Chapter 4
Experiment

In this study, the RBPS model was built to select trusted partners with fine trust characteristics like competence, goodwill and predictability via reputation system and referral networks in a collaborative business environment. The experiments were then developed to test the ability of this model that helps the trustor enterprises to select a trusted trustee in certain values of certain factors. Therefore, there are four objectives to evaluate the proposed model:

1. To test the model that can help the trustor to select the partner candidate with fine characteristics in three trust types by using reputation system and referral networks.
2. To identify the critical factors that most affect the results in the experiment.
3. To identify the critical values of the critical factors that lead to the steadiness of the results during multiple tests in the experiment.
4. To identify the most critical trust type among competence trust, goodwill trust and predictability trust.

4.1 Experiment Design

Four experiments were conducted to achieve the objectives previously mentioned. First, a computer simulation was designed to demonstrate that the model is an effective way to help trustor enterprises to select a partner, among eight various candidates, with fine characteristics in three trust types. Second, a 2^k factorial design was created to identify the critical factors by using multivariate statistical analysis method as ANOVA test. Third, a factorial design was to identify the critical values of the critical factors by using ANOVA test. Finally, this study identifies what is the most critical trust type among three trust types. Four experiments were described as below:

4.1.1 Partner Selection

Numerous agents were created in the agent community during the partner selection phase of the simulation. Each agent, with different

characteristics in three trust types, had various numbers of friends who can recommend others to explore the rater agents. The identified rater agents were weighted according to the position in the referral networks. The testimonies of trustee agents were then gathered and translated into an initial-trust score. Finally, the trustor agent selects a trustee agent with the highest initial-trust score to be a partner during each CPS process. After 500 times of CPS (as one round of CPS) the frequency for each trustee agent who was selected by the trustor agent was obtained. To determine the performance of the RBPS model for selecting the collaborative partner, the most frequently selected trustee agent was compared with the candidate with fine temperament in competence, goodwill and predictability.

The partner selection process was performed in two steps: namely (1) environment setting step, and (2) partner selection step. The environment setting step involved creating many agents, and defining agents as trustees, raters and recommenders to form an agent community. During the partner selection step, the trustor agent was chosen from agent community in the beginning of the process to select a partner namely Collaborative Partner Selection (CPS) and the rater agents were then searched from among the agent's friends. The referral network was then constructed, the identified rater agents were weighted, and the initial-trust scores of trustee agents were determined.

4.1.1.1 Environment Setting Step

In the environment setting step, many agents were created to form an agent community, simulating an enterprise selecting a trusted partner in a collaborative business environment. The environment of the agent community was defined as follows:

- An agent community was created with *M* agents.
- Eight agents were chosen from the agent community to be trustee agents (named AH, BH, CH, DH, AL, BL, CL and DL). Each trustee agent had a given level of performance in competence, goodwill and predictability.
- *N* rater agents were randomly chosen for each trustee agent from

the agent community.

- *P* recommender agents were randomly chosen for each rater agent from the agent community.
- The searching depth *S* was defined by the trustor agent to identify the rater agents in a specific searching path of referral networks.
- The collaboration threshold was set to 0.

The eight trustee agents were assigned with various probabilities of performing well in the trust types such as competence (α), goodwill (β) and predictability (γ) (see Table 4.1).

Good performance in these characteristics was denoted as "H", while bad performance was given as "L". In other words, if a trustee agent had a performance "H", he would behave well with a high probability of 0.8; while a trustee agent had a performance "L" would he behaves well with a low probability of 0.2.

Table 4.1 The performance level of various trust types

trustees	Competence (α)	Goodwill (β)	predictability (γ)
AH	H	H	H
BH	H	H	L
CH	H	L	H
DH	H	L	L
AL	L	H	H
BL	L	H	L
CL	L	L	H
DL	L	L	L
H=0.8 L=0.2			

The rules for obtaining competence reputation Z^{R_i} were listed as Rule_Comp.

- Rule_Comp:
  - *If α is "H"*

If random_number (i) ≤ 0.8 then

$0.5 \le Z^{R_i} \le 1$

else

$0.1 \le Z^{R_i} < 0.5$

- *If α is "L"*

If random_number (i) ≥ 0.2 then

$0.1 \le Z^{R_i} < 0.5$

else

$0.5 \le Z^{R_i} \le 1$

The initial-trust score of competence could then be calculated using Eqn. (7) in chapter 3.

The rules for deriving the goodwill reputation $\overline{T}^{R_i}$ were listed as Rule_GW:

- Rule_GW:
  - *If β is "H"*

If random_number (j) ≤ 0.8 then

$0.5 \le \overline{T}^{R_i} \le 1$

else

$0.1 \le \overline{T}^{R_i} < 0.5$

  - *If β is "L"*

If random_number (j) ≥ 0.2 then

$0.1 \le \overline{T}^{R_i} < 0.5$

else

$0.5 \le \overline{T}^{R_i} \le 1$

The score of goodwill initial trust could then be derived by utilizing Eqn. (11) in chapter 3.

Finally, the predictability initial trust score $\mathrm{Pr}ed_{AT_j}$ was determined by adopting the rules as Rule_Pred:

- Rule_Pred:
  - *If γ is "H"*

If random_number (k) ≤ 0.8 then

$0.5 \le \mathrm{Pr}ed_{AT_j} \le 1$

else

$0.1 \le \mathrm{Pr}ed_{AT_j} < 0.5$

- *If γ is "L"*

  If random_number (k) $\geq$ *0.2 then*

  $0.1 \leq \Pr ed_{AT_j} < 0.5$

  else

  $0.5 \leq \Pr ed_{AT_j} \leq 1$

4.1.1.2 Partner Selection Step

Figure 4.1 demonstrates the process to select a trusted partner called Collaborative Partner Selection (CPS), and the CPS was described as follows:

- First: During the partner selection phase, the trustor agent was randomly chosen from the agent community.
- Second: If the trustor agent had no friends, then k friends were assigned to him. These friends could have been recommenders, raters, trustees or agents with no information for further recommendations.
- Third: The agents with various roles (e.g., trustor, recommender, rater and trustee) interacted to identify the rater agents via referral networks.
- Fourth: The identified rater agents were then weighted by using Eqn. (1) in chapter 3.
- Fifth: The trustor agent derived the initial trust score of identified trustee agents based on the rules previously mentioned (i.e., Rule_comp, Rule_GW and Rule_Pred) and by using Eqn. (15) in chapter 3.
- Sixth: The trustor agent selects the trustee agent with the highest initial trust score and reached the thresholds to be the partner.

