

K E R N E L

S O F T W A R E

BRINGING VISION TO OPERATIONS

Solutions

How Kernel Software resource management systems can simultaneously increase productivity, improve the morale of employees and bring under control the complexities of labor rules.

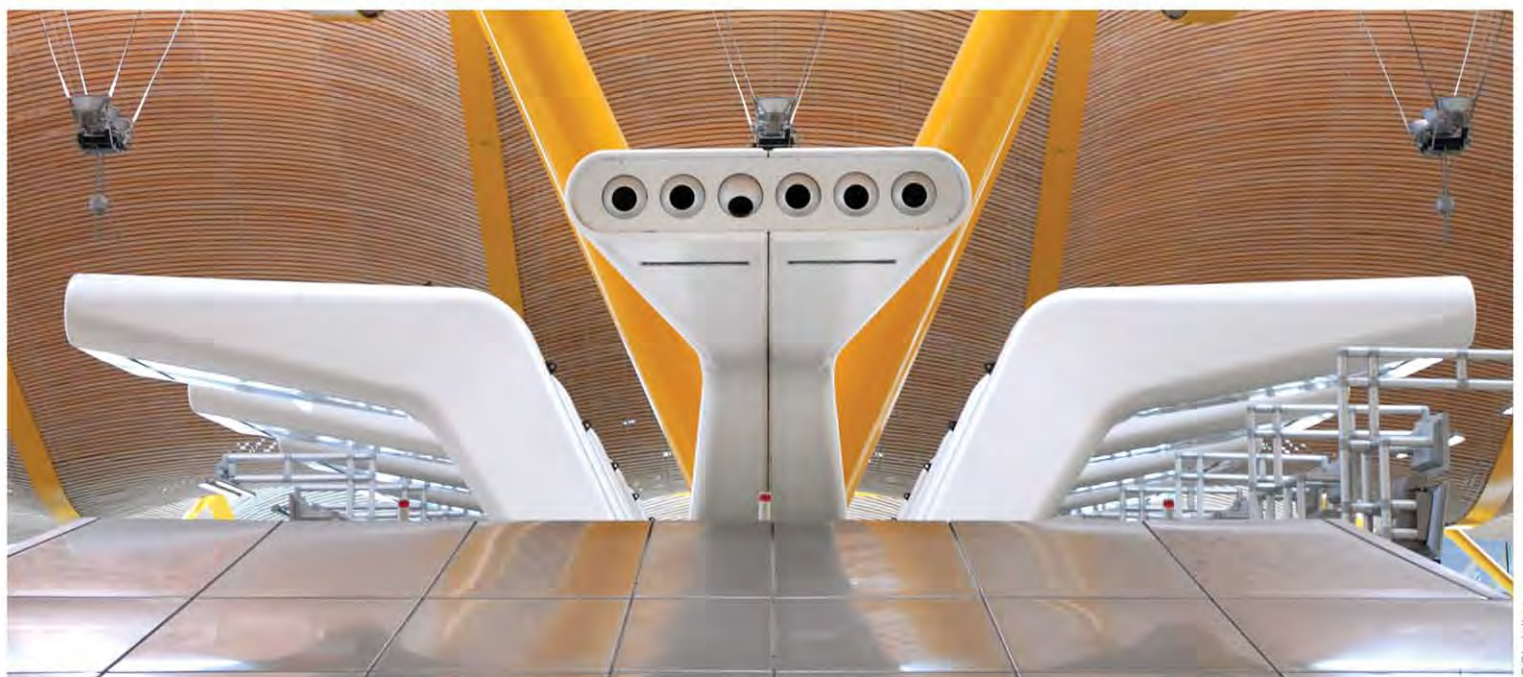
RESOURCE MANAGEMENT

Resource Management is the business process by which the utilization of scarce resources is planned and adapted to the disruptions in the operations/production environment. Scarce resources can be qualified personnel (ranging from the pilots of an airline to ski instructors or to train controllers) or expensive equipment (e.g.: heavy-duty machinery, aircraft flight simulators, etc).

In many cases, existing IT systems only track resource utilization. Deciding which resources should be assigned to which tasks, reacting when tasks are changed or when resources become unavailable, taking into account the personal wishes of those who perform the work, all this is left to the ingenuity of the planners.

Kernel Software develops systems which uniquely improve Resource Management by supporting the planners in these most difficult aspects of their work. Improvements come from innovations in three key areas:

- Automatic planning
- Employee requests
- Labor rule modelling



Automatic Planning

Building schedules which use available resources in the most productive way is a difficult task: it requires envisioning a huge number of possibilities and finding the best one among them. Unfortunately, humans are not very good at reviewing large numbers of possibilities.

Mathematical methods can tremendously help to build productive schedules. However, Resource Management problems often turn out to be so large that general optimization techniques are too slow for practical purposes.

This is where one of Kernel Software's strengths lies: not only is its team of optimization specialists proficient in general optimization techniques, it also knows what to do when such techniques need to be combined with domain-specific knowledge.

