Operational Tools for Effective Employee Timetabling

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EXTENDED Abstract

1. Introduction and motivation

We present here an operational system that produces effective timetables that people want to live with. This task is difficult because of different and often conflicting interests of the actors: employee, top/bottom level management, worker-union, etc.

The woes of fully manual systems are that they take too much time to build and change, and they don't always obey all legal work regulations and practices. On the other hand, fully automatic tools are not always well adapted to fast changing needs of the work place. In other words, these timetables are ineffective.

After 10 years of ***Theory*** ([1] - [9]) in building fully automatic tools and many years of commercialising them, we conclude that effective timetables require a careful mix of interactive and automatic tools, capable of taking into account legal regulations to produce a rough cut and allow users to modify locally. We want to present our ***Practice*** *in Automated Timetabling*, detailing the various steps and the mechanisms needed. The system has already been deployed successfully at many French institutions: a group of food-chain restaurants (350 restaurants in 5 different chains), several public-service hospitals (with 5000+ employees each), and a national network of 10 centres staffed 24 hr. a day, 7 days a week.

2. Iterative timetable construction schema

In order to be simple and effective, we must capture the mental models of good timetabling practices. We conceive that timetable construction is an iterative process incorporating the following phases:

- Pre-planning assignments, including important events such as training, annual/exceptional leave, etc.
- Cyclic timetable generator [1, 4]: the deserving staff (due to past performance and contributions) or staff with disabilities, may follow a fixed cyclic timetable that is adapted to their work permit and preferences.

- Acyclic timetable generator [1]: the extra requirements over the manpower supplied by cyclic planning have to be met by a more dynamic staff (who may be temporary or students). Acyclic planning assigns this staff to meet unsatisfied requirements, while respecting work regulations on work and rest times and durations.
- Local modifications: if some parts of the timetable need to be changed, it is possible to manually delete these assignments and reactivate the acyclic planner. The solver would be able to fill the blanks to complete the timetable. Eventually, the user deactivates some less-important constraints to ensure a planning.
- Last-minute changes: we have tools that propose a replacement, based on their skills, past assignments (with rest duration requirements) and current assignments (e.g. spare team).

Otherwise, the user manually fixes the timetable. Here, automatic real-time counters and verification systems ensure that work regulations are still satisfied.

3. Multiple timetables

To implement such a schema, we propose multiple timetables for the same employee over the same time horizon. For the pre-planning phase, we have the *draft timetable*. It records the requests from the employees as well as special company sessions (e.g. training). These requests are not granted systematically since there may be several choices. If they are not recorded in the tool, they could be easily mislaid. This timetable can also help in discussion and negotiation; a well-known means to solve so called *wicked problems* (see [6]).

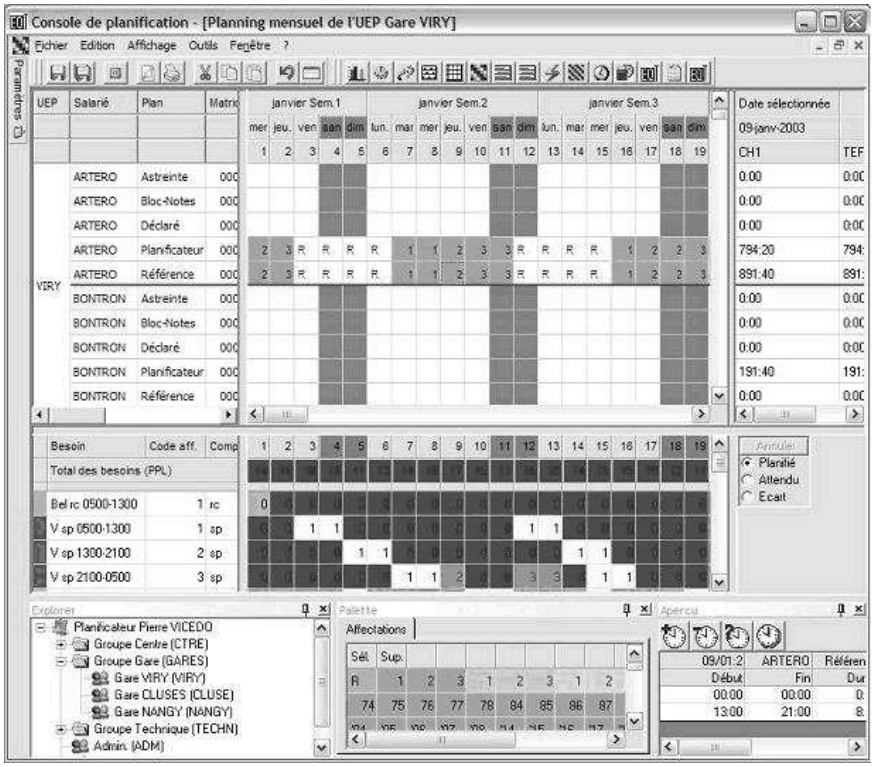
Many institutions use the *reference timetable* at the quarterly / yearly horizon. It is produced on a strictly cyclic basis with well-adapted work cycles to assure perfect equity among the employees who enjoy this basis. The acyclic timetable generator to fill in requirements may complete it. Of course, it has to be re-worked to accommodate specific requests or to allow for absenteeism. Once published, it becomes the *forecast timetable*.

The forecast timetable is special where all changes must be recorded legally, because there are often union restrictions on the advanced warning for timetable changes. Finally, when the timetable comes to past, the worked duration must be recorded. This *recorded timetable* may differ from that validated by the supervisor, e.g. if the worked hours are not requested or not allowed by company rules. The *validated timetable* is sent to the pay department and archived.

4. Conclusion

This abstract shows that practice and theory should go together to construct tools that produce effective timetables. Many theoretical papers propose one automatic program that produces THE timetable. In practice, we find that users prefer small tools and utilities that accompany them through the various steps producing the different

timetables that we have briefly described here. A full paper describing the innovative features of this system is available at [10].



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