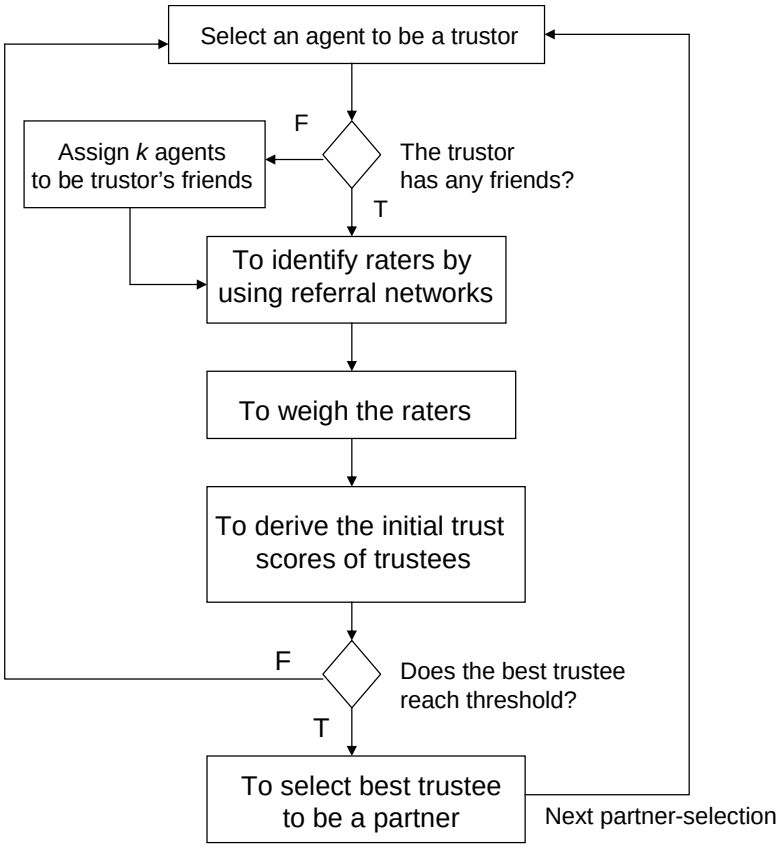

Fig. 4.1 The process of Collaborative Partner Selection (CPS)

The CPS process runs 500 times, constituting "one round of CPS". The number of times for each trustee agent who was selected by the trustor agent was observed. The most frequently selected trustee agent with fine characteristics (e.g., AH) was derived to determine the model's effectiveness in selecting suitable collaborative partners.

The searching path in the referral networks

In the partner selection step, the trustor agent was randomly chosen from the agent community. If the trustor agent had no friends, then *k* friends were assigned to him. Figure 4.2 illustrates the searching path to identify the raters. The searching depth was initially set to zero, and the trustor agent initiated the search path by asking his friends to act as recommenders. The searching degree (S.D) was then incremented by one, and the search path was extended to the friends of the friends of the trustor agent. If the agents, such as friends of the friends, had no further

friends to provide recommendation, or the S.D reached a previously defined threshold of searching depth *S*, then the searching path was terminated. The trustor agent then constructed the referral networks containing the recommender agents, identified rater agents and trustee agents after all searching paths were terminated.

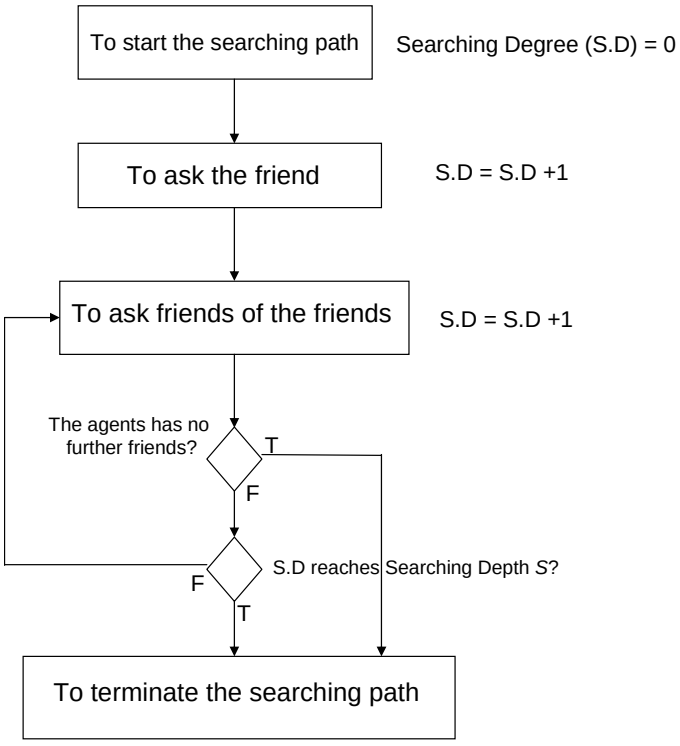

Fig. 4.2 The life cycle of a searching path

For example, Figure 4.3 describes that the trustor agent 'ag12' has no friend in the agent community. Two agents 'ag25' and 'ag66' are assigned to 'ag12'. The 'ag25' has a friend 'ag37', and 'ag37' has no any further friends. On the other hand, the 'ag66' has friend 'ag28', and 'ag28' has friend 'ag127' and so on. The searching paths start from 'ag25' and 'ag66'. One searching path is ag12→ag25→ag37. The other searching path is ag12→ag66→ag28→ag127→ag257→ag352→ag143 due to the searching depth is set to six.

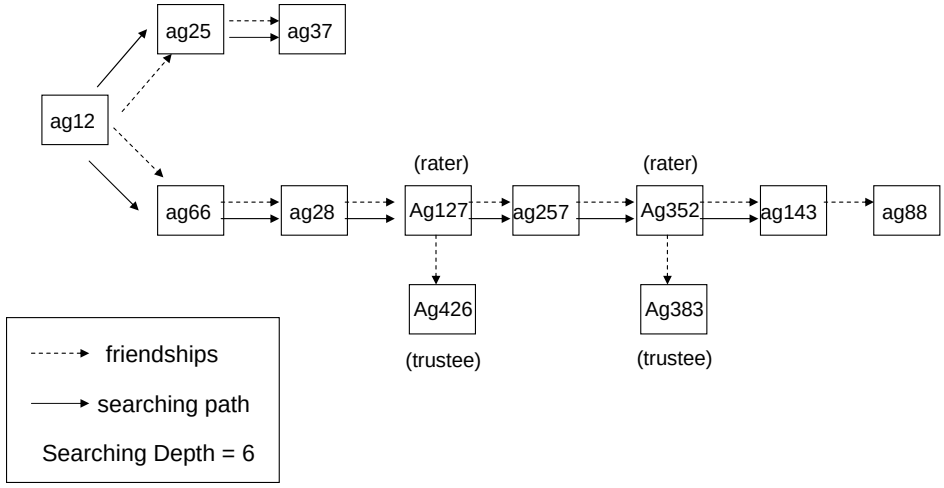

Fig. 4.3 Two searching paths initiated by trustor agent

While the 'ag12' finishes the process of CPS and selects a trustee 'ag383' to be a partner, he adds 'ag25', 'ag66' and 'ag383' to his friend list (e.g., expressed as ag12:[ag25, ag66, ag383]), and these new friends also add 'ag12' to their friends list (e.g., expressed as ag25:[ag37, ag12], ag66:[ag28, ag12] and ag383:[ag12,…]). Therefore, the relationships among the agents in the agent community will evolve into highly connected networks after many runs of CPS. This phenomenon matches the human relationships in the social networks.

