A Decision Support System for Assigning of Personnel to Teams

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In the now-a-days conditions of scarce resources, increasing demand and requirements (do more in less time against lower rewards: where is the win-win philosophy?) the problem of optimal use of those available resources in any sphere of human activities is becoming more evident. Of course, for solving this problem we need people with skills and sufficient knowledge, but in its turn, assign people to fulfill those tasks and manage Human Resources is certainly a problem which should be tackled. It means the scheduler has to find the optimal sequences of available Human Resources and tasks with the responsibilities they should carry out. And he or she has to take into consideration the qualification of the assigned persons (e.g. functions, experience, skill, training, state of mind?), their capacity to work independently or in teams and their individual preferences concerning given tasks. Also the level of difficulty of these tasks and the time required to fulfill them have to be taken into account. Besides these already demanding requirements, the problem can contain a number of additional conditions, for example, personnel availability (e.g. free days, holidays, sickness and courses), number and sort working hours (day, night, weekend), union and labor (government) rules and traditions for which schedulers should be aware of. More specific in this presentation is that personnel working in a team should belong to the same group. Such a group division of all the staff members can be based on the preference of working together or better not.

So, basically the main questions the scheduler must answer are: who is carrying out which task and when? How we will put the right person in the right place at the right time with the right skills while keeping up or even improving quality of life for that person [BhS03]. It means that for each person has to be decided which of all possible tasks in an organization he or she has to carry out. Each workload defined by the management has to be divided into a number of duties each of which can be carried out by a staff member. Each of these duties has to be composed of a set of tasks for a qualified person.

Another problem which is also important to take into account is to reduce optimal solution total cost and average solution CPU time. There are several of different heuristic approaches for solving the assignment problem, see [14,3,17]. Each of them provides a different ratio of heuristic solution cost and average solution CPU time. For instance we can consider the leading of alternative heuristic approaches as Heuristic GAP (**HGAP**), Variable-Depth-Search Heuristic (**VDSH**) and Hybrid Heuristic (**HH**). The use of each of these approaches depends on the objective: to reduce the average solution CPU time or to increase the quality of the solution and what are the problem size and class. We have to work with multiple-conflicting-subjective objectives, overdetermined requirements and both qualitative and quantitative data. Making a selection from a finite number of alternatives proved to be a very attractive solution approach using also optimal solved subproblems as

the winner of the PATAT Timetabling Competition [13] showed. Partial enumeration based exact algorithms have a slow convergence rate, and they can only solve small instances to optimality. Useful support came from converting qualitative information into quantitative data in order to parameterize a multiobjective mathematical programming model, see [6].

The problem of assigning of personnel to teams in Health Services (or Criminal Court sessions) will serve as an example. Each week about 100 persons and 150 sessions have to be scheduled. In this problem the set of different tasks has to be carried out in teams composed of Doctors (D), Assistants (A) and Nurses (N). Each team session has its own category (e.g. MK or EK: team assignment or individual duty), a specific code (e.g. MK4A, MK7A, SR1, PR1), day of the week, part of the day and required team functions. Besides that there are some other rules and conditions helping to make an assignment without clashes: such an assignment that no person has to be on two different places at the same time or no two persons execute the same task.

The general structure of the solution procedure algorithm is as follows.

1. **Initial Schedule**. Here we should indicate the working days and which group and which session should be scheduled in each of those days and in which part of that day. In other words all the necessary data put in tables such that there cannot be any misunderstanding about their values [4,5,11,12,16,18]. Here EXCEL is very useful.
2. **Individual combinations for assignment**. This part should result in different feasible combinations for the assignments of D, A and N in accordance with data personnel, calendar, agenda and already assigned points (number of working hours). Here we should take into account that the difference between the possible points and assigned points should be minimized, the team members belong to the same group and the days (part of) when D, A and N are not available. The development of a possible assignment matrix is vital in this phase. At this step a lot of reductions rules could be applied based on impossible assignments according the input. In mathematical programming terms this is also called preprocessing [1].
3. **Choosing an optimal solution**. Here we should choose from several different combinations for different assignments that one which is the best and make a report of the results. The approach is based on two principles of meta-heuristics: local search (steepest descent) and population search (genetic algorithm) [10]. Experiments show that constructing the combinations based on importance and seniority while reducing impossibilities gives solutions within ten percent of the optimum (all fulfill their hours).

The research described above was carried out based on work in hospitals and applied to criminal court sessions which until now has resulted in a fully functional working prototype system. This system will be demonstrated and is based upon the application of research knowledge to real world situations.

Example

Data Personnel								
Code	**Last name**	**Group**	**FTE**	**Free**		**Func MK**	**In service**	**Specialisation**
AAA	Jansen	1	0,34	Tu		A+D	09-10-1986	MK+EK+PREC
BBB	de Vries	2	0,70	We		A		MK4A+MK+EK
CCC	Peters	2	1,00	Tup		N	23-1-95	MK4A+MK+EK
DDD	de Boer	1	0,90	Tua		D	14-11-88	MK7A+MK+EK
EEE	Klaasen	2	1,00	Tup		N+A	18-6-84	MK+EK
FFF	Timmerman	1	1,00			A	07-12-1981	MK7A+MK+EK
PV1	replacement	5	0,00			N		MK
XXX	not active	9	0,00					
end								

Timetable Department			Period :	14-Jul-03	until	15-Aug-03		
			Week :	29	until	32		
Date	**Day**	**Group**	**Session**	**d/a/p**		**D**	**A**	**N**
14-Jul	Mo	2	MK4A	d		Kin	**BBB**	
	Mo		SR1	a				
	Mo		PR1	p				
15-Jul	Tu							
16-Jul	We	1	MK7A	d		**DDD**	**FFF**	**PV1**
	We		SR1	a				
	We		PR1	a				
	We		PR2	p				
17-Jul	Th		PR1	a				
	Th	1	PR2	p				
18-Jul	Fr		PR1	p				

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