

A Research on Making Numerical Models to Improve Quality of Meetings

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Abstract

This paper pays attention to meetings. Because meetings are held on by every sort of companies and their functions must be very important as a space or a field for intersection of various information. Although having such critical functions for operation of organization, many actual meetings do not seem to be performed in good manner. Furthermore it must be fact that changing manner and culture of meetings is very difficult.

The authors decided to adapt Game Theory to simulate real meetings for showing some factors that should be improved. To do that, several behaviors of chairperson and participants of meetings are abstracted as "strategies" called in OR (Operations Research) field.

Collecting real data from active executive director who cooperates to this research, the authors develop numerical model based on knowledge of Game Theory, and make some simulations. Nominated factors shown by simulations get good feeling from executive director.

1 . The Aim of This Paper

The aim of this paper is to develop numerical model based on knowledge of OR (Operations Research) and Game Theory, to simulate some real phenomena occurred in real companies with a model, and to get remedy for good operation of real companies through simulation.

Even though there are much works in OR, most of them actually seem to be not so useful for real problems happened in real companies or organization. Thus, the most important interest for the authors is to make theoretical knowledge up into a useful numerical model.

2 . How to Collect Data.

As mentioned above, this paper has to confront with a real company, so the authors asked cooperation to active executive director who is one of authors' acquaintances. He accepted our request comfortably and spent much time to reply to our interviews and filled in questionnaires sent on e-mail.

3 . Preconditions for Developing Numerical Models

(1) Real Object

After getting general information about his company, the authors decided to pay attention to some official meetings as intersections of various information and knowledge. In this company, there are three kinds of official meetings called by the executive director. This paper calls them M-meeting, H-meeting, and O-meeting.

M-meeting

Participants of M-meeting are all executive managers, and there are two main purposes. The first purpose of this meeting is giving sanction to important questions such as developing new product and changing institutional systems. The second one is informing report of progress of each approved matter, which is done by executive manager who is in charge of it. And furthermore, other important things judged by participants and executive director are discussed at any time.

H-meeting

Participants of this meeting are all head chiefs of branch offices, all executive managers and the president. This meeting is held once a month. Branch chiefs have to make explanation about sales results and status of operation of their own offices. For example, some new strategies adapted by one branch and the progress of them must be typical topic of this meeting.

H-meeting is mainly for sales activities rather than manufacturing activities. The position of this meeting is under M-meeting and at the same time this meeting is the top meeting of sales department.

O-meeting

All executive managers, all vice chiefs of manufacturing department, all executive managers, and some vice chiefs of sales department participate in this meeting. Executive managers and vice chief of manufacturing division have to present the current status of cost reduction projects.

The organization of these three meetings called by the executive director is shown in Figure 1.

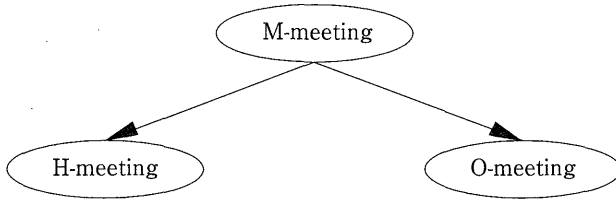


Figure 1. Organization of three meetings

(2) Definitions for Modeling

As a policy to develop numerical model, the authors decided to adapt knowledge of Game Theory. Based on this policy, some definitions are set as follows.

Players :

The number of participants of M-meeting, H-meeting, and O-meeting are about eight, twenty and fifteen, respectively. So, it's actually impossible to regard each participant as one player of Game. In other words, we have to usually avoid to adapt many-person-games of Game Theory in case of such not small number meeting or game. Based on this reason, following two kinds of players are set;

- Chair-person
- Other Participants (called just "Participants" in following part of this paper)

With this definition, two-person-game is available and at the same time an assumption must be introduced, that is, the chair-person have to regard other participants as one average usual participant.

Behaviors (called "strategies" in the OR field) of Chair-person :

The chair-person has $I (=6)$ strategies given as follows.

- 1) Explaining the today's subjects at the beginning of meeting each time (x_1 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 2) Explaining the original purpose of the meeting (x_2 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 3) Explaining how it comes about (x_3 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 4) Informing subjects of the next meeting in advance (x_4 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 5) Making negotiation in advance (x_5 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 6) Leading of argument and discussion into specific direction (x_6 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).

Behaviors (called "strategies" in the OR field) of Participants :

Every participant has J (=5) strategies given as follows.

- 1) Taking a part in a discussion (y_1 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 2) Understanding subjects of each meeting (y_2 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 3) Understanding original purpose of the meeting (y_3 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 4) Understanding how it comes about (y_4 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).
- 5) Considering about subjects or problems before or after the meeting (y_5 denotes the degree of the intension and takes five different values ; 1, 2, ..., 5).