To weigh the identified raters

The trustor agent constructed the referral networks and then derived the weights of the raters. The following rules were utilized to determine the weights of the rater agents:

- The searching path SP_i was represented as a set that contains m agents (e.g., SP_i = {ag12, ag66, …}).
- The threshold was defined as θ.
- The rater ag_i was the nth element in SP_i and the pth element in SP_k.
- The weight of the rater *agi* was calculated as: $wr_{agi} = (\frac{1}{\theta})^{n-1} + (\frac{1}{\theta})^{p-1}$

For example, Figure 4.4 demonstrates that the trustor agent ‘ag6’ identifies the rater ‘ag9’ via two searching path ‘SP_1’ and ‘SP_2’ and expressed as:

- SP_1 = {ag6, ag1, ag5, ag9}.
- SP_2 = {ag6, ag2, ag9}.

The ’ag9’ is the fourth element in the SP_1 and the third element in the SP_2. Finally, we set the threshold θ = 2 and the weights of ‘ag9’ can be obtained as: $wr_{ag9} = (\frac{1}{2})^3 + (\frac{1}{2})^2 = 0.375$.

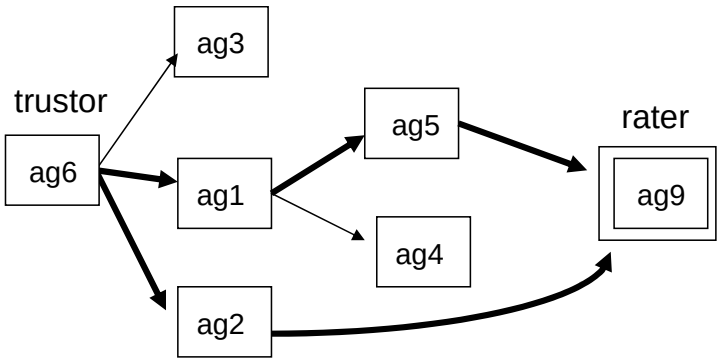

Fig. 4.4 To weigh the identified rater

To derive the initial trust scores

The trustor agent has identified the raters and trustees in a specific CPS, and then the weights of raters were derived. During the testimony aggregation step, the testimonies of competence, goodwill and predictability were obtained for deriving the score of initial-trust for trustees.

An example illustrates the process to derive the initial-trust score of the identified trustee AH in the experiment. The trustee has two identified raters: ‘ag9’ and ‘ag483’; thus, the normalized weights of two raters are defined as $Nwr_{AH}^{ag9} = 0.7$ and $Nwr_{AH}^{ag483} = 0.9$. The scores of competence, goodwill and predictability trust were calculated as follows:

- The competence initial-trust score

The $\alpha_{AH} = 0.8$ and random_number(ag9_i) = 0.5; then, the

$Z_{AH}^{ag9} = 0.8$ was obtained by Rule_Comp. Similarly, the random_number(ag483_i) = 0.7 and the $Z_{AH}^{ag483} = 0.6$ was derived. Finally, the competence initial-trust score is obtained by Eqn. (7):

$$Comp_{AH} = \frac{Nwr_{AH}^{ag9} \times Z_{AH}^{ag9} + Nwr_{AH}^{ag483} \times Z_{AH}^{ag483}}{Nwr_{AH}^{ag9} + Nwr_{AH}^{ag483}}$$
$$= \frac{0.7 \times 0.8 + 0.9 \times 0.6}{0.7 + 0.9} = 0.687$$

- The goodwill initial-trust score

The $\beta_H = 0.8$ and random_number(ag9_j) = 0.9; then, the $\overline{T}_{AH}^{ag9} = 0.4$ was obtained by Rule_GW. Similarly, the random_number(ag483_j) = 0.4 and then $\overline{T}_{AH}^{ag483} = 0.6$. Finally, the goodwill initial-trust score is derived by Eqn. (11):

$$Gw_{AH} = \frac{Nwr_{AH}^{ag9} \times \overline{T}_{AH}^{ag9} + Nwr_{AH}^{ag483} \times \overline{T}_{AH}^{ag483}}{Nwr_{AH}^{ag9} + Nwr_{AH}^{ag483}}$$
$$= \frac{0.7 \times 0.4 + 0.9 \times 0.6}{0.7 + 0.9} = 0.512$$

- The predictability initial-trust score

The $\gamma_{AH} = 0.8$ and the random_number(k) = 0.7; then, the $\Pr ed_{AH} = 0.8$ was derived by Rule_Pred.

- To obtain the initial-trust of trustee

The initial-trust score was derived by using Eqn. (15) in chapter 3. The w_c and w_g were set equally as 0.5 and initial-trust for 'AH' is expressed as:

$$dt_{AH} = (w_c \times Comp_{AH} + w_g \times GW_{AH}) \times \Pr ed_{AH}$$
$$= (0.5 \times 0.687 + 0.5 \times 0.512) \times 0.8 = 0.4796$$

The initial-trust scores of all identified trustees are obtained and the highest one is selected to be the collaborative partner due to the threshold

is set to zero in the experiment. The process of the selection runs numerous times and we can obtain the frequency that each trustee was selected as a collaborative partner.

4.1.2 To Identify the Critical Factors

After each process of CPS, the trustor agent selects one or no trustee agent to be a partner. Therefore, one round of CPS may obtain the frequency of each trustee agent who was selected by the trustor agent. The simulation of the experiment was programmed by Java language and the factors are described as Table 4.2.

Table 4.2 The factors in the simulation

Factors	Description
AgentsNo. (**AgNo**)	The number of agents in the agent community.
RaterNo. (**RaNo**)	The number of rater agents for each trustee agent.
RecommenderNo. (**ReNo**)	The number of recommender agents for each rater agent.
InitialFriendNo. (**IFNo**)	The number of friends assigned when the trustor agent has no any friend initially.
SearchingDepthNo. (**SDNo**)	The number of searching depth for identifying rater agents in the referral networks.
PartnerSelectionNo. (**PSNo**)	The number of CPS for each round of simulation.
RoundsNo. (**RoNo**)	The number of rounds of simulation for CPS.
θ	The thresholds for calculating the weights of rater agents.
W_c	The weights of trust type “competence”, always set 0.5
W_g	The weights of trust type “goodwill”, always set 0.5

For identifying the critical factors which most affect the results of the simulation, a 2^k factorial design was develop that includes factors like RaNo, ReNo, IFNo and SDNo. The values of factors are ‘3’ and ‘6’ (see Table 4.3).

