

CompuOpti

We are interested in CompuOpti, a company that develops and implements optimization and decision support solutions for its clients. CompuOpti employs a number of engineers and developers who are staff on client projects.

Each project requires a certain number of staff days/men on specific skills (optimization, project management, web development, ...).

Thus, a project may require 6 days/person of A skills, 2 days/person of B skills, and 5 days/person of competences C. The allocation of personnel to projects and their planning is a crucial issue at CompuOpti, and you are mandated to develop a solution for Margaux Dourtille, CEO of CompuOpti, which will allow her to efficiently plan her staff on projects.

The problem studied is therefore a problem of personnel planning and project assignment.

We consider that the problem takes place on a given time horizon (we will only consider working days).

Each CompuOpti staff member has certain qualifications, among a given set of qualifications (for example {A, B, C, D, E}), and predefined days off intervening during the time horizon.

Each project calls for qualifications from the set of qualifications (a subset of {A, B, C, D, E}). Each qualification intervening in the project is associated with a number of days of dedicated work.

Each qualification involved in the project is associated with a number of work days dedicated to this qualification. Moreover, each project produces a profit if it is carried out, and Margaux seeks to maximize the total profit induced by the projects carried out. For each project, a delivery date has been set.

For each project, a delivery date has been negotiated with the client; this date must not be missed, otherwise a financial penalty per day of delay is charged.

This date must not be exceeded, otherwise a financial penalty per day of delay is written into the service contract.

It is therefore necessary to define schedules for staff members, i.e. to assign each day of work to a member of staff. This means assigning each day a staff member works to a project qualification (or to no activity). Besides the benefit for CompuOpti, Margaux wants to take into account other aspects in the elaboration of the planning. The criteria are multiple:

- Firstly, it is a question of maximizing the company's financial results and therefore of creating a schedule that maximizes the company's profitability.

The first criterion is to maximize the financial result of the company and therefore to create a schedule that maximizes the profit (including possible penalties).

- We wish that the collaborators do not have to change projects too often and, to do this, we will try to minimize the time spent on each project.

In order to do so, we will try to minimize the number of projects on which any collaborator is assigned.

In the example below, it is Bob who is assigned to the largest number of projects (5).

- It is important that the projects are carried out in a limited number of consecutive days, so Therefore we will try to execute the longest project in a minimum number of days.

In the example below, projects II and III take the longest to complete (5 days).

The figure below gives a simple example of a schedule with 5 people (alice, bob, charlie, david and eve) 3 competences (A,B and C) and 5 projects (I,II, III, IV and V).

Personnel		Projets			
nom	compétences		A	B	C
alice	A,B	I	4	3	2
bob	C	II	3	2	7
charlie	A	III	4	1	5
david	B	IV	3	3	3
eve	A,B,C	V	1	1	4

eve	C	C	C	C	C	C	C	C	C	C		
david	B	B	B	B	B	B	B					
charlie	A	A	A	A	A	A	A	A				
bob	C	C	C	C	C	C	C	C	C			
alice	X	A	A	A	A	X	A	B	X	A	B	
	1	2	3	4	5	6	7	8	9	10	11	12

In the constitution of the schedule, a certain number of constraints are of course to respect:

- A staff member can only be assigned to a qualification of a project if he possesses this qualification (staff qualification constraint).
- At any time, a staff member can only be assigned to one project and to one qualification in this project (staff qualification constraint) only one qualification involved in this project (constraint of uniqueness of the daily assignment of the personnel).
- A staff member cannot be assigned to a project qualification on a day off. (congé constraint).
- A project is only considered completed if all the working days dedicated to each of the qualifications involved in the project have been completed by staff members (coverage constraint of the project's qualifications).
- Finally, a project can only be realized once in a given period of time (uniqueness constraint of the realization of a project).