Benefits of meeting :

To enable the new model to simulate, some sort of benefit of meeting must be defined. Because the idea of "Payoff" in OR field must be incorporate into the new model. So, following K (=6) matters are defined as benefits.

- 1) Contribution to achieving current benefits and goal of whole company. $k=1$:
- 2) Contribution to achieving current benefits and goal of each division. $k=2$:
- 3) Contribution to achieving current benefits and goal of each individual. $k=3$:
- 4) Contribution to achieving long-term benefits and goal of whole company. $k=4$:
- 5) Contribution to achieving long-term benefits and goal of each division. $k=5$:
- 6) Contribution to achieving long-term benefits, goal and skill-up of each individual. $k=6$:

4. Modeling

Payoff of a decision maker must be given with the effectiveness of each meeting, which is judged from the decision maker's viewpoint. All payoffs of every player for behavior combination need to be determined in order to apply the usual Game Theory. But it is actually impossible to collect all payoffs for all possible combinations of behaviors. Thus the authors collect some limited kinds of data and proceed in the following way instead of trying to collect all of payoffs and computing Nash equilibrium.

In this paper, the chair-person's part of the problem is considered.

From the viewpoint of chair-person, that is decision maker, the effectiveness of the meeting is measured according to K (=6) benefit items. Furthermore, the authors assume that the benefit of a meeting in k -th item is given by the product of the *maximum benefit* Efc_k of the meeting and the *rate of achievement* $Efcr_k$. The maximum benefit Efc_k depends only on the type of the meeting. On the other hand the rate of achievement $Efcr_k$ depends only on the strategies that the players take. Both of them take five different values, 1, 2,..., 5.

The following relation of $Efcr_k$ ($k=1,\dots,6$) is assumed :

$$\begin{aligned}
 Efcr_k(x, y) &= \sum_{i=1}^I \sum_{j=1}^J Efcr_{k,i,j}(x_i, y_j) \\
 &= \sum_{i=1}^I \sum_{j=1}^J (Efcr_{k,i}x_i + Efcr_{k,..,j}y_j) \\
 &= \sum_{i=1}^I JEfcr_{k,i}x_i + \sum_{j=1}^J I Efcr_{k,..,j}y_j \\
 &= \sum_{i=1}^I Efcr_{k,i}x_i + \sum_{j=1}^J Efcr_{k,..,j}y_j \text{ (by rewriting)}
 \end{aligned}$$

The above assumption implies that the effectiveness of the meeting judged as degree of each benefit from the viewpoint of chair-person is linear in behaviors x and y , and is given by the sum of each part by two players, the chair-person and the average participants. With this simplification, $Efcr_{k,i}$ and $Efcr_{k,..,j}$ are collected through interviews and/or questionnaires in order to obtain $Efcr_k(x, y)$.

The chair-person supposes that the behavior y of the average participants is subject to depend linearly on his behavior x as follows :

$$y_j = \sum_{i=1}^I \bar{c}_{ij}x_i$$

$$\begin{aligned}
 Efc_{r_k}(x, y(x)) &= \sum_{i=1}^I Efc_{r_{k,i},x_i} + \sum_{j=1}^J Efc_{r_{k,..j}} y_j & (1) \\
 &= \sum_{i=1}^I Efc_{r_{k,i},x_i} + \sum_{j=1}^J Efc_{r_{k,..j}} \left(\sum_{i=1}^I \bar{c}_{ij} x_i \right)
 \end{aligned}$$

Thus the chair-person tries to increase the amount $Efc_{r_k}(x, y(x))$ by varying x , instead of computing Nash equilibrium.

$$\Delta_1 Efc_{x_i} = \sum_{k=1}^K Efc_k \cdot Efc_{r_{k,i}} \quad (A)$$

$$\Delta_2 Efc_{x_i} = \sum_{k=1}^K Efc_k \sum_{j=1}^J Efc_{r_{k,..j}} \bar{c}_{ij} \quad (B)$$

Total effect on the benefit by increasing x_i by one unit is given by

$$\Delta Efc_{x_i} = \Delta_1 Efc_{x_i} + \Delta_2 Efc_{x_i} \quad (T)$$

5. Results

In the above discussion, it was considered to deal with only nonnegative benefit items as payoff. Changing behavior from the present one is regarded as cost. Now the model discussed above is applied to the collected data.

The results would be as follows under one assumption, that is, when the chair-person or the executive director improves his own behavior to make meetings more effective, he is able to raise two behaviors with one unit for each of the two.