Table 4.3 2^k factorial design

Factor combination (design point)	RaNo	ReNo	IFNo	SDNo
1	3	3	3	3
2	3	3	3	6
3	3	3	6	3
4	3	3	6	6
5	3	6	3	3
6	3	6	3	6
7	3	6	6	3
8	3	6	6	6
9	6	3	3	3
10	6	3	3	6
11	6	3	6	3
12	6	3	6	6
13	6	6	3	3
14	6	6	3	6
15	6	6	6	3
16	6	6	6	6

The results of each factor combination are the number of being selected by trustor agent for each trustee agent after one round of CPS. This study focuses on the selections of the fine trustee agent AH. However, the AH% represents the percentage that the number of selections for AH in the total number of selections in one round of CPS. Further, the average_AH% represents the average of AH% in *m* rounds of CPS. The equation was showed as follows: $Average\_AH\% = \frac{\sum_{i=1}^{m} AH_i\%}{m}$

This study hopes to identify the critical factors and specific factor combination that may result in high average_AH% and low variation of AH% during multiple rounds of CPS. The results of all factor combinations are processed by multivariate statistics analysis as 4-way ANOVA test for identifying the effect power of each factor and their interaction effects. Finally, the critical factors that most affect the results in the simulation can be observed.

4.1.3 To Identify the Critical Values of the Critical Factors

The critical factors were identified, and a factorial design for recognizing the critical value of the critical factors was developed to test the experiment.

The factors in factor combination were arranged as RaNo, ReNo, INFNo and SDNo, and they were defined as follows:

- The AgNo = 1000.
- The PSNo = 500.
- The RoNo = 30.
- The RaNo and ReNo are combined and ranged as {22, 33, 44, 55 and 66}. That is, the term '22' represents RaNo = 2 and ReNo = 2.
- The IFNo is ranged as [2, 6].
- The SDNo is ranged as [2, 6].

The results of the simulation for 125 factor combinations were processed by using ANOVA test. First, the AH% of all factor combinations during each round of CPS was tested for homogeneity of variance. Second, the factor combinations were filtered out if their AH% with extremely high variance as standard deviation and could not pass the test for homogeneity of variance. Third, the one-way ANOVA test was processed and the multiple comparison and homogeneous subset were obtained for remaining factor combinations. Finally, the critical values of critical factors for critical factor combinations can be observed and identified.

4.1.4 To Identify the Critical Trust Type

In this study, we adopt three trust types (as competence, goodwill and predictability) to evaluate a trustee as a trusted collaborative partner. From the results of the average percentage of selection for each trustee, we may observe the critical trust type among competence, goodwill and predictability.

4.2 Experiment Results

The programs for environment setting and partner selection were coded by Java language, and the factors were then identified to test the simulation. The tests for identifying critical factors and critical values of critical factors are tested by ANOVA test and processed by using software as SPSS v.15.0 for Microsoft Windows. Analytical results indicate that the RBPS model can be an effective way to select a fine candidate in multiple CPS.

4.2.1 Partner Selection

One round of CPS

The trustor agent selects a partner after each CPS. Therefore, many CPS (as one round of CPS) were utilized to obtain the number of times of selections that each trustee agent was selected.

A round of CPS was called *PS1*, where AgNo = 1000, RaNo = 5, ReNo = 3, IFNo = 5, SDNo = 6, PSNo = 500, RoNo = 1, $\theta = 2$, $W_c = 0.5$ and $W_g = 0.5$. The factors were listed in the following:

Factor Combination	**AgNo**	**RaNo**	**ReNo**	**IFNo**	**SDNo**	**PSNo**	**RoNo**
PS1	1000	**5**	**3**	**5**	**6**	500	1

The results demonstrate that the trustee agent ‘AH’ won 268 selections, which was 55% of total selections (AH% = 0.55), in 500 times for the CPS (see Fig. 4.5). The RBPS model performed well in this factor combination.

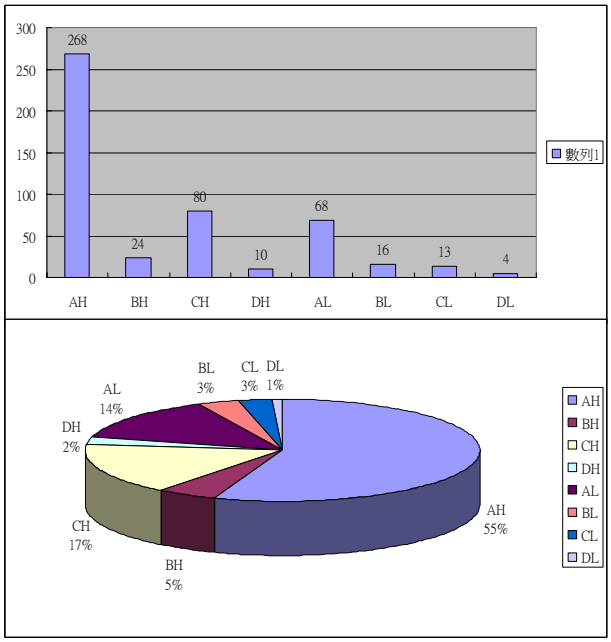

Fig. 4.5 The results of PS1

A round of CPS was called *PS2*, where AgNo = 1000, RaNo = 5, ReNo = 3, IFNo = 5, SDNo = 3, PSNo = 500, RoNo = 1, $\theta = 2$, $W_c = 0.5$ and $W_g = 0.5$. The factor combination was listed in the following:

Factor Combination	**AgNo**	**RaNo**	**ReNo**	**IFNo**	**SDNo**	**PSNo**	**RoNo**
PS2	1000	**5**	**3**	**5**	**3**	500	1

The results demonstrate that the trustee agent 'AH' won 26 selections, which was 10% of total selections (AH% = 0.1), in 500 times for the CPS (see Fig. 4.6). The RBPS model performed not well in this factor combination.

