of system. Thus it is found that structural inertia, the degree of interest and existent power of groups will have impact on the level of accepting information technology (LAIT) of groups, and imposing different types of incentive measures on people with different value types respectively leads to fairly good results. Moreover, based on Repast, the E-Government Group Behavior Model (EGGBM) is implemented. Then, qualitative validation is proposed to assure that EGGBM is qualitatively consistent with the real system. We can use EGGBM for implementation of measures to simulate the process of decision-making and forecasting application of information technology, which can provide basic analysis for some unpredictability in E-government implementation.

For further work, we will continuously study in depth the impact of information technology on organizational design and the impact of informal groups on E-government implementation. We will also introduce genetic algorithm into parallel computing simulation of groups and organization. There has been still no full proof to validate EGGBM yet. It is known that VDT has spent two decades for various validations (Raymond E. Levitt, 2005). Therefore, validation needs long-term effort to be applicable. We plan to combine case study with simulation to validate our model.

ACKNOWLEDGMENTS

Our work was conducted as part of the Qualitative Simulation Team Work for Complex Management Systems in Institute of Intelligent Management and Complex System, Huazhong University of Science and Technology , P.R.China. Our work of Qualitative Simulation Team work is funded by the China National Natural Science Fund (No. 70671048).

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