<M-meeting>

Table 1 gives the collected data of M-meeting. Table 2 shows the total effect on the effectiveness by increasing x by one unit given in (T). Since

the maximum of the total effect is given in coefficient of x_3 (computed value is 20.682), the chair-person had better pay the most attention to the behavior "Explaining how it comes about." In other words, to increase x_3 from 3 to 4 would be the most effective way to improve M-meeting. And similarly the second best is x_4 (computed value is 19.681), that is, "Informing subjects of next meeting in advance." It is possible for the chair-person to raise x_4 from 3 to 4.

⟨H-meeting⟩

Table 3 gives the collected data of H-meeting. Table 4 shows the total effect on the effectiveness by increasing x by one unit given in (T). Since the first, the second and the third maximum of the total effect are given in coefficient of x_4 , x_5 and x_1 in this order (computed value is 51.06, 47.85, and 35.52, respectively), the chair-person had better pay the most attention to the behavior "Making negotiation in advance" and more attention to "Explaining the today's subjects at the beginning of meeting each time." Note that we cannot choose x_4 though the coefficient of x_4 is the largest. Because, the present value of x_4 has already become maximum value, that is, five (see the present value of x_4 in Table 3).

⟨O-meeting⟩

Table 5 gives the collected data of O-meeting. Table 6 shows the total effect on the effectiveness by increasing x by one unit given in (T). The best two items derived from Table 6 are x_1 and x_6 (computed value is 76.51 and 53.46, respectively), so the chair-person should pay the most attention to the behavior "Explaining the today's subjects at the beginning of meeting each time" and more attention to the behavior "Leading of argument and the discussion into specific direction."

Table 1. M-meeting (collected data)

	x_1	x_2	x_3	x_4	x_5	x_6
present value	2	4	3	3	2	3.5

Item of $Efc(k=)$	1	2	3	4	5	6
Efc_k	4.5	5	4	3.5	3	4

 $Efcr_{k,i}$

Item of $Efc(k=)$	1	2	3	4	5	6
$i=1(x_1)$	4	2	2	4	3	4
$i=3(x_3)$	4	4	3	4	4	3
$i=4(x_4)$	4	3	3	4	4	3

 $Efcr_{k,j}$

$j=1(y_1)$	5	4	3	4	4	3
$j=2(y_2)$	4	4	3	4	4	3
$j=3(y_3)$	4	4	3	4	4	3
$j=4(y_4)$	4	4	3	4	4	3
$j=5(y_5)$	4	5	4	3	4	4

 c_{ij}

- >	$j=1(y_1)$	$j=2(y_2)$	$j=3(y_3)$	$j=4(y_4)$	$j=5(y_5)$
$i=1(x_1)$	4	4	3	4	2
$i=2(x_2)$	3	3	3	3	3
$i=3(x_3)$	4	3	3	4	3
$i=4(x_4)$	4	4	3	4	3
$i=5(x_5)$	4	4	3	3	3
$i=6(x_6)$	3	4	4	3	3

Table 2. M-meeting (computed data)

x_1	x_2	x_3	x_4	x_5	x_6	
2.9454	-3.714	4.6807	8.6807	4.4902	4.9173	<= (B)
3		16	11			<= (A)
5.9454	-3.714	20.681	19.681	4.4902	4.9173	<= (T)

Table 3. H-meeting (collected data)

	x_1	x_2	x_3	x_4	x_5	x_6
present value	3	4	3.5	5	4	4

Item of $Efc (k=)$	1	2	3	4	5	6
Efc_k	4	5	4	3	4	3.5

$Efc_{k,i..}$

Item of $Efc (k=)$	1	2	3	4	5	6
$i=1 (x_1)$	3	5	5	4	4	5
$i=2 (x_2)$	4	4	4	4	4	5
$i=3 (x_3)$	4	4	4	3	4	4
$i=4 (x_4)$	4	5	5	4	5	5
$i=5 (x_5)$	4	5	5	4	5	4
$i=6 (x_6)$	4	4	4	3	4	4

$Efc_{k,..j}$

$j=1 (y_1)$	3	4	4	3	4	4
$j=2 (y_2)$	4	4	4	3	4	4
$j=3 (y_3)$	4	4	4	4	4	5
$j=4 (y_4)$	4	4	4	3	4	4
$j=5 (y_5)$	4	4	4	4	4	4

c_{ij}

$->$	$j=1 (y_1)$	$j=2 (y_2)$	$j=3 (y_3)$	$j=4 (y_4)$	$j=5 (y_5)$
$i=1 (x_1)$	4	4	3	4	3
$i=2 (x_2)$	4	3	3	4	4
$i=3 (x_3)$	4	4	3	4	4
$i=4 (x_4)$	5	4	3	4	4
$i=5 (x_5)$	4	4	3	4	5
$i=6 (x_6)$	3	3	4	3	4