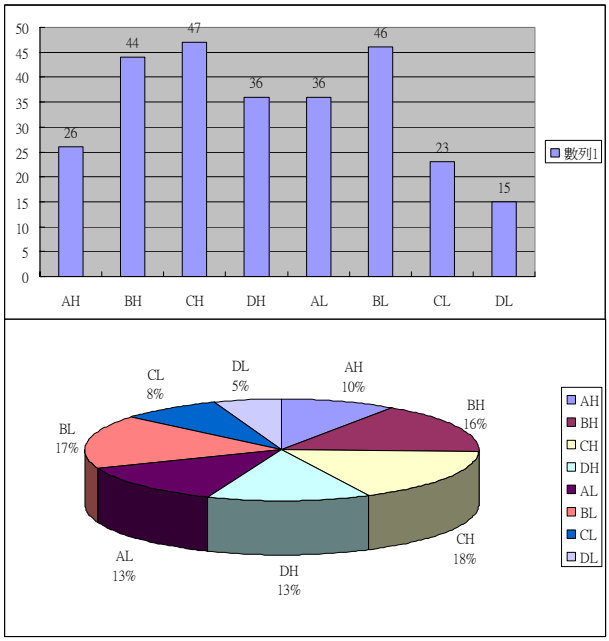

Fig. 4.6 The results of PS2

In a case of CPS namely *PS3*, we define 1000 agents in the agent community and RoNo = 1, $\theta = 2$, $W_c = 0.5$ and $W_g = 0.5$; besides, the values of factors such as RaNo, ReNo, IFNo, SDNo and PSNo were defined as the following:

Factor Combination	**AgNo**	**RaNo**	**ReNo**	**IFNo**	**SDNo**	**PSNo**	**RoNo**
PS3	1000	**3**	**3**	**3**	**3**	500	1

The results demonstrate that the trustee agent ‘AH’ only won 16 selections, which was 12% of total selections (AH% = 0.12), in 500 times for the CPS (see Fig. 4.7). The proposed results for selecting AH in this factor combination performed not well.

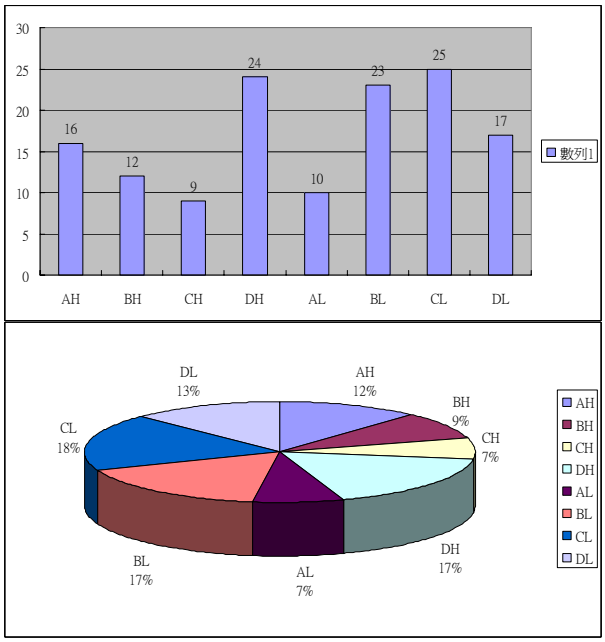

Fig. 4.7 The result of PS3

In the last case *PS4*, we define 1000 agents in the agent community and RoNo = 1, $\theta = 2$, $W_c = 0.5$ and $W_g = 0.5$; besides, the values of factors such as RaNo, ReNo, IFNo, SDNo and PSNo were defined as follows:

Factor Combination	**AgNo**	**RaNo**	**ReNo**	**IFNo**	**SDNo**	**PSNo**	**RoNo**
PS4	1000	**6**	**6**	**6**	**6**	500	1

The results demonstrates that the ‘AH’ won 284 selections, 57% of total selections (AH% = 0.57), in 500 times for the CPS (see Fig. 4.8). Therefore, the results demonstrate that the RBPS model performs well in this factor combination.

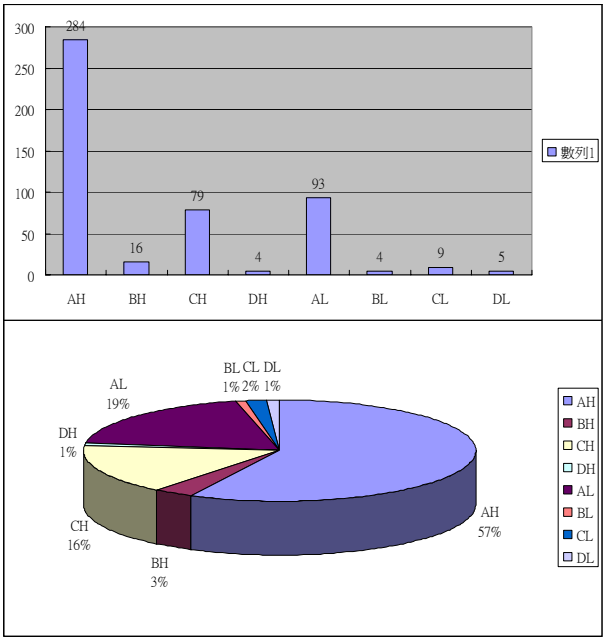

Fig. 4.8 The results of PS4

Multiple rounds of CPS

Four sets of values of factor combinations are created namely MPS1, MPS2, MPS3 and MPS4. They are defined as below:

Factor Combinations	AgNo	RaNo	ReNo	IFNo	SDNo	PSNo	RoNo
MPS1	1000	**5**	**3**	**5**	**6**	500	50
MPS2	1000	**5**	**3**	**5**	**3**	500	50
MPS3	1000	**3**	**3**	**3**	**3**	500	50
MPS4	1000	**6**	**6**	**6**	**6**	500	50

The simulations for each factor combinations run 50 times. The MPS1 simulation yielded 50 values (as the percentage of being selected) for each trustee agent (e.g., AH%, BH%, CH% etc.). The Figure 4.9 demonstrates that the trustee agent AH performs well over 50 rounds of CPS. The results of mean and standard deviation of AH% were 0.54 and 0.054, respectively.

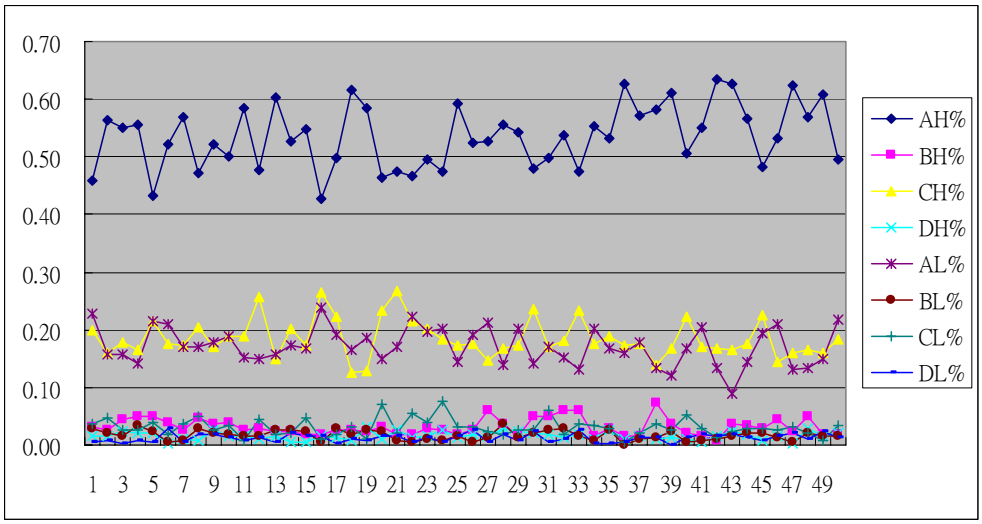

Fig. 4.9 The results of MPS1

The results of the simulation MPS2 are shown as Figure 4.10. There are no trustee agents performs well over 50 times of simulations, and we obtain the average_AH% = 0.14 and standard deviation of AH% = 0.07.

