

A Personnel Allocation Problem in a Japanese Electrical Manufacturer: A Brief Note

Questions

1. Can a personnel allocation planned with researcher-proposing DA algorithm be, in theory, an effective way to solve a personnel problem this electrical manufacturer is currently faced with?
2. What are pros and cons of a personnel allocation planned with researcher-proposing DA algorithm?
3. Consider whether a personnel allocation planned with researcher-proposing DA algorithm can be an effective way to solve a personnel problem for this manufacturer, referring to data described in this case.
4. A clinical training system reform made in 2004 is a precedent of application of the DA algorithm to real practices in Japanese society. Consider pros and cons of introducing DA algorithm to the Japanese firms which have different employment systems and practices.
5. To what industries can we apply the DA algorithm to personnel allocation problems?

1 A situation

1.1 Allocation of in-house researchers to R&D teams

In a Japanese electrical manufacturer, there are some departments which are covered with inter-departmental divisions. The R&D division is one of those divisions, which functions as a control office of technical things for each department. There are 113 researchers in the R&D division and department, each belonging to one of 13 R&D teams.

- The configuration of the R&D teams and the allocation of in-house researchers placed in each team may be fine-tuned as necessary, but in most cases, those are reviewed in the budget formulation period (in January or February) for the next fiscal year.
- It is the group manager (**GM**) who is responsible for senior management in the R&D division to examine the allocation of researchers to each R&D team; For each team, GM **one-sidedly** determines a team manager (TM) who manages the team and assigns some researchers to the team.
- Researchers' requests are rarely reflected on their personnel assignment, because of their placement history, past evaluation, the in-house qualifications and positions, and their future career development planned by the company.
- The tendency to be fixed is rigid in their allocation to each division; Since each researcher has a technical expertise area, it is difficult to replace researchers even when it is desired according to the amounts or types of various tasks required by the company.
- **Problem:** Further innovation in R&D is constantly being sought within this company, and there is concern that the rigid assignment of researchers in R&D teams may be a factor that hampers this.
- In addition, This company well recognizes that, in order to promote R&D activities, it is **necessary to motivate researchers and induce them to invest for further skill acquisition.**

- This electrical manufacturer has several R&D themes and priority differs according to each theme. In addition, complementarity among themes should also be considered.

There are many evaluation criteria on personnel assignment of in-house researchers to R&D teams; The company must take into consideration various factors, as noted above.

1.2 Researcher-proposing DA algorithm

In late 2016, before the time of budget formulation for the next fiscal year, this electrical manufacturer examined a test with researcher-proposing DA algorithm, which has the following nice properties.

- **Stability:** When a personnel allocation is proposed, if, for any objections that are claimed by any groups consisting of researchers and a R&D team, (1) no researcher in such a group is not matched with the team within the group which is at a higher rank in his or her preferences and (2) no researcher who is at a higher rank in the evaluation of the team is not assigned to the team, then the matching is called a stable matching.
- **Strategy-proofness for researchers:** For each researcher, whatever other researchers report their preferences over R&D teams, it is never assigned to the more preferable R&D team for him- or her-self by misrepresenting their true preference.
- **Optimality for researchers:** Every researcher is matched with the team he or she most prefers among among R&D teams with which he or she can be matched with in all stable matchings.

Any (pair-wise) objections to stable matchings do not make sense from its definition, if they exist. In other words, unless there is no change in the company's R&D policy and there is no unexpected shock in the external environment, for any researches and any R&D teams, any replacements of human resources due to their dissatisfaction at the current assignment do not occur.

On the other hand, the following property is not guaranteed for researcher-proposing DA algorithm.

- **Pareto efficiency among researchers:** In order for a researcher to be matched with an R&D team which is at a higher rank than a team currently assigned to in his or her own preference, someone(s) else must be transferred to a team which is at a lower rank in their preferences.