Table 4. H-meeting (computed data)

x_1	x_2	x_3	x_4	x_5	x_6	
3.516	3.297	7.433	11.06	11.35	0.847	$\leq (B)$
32	27	20.5	40	36.5	20.5	$\leq (A)$
35.52	30.3	27.93	51.06	47.85	21.35	$\leq (T)$

Table 5. O-meeting (collected data)

	x_1	x_2	x_3	x_4	x_5	x_6
present value	4	5	5	4	3	2

Item of $Efc (k=)$	1	2	3	4	5	6
Efc_k	5	5	4	5	5	4

$Efcr_{k,i.}$

Item of $Efc (k=)$	1	2	3	4	5	6
$i=1 (x_1)$	4	5	5	4	5	5
$i=2 (x_2)$	4	4	4	4	4	5
$i=3 (x_3)$	4	4	5	4	4	5
$i=4 (x_4)$	4	4	4	4	4	5
$i=5 (x_5)$	4	4	4	4	4	4
$i=6 (x_6)$	4	5	4	4	5	4

$Efcr_{k..j}$

$j=1 (y_1)$	4	5	4	4	4	5
$j=2 (y_2)$	4	4	4	3	4	4
$j=3 (y_3)$	4	4	4	4	4	4
$j=4 (y_4)$	4	4	4	3	4	4
$j=5 (y_5)$	4	5	4	4	4	5

c_{ij}

- >	$j=1 (y_1)$	$j=2 (y_2)$	$j=3 (y_3)$	$j=4 (y_4)$	$j=5 (y_5)$
$i=1 (x_1)$	5	5	4	4	4
$i=2 (x_2)$	4	4	4	3	3
$i=3 (x_3)$	3	3	3	3	3
$i=4 (x_4)$	4	4	3	3	3
$i=5 (x_5)$	3	4	4	4	3
$i=6 (x_6)$	4	4	3	4	4

Table 6. O-meeting (computed data)

x_1	x_2	x_3	x_4	x_5	x_6	
30.51	9.646	-5.41	4.313	9.48	15.46	<= (B)
46	28	36	32	28	38	<= (A)
76.51	37.65	30.59	36.31	37.48	53.46	<= (T)

Note : If the collected raw data c_{ij} of Table 1, 3 and 5 are used to compute y_j in expression (1), it is impossible to assure that $1 \leq y_j \leq 5$. Therefore the normalized data \bar{c}_{ij} given by the following formula are used in expression (1) :

$$\bar{c}_{ij} = \frac{c_{ij}}{\sum_{i=1}^I c_{ij}} \left(y_i = \sum_{i=1}^I \bar{c}_{ij} x_i \right), \text{ since}$$

$$\sum_{i=1}^I c_{ij} \leq \sum_{i=1}^I c_{ij} x_i \leq 5 \sum_{i=1}^I c_{ij},$$

$$1 \leq \frac{\sum_{i=1}^I c_{ij} x_i}{\sum_{i=1}^I c_{ij}} \leq 5.$$

5. Evaluation of Results

Table 7 shows the derived items to improve each meeting.

Table 7. Derived Items

M-meeting	<ul style="list-style-type: none"> ➤ Explaining how it comes about. ➤ Informing subjects of next meeting in advance.
H-meeting	<ul style="list-style-type: none"> ➤ Making negotiation in advance. ➤ Explaining the today's subjects at the beginning of meeting each time.
O-meeting	<ul style="list-style-type: none"> ➤ Explaining the today's subjects at the beginning of meeting each time. ➤ Leading of argument and the discussion into specific direction.

Needless to say the authors sent the result mentioned above to the executive director, and his evaluation must be expressed with his first phrase,

that is, "Ah, that's exactly what I thought."

He told us that the members of M-meeting are just only executive managers, so they must have much positive concern about operation of the company. The discussions of M-meeting become so hot sometimes that they have tendency to forget how things got this way.

On the other hand, H-meeting and O-meeting include some young members who don't seem to have much positive interesting about operation and/or management of the company. So, some member would not understand the role hidden in by subjects of meetings. Therefore, the discussions of meetings often go in strange direction.

What the executive director told us like mentioned above shows our results must have much validity.

6 Implication of This Research

Although the model developed in this research is based on some knowledge of Game Theory, what has been adapted does not include so difficult ones, but easy and primitive ones. And there must be some validity and usefulness in it.

What this means must implicate that researchers or scholars should make more effort to adapt their works or theories to real phenomenon occurred in real organizations, in real companies, in real society, and in the real world.