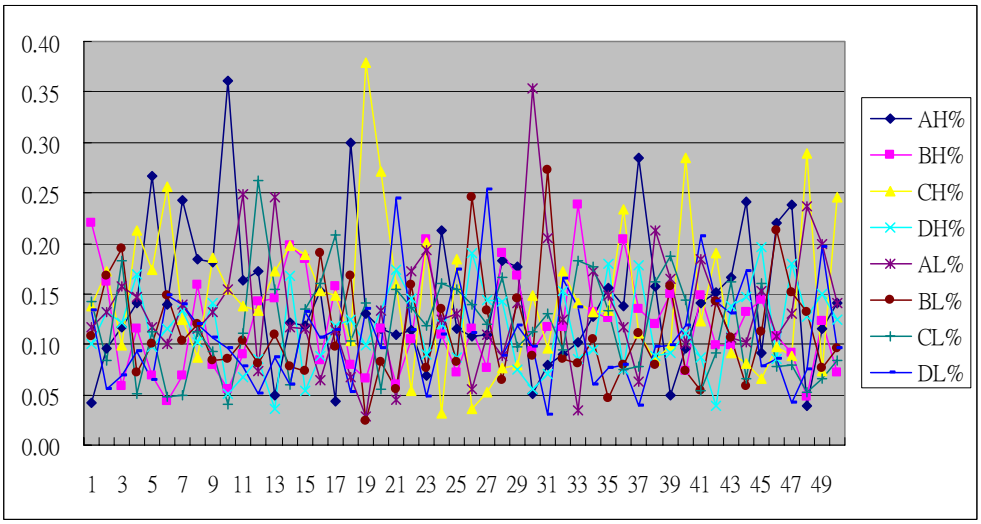

Fig. 4.10 The results of MPS2

The Figure 4.11 demonstrates that no trustee agents perform well in this factor combination over 50 times for simulation MPS3. The result

showed that the average_AH% = 0.14 and standard deviation of AH% = 0.057.

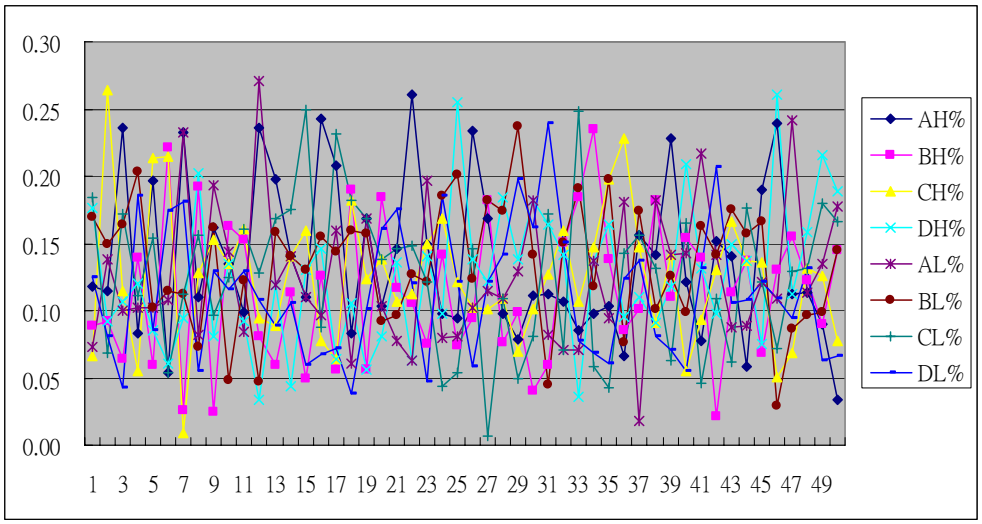

Fig. 4.11 The results of MPS3

The last case MPS4 demonstrates that the factor combination performed well for selecting AH and won selections far more often than other trustee agents over multiple rounds of simulations (see Fig. 4.12). The results of the simulation showed that the average_AH% = 0.57 and standard deviation of AH% = 0.03.

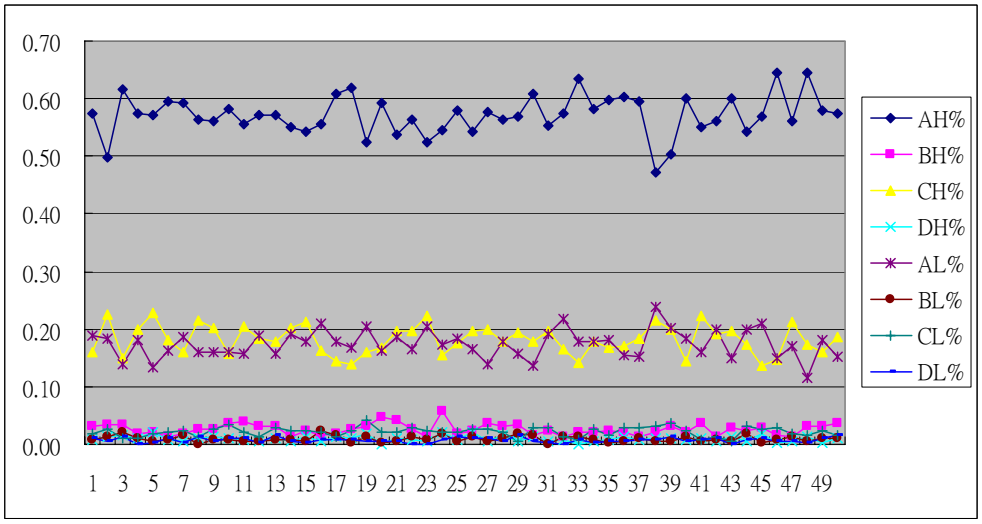

Fig. 4.12 The results of MPS4

4.2.2 Critical Factors

The results of the factor combinations such as MPS1, MPS2, MPS3 and MPS4 demonstrate that the specific values for specific factors may seriously affect the performance of the RBPS model to select the fine trustee agent AH to be a partner. Therefore, a factorial design is developed by using ANOVA test to identify the critical factors that most affect the results of CPS.

The 2^k factorial design (see Table 4.3) was developed and all the 16 factor combinations performed 30 rounds of CPS, and then obtains the results as AH% for each round of selection. The 4-way ANOVA test was used for identifying the most effective factors that cause the most portion of total variation for the results of the simulation. The confidence interval was 99% (α=0.01), and the test of between-subjects effects was shown in Table 4.4.