2 Personnel Allocation Plan

The examiner asked researchers to represent their preferences and solicited TMs to state their evaluation via emails. All data were put IDs in order to secure their privacy. GM was asked to submit the quotas of teams, where quota A is the current one while quota B was the one planned for the next fiscal year. There are two types of questionnaire to researchers.

- (1) Simply asked to represent their preferences over R&D teams
- (2) After suggesting the directions of R&D in the division, asked to state their preferences in order to make further innovation in this electrical manufacturer.

In practice, people in the department other than the personnel department do not recognize all researchers. As for questionnaires to 13 TMs, the examiner thus asked to refer to the department of human resources with evaluation items such as skills, knowledge, job qualifications and carriers that each division emphasizes in the execution of tasks, as evaluation items, if TMs do not know some researchers other than particular ones.

In practice, the department other than the Personnel Department does not recognize all employees, it is difficult to rank accurately and it is inconvenience.

10 researchers who could not reply to questionnaires by the due date are deduced from the quota of teams. Thus, the number of researchers in this examination is 103.

Table 1: Questionnaire (1) to researchers

resercher ID	rank 1	rank 2	rank 3	...	rank 12	rank 13
1	1	4	2	...	12	13
2	1	11	12	...	3	2
3	3	13	4	...	1	2
⋮	⋮	⋮	⋮		⋮	⋮
102	2	12	9	...	1	8
103	2	11	7	...	1	3

Table 2: Questionnaire (2) to researchers

researcher ID	rank 1	rank 2	rank 3	...	rank 12	rank 13
1	3	6	5	...	2	1
2	2	11	12	...	3	1
3	3	7	5	...	2	1
⋮	⋮	⋮	⋮		⋮	⋮
102	2	11	6	...	1	5
103	2	11	7	...	1	3

Table 3: Questionnaire to teams

team ID	rank 1	rank 2	rank 3	...	rank 102	rank 103
1	11	4	12	...	13	14
2	75	102	92	...	97	98
3	75	102	92	...	97	98
4	75	102	99	...	98	100
5	74	102	27	...	97	101
6	74	102	24	...	97	101
7	102	103	81	...	100	101
⋮	⋮	⋮	⋮		⋮	⋮
13	9	15	14	...	1	4

Table 4: Quota of teams

team ID	quota A	quota B
1	8	8
2	12	12
3	8	8
4	10	9
5	11	10
6	6	6
7	13	12
8	4	5
9	8	8
10	10	10
11	5	5
12	3	3
13	5	7
total	103	103

Excel for Two-Sided Matching ver.1 (sample1.xlsm) was used for computing matchings. (1) and (2) in Tables 5-7 correspond to Questionnaires (1) and (2). For researchers, the efficiency of allocations is measured with the total sum of ranks of teams matched with researchers in their preferences divided by 103. For teams, similarly, the efficiency is measured with the total sum of ranks of researchers matched with teams in their evaluation divided by 103. In Table 7, values of the efficiency index is shown also for researchers and for teams, separately.

Table 5: Teams with which researchers are matched

	1	2	3	...	102	103
current	1	1	1	...	12	12
(1)+quota A	1	1	3	...	2	11
(1)+quota B	1	1	3	...	2	6
(2)+quota A	3	2	3	...	2	11
(2)+quota B	3	2	3	...	2	11

Table 6: Ranks of teams to which researchers are assigned

	1	2	3	...	102	103
current	1	1	3	...	1	1
(1)+quota A	1	1	1	...	1	2
(1)+quota B	1	1	1	...	1	2
(2)+quota A	1	1	1	...	1	2
(2)+quota B	1	1	1	...	1	2

Table 7: efficiency for assignments

	current	(1)+quota A	(1)+quota B	(2)+quota A	(2)+quota B
efficiency	12.9	39.4	40.0	29.4	33.4
teams	10.4	37.6	38.2	27.1	31.1
researchers	2.5	1.8	1.8	2.3	2.3