The Automatic Crew Assignment module that Kernel Software provides Lufthansa with, demonstrates this point: month after month, it builds the monthly schedules of Lufthansa's 20,000 pilots and flight attendants. A task which used to keep several planners busy for two weeks is now performed in a few hours, with better results and with fewer planners.

Employee Requests

Planning of personnel resources cannot be done while ignoring its impact on the daily life of employees. This is especially true for operations in which people have to work during week-ends or at night. On one hand, planning should be done as late as possible in order to better take into account market variations; on the other hand, people need to know sufficiently in advance what their work schedule will be, so that they can organize their private life. As a result, the interests of the employees conflict with the interests of their company.

Kernel Software's systems provide an elegant solution to the issue: by combining automatic planning tools with personal request systems, they make it possible to create schedules which take into account the individual wishes of the employees while achieving better global productivity. Changes in the business processes which would have been fiercely resisted become acceptable because technology has created possibilities whose benefits can be shared between the operator and its employees.

There is one feature which is critical to the success of the approach, and for which Kernel Software has a unique expertise: its personal request systems are **real-time request systems**. The concept is so new that it requires some explanation:

A personal request system enables employees to request the rest periods and/or tasks they like most. An obvious problem is that many employees have similar requests (typically, almost everybody wants to avoid shifts starting early in the morning or extending into the week-end). The main function of a personal request system is thus arbitrage: when too many employees request the same rest period or task, the request system must apply fairness rules in order to decide which requests will be granted and which ones will be denied.

If arbitrage is done off-line (for instance, once per month), the employees whose requests are denied do not have the possibility to submit a different request. This is why it is critical that a request system be a real-time system, in which arbitrage is recalculated whenever a request is submitted.

Real-time request systems are a technical challenge, because checking whether a request is compliant with labor rules can be extremely complex, and because a new request can cause many existing requests to be denied and/or re-satisfied in another way. Kernel Software relies on its high-speed labor rule checker and on parallel computing techniques in order to provide real-time request systems for very large companies.



(CC) The Wandering Angel



(CC) iugiboy

Kernel Software's dedicated rule tools can handle the most complicated labor rules.

Labor Rule Modelling

Resource schedules must follow rules which can be highly complex. This is especially true for labor rules applicable to personal schedules. In some companies, labor rules are the results of years of negotiations with trade unions; the number of rules, exceptions to the rules and other special cases is simply mind-boggling. Furthermore, labor rules change quite frequently, and maintaining the programs that check them is often an operational nightmare.

Kernel Software has developed the c-laws(*) and e-rules tools for describing resource utilization rules and for checking whether a particular schedule obeys them.

(*) Pronounced "clause".

Case study

Lufthansa

How one of the largest airlines has achieved outstanding improvements of its crew planning processes by using Kernel Software's systems.

In the jargon of airlines, a roster is the monthly schedule of a pilot or flight attendant. It describes the flights of the crew-member, their rest days, their vacation days and their training activities.

Each month, Lufthansa faces the gigantic task of building an individual roster for each of its 20,000 crew-members. Each roster must obey highly-complex rules. Additionally, rosters must be planned close to the average number of flight hours in order to reduce overtime costs.

Lufthansa operates in a market that has become extremely volatile and difficult to forecast. As a result, it needs to build the monthly rosters of its crew-members as late as possible. However, this raises two issues:

- 1) Building rosters is a truly difficult task. In most airlines, planners need several weeks to complete it. Reducing this time to a few days is far from obvious.
- 2) Crew-members like to know as early as possible what their monthly roster will look like, so that they can plan their personal life. They are not asking for late planning.



The solution to these two issues is based on two systems developed by Kernel Software:

MPG enables the crew-members of Lufthansa to request their rest days, the rotations they would like to fly and the dates on which they would like their training activities to take place. It gives them more control on their rosters, thus compensating for the late building of the rosters.

ACA builds rosters automatically, taking into account productivity as well as requests, and producing balanced rosters.

The benefits of the compressed planning cycle that **ACA** and **MPG** have made possible are not limited to considerable cost savings. They have also greatly increased Lufthansa ability to react to major disruptions, and significantly improved the robustness of a critical business process.

"Today, the rosters of Lufthansa 15,000 flight attendants are built in less than 15 days, with a satisfaction ratio exceeding 90% for the two main requests.

The outstanding improvement of our crew planning processes could not have been achieved without the real-time Preferential Bidding System and Automatic Rostering System of Kernel Software."