Table 4.4 The test of between-subject effects

source	F	Sig.	Partial Eta Squared
Corrected Model	221.787	0.000	0.877
RaNo	5.530	0.019	0.013
ReNo	6.284	0.013	0.014
IFNo	127.368	0.000***	0.227
SDNo	2555.503	0.000***	0.855
RaNo*ReNo	0.164	0.686	0.000
RaNo*IFNo	0.153	0.696	0.000
ReNo*IFNo	0.210	0.647	0.000
RaNo*ReNo*IFNo	2.563	0.110	0.006
RaNo*SDNo	0.738	0.391	0.002
ReNo*SDNo	0.113	0.737	0.000
RaNo*ReNo*SDNo	0.168	0.682	0.000
IFNo*SDNo	87.561	0.000***	0.168
RaNo*IFNo*SDNo	2.440	0.119	0.006
ReNo*IFNo*SDNo	2.134	0.145	0.005
RaNo*ReNo*IFNo*SDNo			0.000

a.Computed using alpha = .01

b.R Squared = .877 (Adjused R Squared = .873)

The term ‘source’ in Table 4.4 lists the individual factor and the interaction between the factors. Besides, the ‘partial-eta-squared’ means “the proportion of total variability attributable to a factor” and is ranged as [0, 1]. From the results of ANOVA test, the factors that mostly contribute to the total variation can be obtained. We observe that the significances (as ‘sig.’ in Table 4.4) for IFNo, SDNo, and IFNo*SDNo are less than 0.01, and the ‘partial-eta-squared’ for SDNo = 0.855, IFNo = 0.227 and interaction effect as IFNo*SDNo = 0.168. That is, the number of initial friends of the trustor agent and the searching depth of each searching path (as SDNo and IFNo) are two critical factors that mostly affect the results of the RBPS model. This phenomenon indicates

that the searching width and depth may seriously affect the results to identify resources in the social networks over the real world.

4.2.3 Critical Values of the Critical Factors

Two factors, IFNO and SDNo, were identified as the critical factors to affect the performance of the RBPS model. Next, an ANOVA test was designed to identify the critical values for these two factors that make the model selects the AH with high level of average_AH% and low variance of AH%. The 125 factor combinations, illustrated in the section 4.1.3, are created and the simulation was processed as follows: First, we defined that the significance level was 0.05; namely, the confidence intervals were 0.95, and the results of all factor combinations were tested by one-way ANOVA; then, the results with extreme high standard deviation were filtered out by using homogeneity test of variation. Second, the result of homogeneity of variance, measured by Levene Statistics, for remaining 33 factor combinations was 0.053 (as sig. = 0.053). That is, the variances of multiple rounds of CPS for AH% among remaining factor combinations were not different.

After evaluating the homogeneity of variances by using descriptive data, the results of Post Hoc tests could be obtained for multiple comparisons in One-Way ANOVA by using 'scheffe' method. The results of homogeneous subset were derived in Table 4.5. The factor combinations for selecting AH are divided into two groups: (1) the subset with lower Average_AH% and (2) the subset with higher Average_AH%. They are illustrated as follows:

- In subset 1, we observe that the factor combinations obtain low level of Average_AH%, less than 0.2, due to with low level of SDNo or IFNo (SDNo $\leq$ 3 or IFNo $\leq$ 3). For example, the factor combination '3326', obtains Average_AH% = 0.151, that involves low level of IFNo (e.g., IFNo = 2). On the other hand, the factor combination '6663', obtains Average_AH% = 0.1653, due to with low level of SDNo (SDNo = 3). Actually, the RBPS model is not suitable for the trustor as a newcomer with few friends or less searching depth in the business environment.

- In subset 2, the factor combinations can be observed that they derive high level of Average_AH%, higher than 0.5, and low level of standard deviation, less than 0.041, due to the trustor agent who has more friends and searching depth. For example, the factor combination '5565', obtains Average_AH% = 0.543, due to the IFNo = 6 and SDNo = 5. That is, for obtaining high level of Average_AH%, the trustor has to increase the number of his neighbors and searching depth in the social networks simultaneously.

Table 4.5 The homogeneous subset

Factor Combinations					Subset for Alpha=0.05	
RaNo	ReNo	IFNo	SDNo	RoNo	1	2
3	3	2	3	30	0.1200	
5	5	4	3	30	0.1250	
5	5	2	3	30	0.1270	
4	4	4	3	30	0.1277	
6	6	2	3	30	0.1283	
4	4	2	3	30	0.1337	
5	5	3	3	30	0.1403	
3	3	2	4	30	0.1443	
6	6	4	3	30	0.1457	
6	6	5	3	30	0.1473	
6	6	3	3	30	0.1503	
3	3	2	6	30	0.1510	
4	4	2	5	30	0.1647	
6	6	6	3	30	0.1653	
5	5	2	4	30	0.1657	
6	6	2	4	30	0.1657	
5	5	5	3	30	0.1753	
6	6	2	5	30	0.1847	
5	5	2	5	30	0.1873	
6	6	4	6	30		0.5067
5	5	4	6	30		0.5257
6	6	5	5	30		0.5373
5	5	6	5	30		0.5430
6	6	6	5	30		0.5527
4	4	6	5	30		0.5577
4	4	5	6	30		0.5580
6	6	5	6	30		0.5590
5	5	5	6	30		0.5590
5	5	6	6	30		0.5593
3	3	5	6	30		0.5600
4	4	6	6	30		0.5657
6	6	6	6	30		0.5673
3	3	6	6	30		0.5723

- The analysis for members in subset 2 are illustrated as below:
  - If IFNo = 4 and SDNo = 6 (e.g., factor combinations as '5546' and '6646'), the trustor agent can only select the trustee agent with more than five raters (e.g., RaNo ≥ 5) who have more than five recommenders (e.g., ReNo ≥ 5). We can observed that if the trustor agent with less friends (e.g., IFNo = 4), he has to increase the searching depth up to 6 (e.g., SDNo =6). The trustee with less than 5 raters can not be identified by using this factor combination.
  - If IFNo ≥ 5 and SDNo = 5 (e.g., factor combinations as '4465' and '6655'), the trustor agent can only select the trustee agent with more than four raters (e.g., RaNo. ≥ 4) who have more than four recommenders (e.g., ReNo. ≥ 4). That is, the trustee with less than 4 raters can not be identified by using this factor combination.
  - If IFNo ≥ 5 and SDNo = 6 (e.g., factor combinations as '3356' and '3366'), the trustor agent can select the trustee agents with fewer rater agents (e.g., RaNo = 3) who have fewer recommender agent (e.g., ReNo=3). These kinds of factor combinations can make the model to select a fine collaborative partner AH with high mean (Average_AH% ≥ 0.5) and low variance (Std. deviation < 0.041). That is, the trustee agent as a newcomer who has fine temperament can easily be selected by the trustor agent who has more friends and searching depth.

From the results of Table 4.4 and previously mentioned experiments (see Table 4.5), we observe that the factor SDNo is more critical than the factor IFNo. That is, more SDNo can make our model to identify the trustees with few rater and recommender. For identifying the appropriate critical value of the factor SDNo, we compare the results of SDNo = 6 with SDNo = 7 by using 'Independent-Sample T test' and observe the difference between them. The factor combination was listed as below:

Factor Combinations	AgNo	RaNo	ReNo	IFNo	SDNo	PSNo	RoNo
6666	1000	**6**	**6**	**6**	**6**	500	30
6667	1000	**6**	**6**	**6**	**7**	500	30

The results of two factor combinations as ‘6666’ and ‘6667’ were calculated by SPSS (see Fig. 4.13). We observed that the mean of ‘6666’ was 0.5673 and standard deviation was 0.0287. On the other hand, the mean of ‘6667’ was 0.5717 and standard deviation was 0.0232.

Factor Combinations				RoNo	Mean	Std. Deviation
RaNo	ReNo	IFNo	SDNo			
6	6	6	6	30	0.5673	0.0287
6	6	6	7	30	0.5717	0.0232

Fig. 4.13 Group Statistics of two factor combinations

The confidence interval is 95%. Figure 4.14 demonstrates that the result of the test for equality of variance is not significant (as sig. = 0.391) and the test for equality of means is not significant because that the sig. = 0.523. That is, the Average_AH% of two factor combinations as ‘6666’ and ‘6667’ were not different. Due to the simulation time increased exponentially by increasing the number of SDNo, we can reason that the appropriate critical value of critical factor SDNo is ‘6’.

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df.	Sig. (2-tailed)
Equal variances assumed	0.747	0.391	-0.642	58	0.523
Equal variances not assumed			-0.642	55.52	0.523

Fig. 4.14 Independent sample test for two factor combinations

4.2.4 Critical Trust Type

In this study, the initial-trust of trustees was evaluated by using the trust types like competence, goodwill and predictability. Next, this study aims to identify the critical trust type from the results of the experiments. It could provide a more comprehensive picture in the essence for collaborative partner selection and help us to understand the specification for selecting partner candidates during the testimony definition step previously mentioned.

Figure 4.15 demonstrates the experiment results with factor combination as '3366' (RaNo = 3, ReNo = 3, IFNo = 6, SDNo = 6) that the trustee agent AH won far more selections (as AH% = 0.6) than others; however, the trustee agent CH and AL were the second and third winner respectively (as CH% = 0.16 and AL% = 0.14).

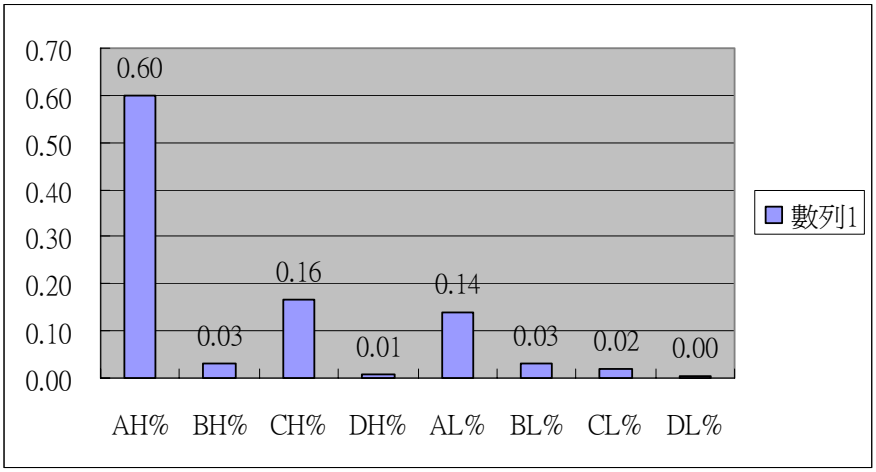

Fig 4.15 The result of factor combination of '3366'

To obtain more information about the trustee agents that won the selection in the various factor combinations, we created the experiments with factor combinations '3366', '4466', '5566' and '6666'. The results are shown as Figure 4.16. We observed that the AH won selections with AH% = 0.6 on average; additionally, the CH and AL won selections with CH% = 0.16 and AL% = 0.16. The other trustee agents all won selections under 0.03 in average.

The trustee agents AH, CH and AL are top three winners among

eight trustees. The characteristics of these winners in competence, goodwill and predictability were shown as (see Table 4.1):

- The trustee AH: α_{AH} = 'H', β_{AH} = 'H' and γ_{AH} = 'H'.
- The trustee CH: α_{CH} = 'H', β_{CH} = 'L' and γ_{CH} = 'H'.
- The trustee AL: α_{AL} = 'L', β_{AL} = 'H' and γ_{AL} = 'H'.

Factor Combination	Trustee Agents							
	AH%	BH%	CH%	DH%	AL%	BL%	CL%	DL%
3366	0.6	0.03	0.16	0.01	0.14	0.03	0.02	0
4466	0.58	0.04	0.16	0.01	0.18	0.01	0.01	0.02
5566	0.63	0.02	0.14	0	0.18	0.01	0.02	0.01
6666	0.59	0.05	0.17	0	0.16	0	0.02	0
Average	0.6	0.03	0.16	0.01	0.16	0.01	0.02	0.01

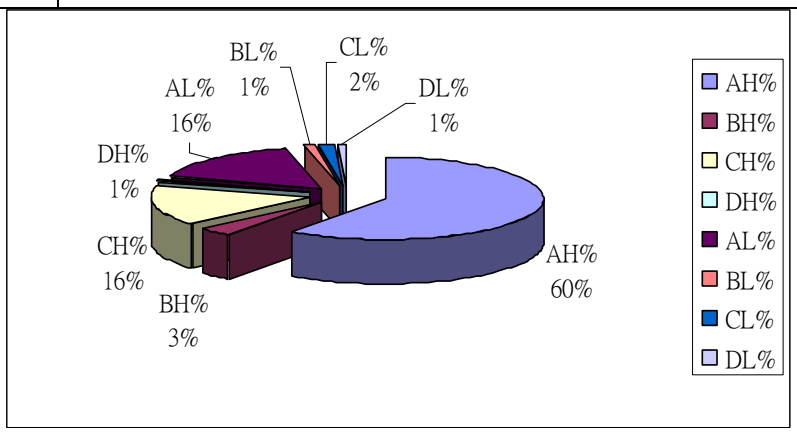

Fig. 4.16 The experiment results for critical trust type

Indeed, the characteristics demonstrate that they all behave well in the trust type as predictability (γ= 'H') and behave well in one of the trust types as competence or goodwill (α = 'H' or β =' H'). The trustee agent CL whose γ_{CL} = 'H', but can not to be a winner due to the poor behavior in competence and goodwill (α_{CL} = 'L', β_{CL} = 'L'). We may reason that the 'predictability' was the critical trust type.