Stefan Wendlandt

Manager Cabin Staff Communication, Training and Development - Deutsche Lufthansa AG

Crew Management

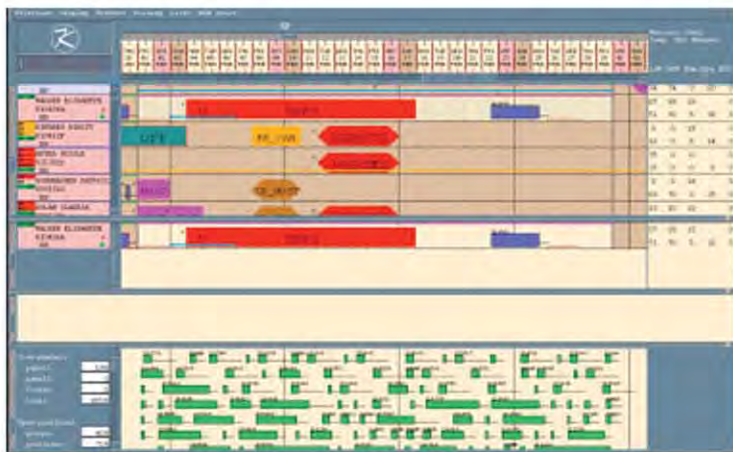
Automatic Rostering

Kernel Software's automatic rostering tool builds efficient, legal and well-balanced rosters for groups of several thousand crew-members. In a few hours, it performs a task that requires several days of manual planning, while producing better-quality rosters.

A powerful language enables airline administrators to define precisely what is a good quality roster, taking into account a variety of factors such as flight hours, paid hours, duty days, crew request satisfaction, recurrent training requirements, influence on the following month, etc.

Graphical Rostering

Kernel Software's graphical rostering interface enables crew planners to review and modify rosters, to start automatic rostering runs and to analyze their results.



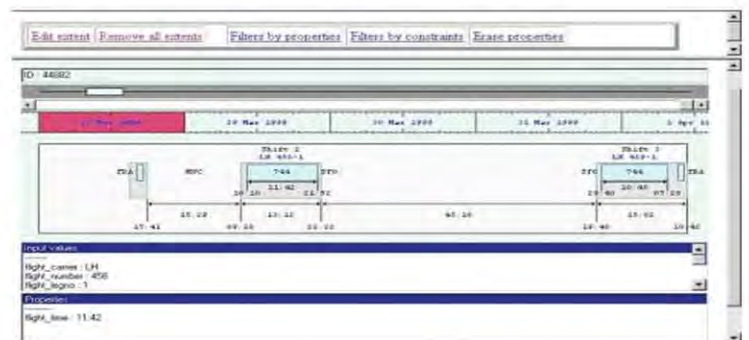
Legality Checking

c-laws

c-laws is a general declarative language for describing airline labor rules and for checking whether rotations and rosters comply with the rules. It has been designed to handle the complex rules of large airlines and railways.



c-laws generates efficient code in C, C++, Java or COBOL, which is compiled and linked into various crew management applications, including rule servers, automatic rostering modules and statistical analysis tools.



e-rules

e-rules is a legality checking language designed for crew planners without an IT background. It makes it possible to describe a large class of rules in a simple syntax, and to install the rules in production systems without the help of a programmer.

Training and Simulator Management

Kernel Software's training management tool makes it possible to define complex courses and to ensure that the necessary resources are available.



Real-Time Crew Requests

PBS with immediate feedback and full transparency

Kernel Software's unique system checks the legality of crew requests and arbitrates in real time among competing requests for OFF days and rotations. Crew-members no longer discover, weeks after their requests have been submitted, that they are denied for unexplained reasons. Instead, they can check that the rotations and OFF days are really distributed according to the defined rules.

Available rotations are displayed using a straightforward color code:

green : a request for the rotation would be granted with an open position

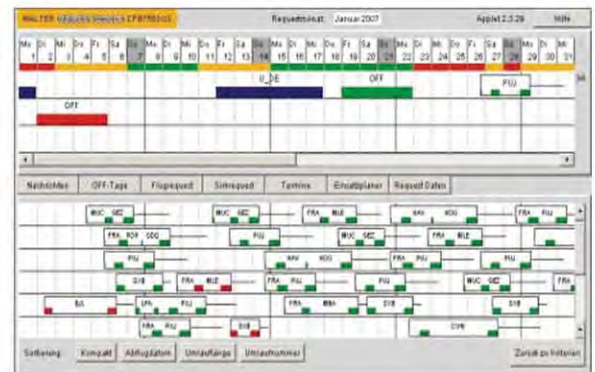
yellow : a request for the rotation would be granted at the expense of a lower-priority colleague

red : all positions are granted to higher-priority colleagues

Qualitative requests

Qualitative requests let the crew-members provide an abstract description of the rotations they are interested in. For instance, instead of requesting a specific rotation, a crew-member can submit a request for any rotation which includes a layover in Singapore and which returns on a Friday.

A high number of criteria are available: departure date, return date, number of duty days, length of the rest time following the rotation, layovers, shift departure times, etc.



Alternative requests

Alternative requests are second-best choices which are used when all best-choice rotations are either illegal or granted to higher-priority colleagues.

Alternative requests can be combined with qualitative requests. For instance, a best choice can be “any SIN rotation returning on a Friday”, a first alternative can be “any SIN rotation” and a second alternative can be “any SIN or BKK or MNL rotation”.

Partner requests

Two or more crew-members can submit a common request. A rotation is granted only if it can be granted to all partners.



K E R N E L

S O F T W A R E

KERNEL SOFTWARE SARL

18 avenue du Touring Club 77300 Fontainebleau
France

Tel.: +33 (0) 1 60 72 75 21

www.kernel-software.com
contact@kernel-software.com

