

Your Opinion is Interesting, but Optimization Matters

The value of great decision support and basing decisions on facts, not opinions

There is significant value connected to taking the right decisions when implementing change. To find the valuable options, and avoid the costly ones. Far too often, decisions are taken without proper analysis and quantification upfront. This paper briefly explains how the Jeppesen production system doubles up - being also the perfect gauge for decision making.

Background and design

The Jeppesen Crew Management suite ([link](#)) is built for quickly producing the best possible planning results, using leading optimization techniques. The challenge is doing this, not only right after installation, but year after year while the airline evolves and circumstances change. To facilitate this, Jeppesen has built in a high-level business modelling language, called Rave, that makes it easy for customers to define or modify a new rule or penalty that limits or guides the optimizers when constructing solutions.

The system architecture has a clear separation between solution methodology and problem description; something we often refer to as the 'Avocado'. The core of the Avocado corresponds to the optimization technology, while the tasty part is the customer-specific configuration layer with Rave, where the business logic resides. A positive spin-off from this architecture, designed for keeping the system in sync with business requirements, is the decision support capabilities it brings. Instead of 'guesstimating' the effect of a change; why not model it, apply it on real data, and properly quantify the results in a 'what-if' scenario?



The improvement and analysis methodology can be broken down into four simple steps:

1. Rave

Rave is an easy-to-use high-level language for defining business logic. Rave is used for two things mainly;

1. Defining the hard constraints of the planning problem, i.e. is a sequence of activities legal or not? It could be as easy as writing this statement to limit FDP to 60 hours in seven days:

```
Rule Max_FDP =  
FDP_in_7_days < 60:00;  
end
```

2. Defining the cost of a sequence of activities. You could, for example, express a cost for a flight being planned in a fatiguing way (and then add up that cost over all crew):

```
Cost_fatigue_risk = if alertness < 1500  
then 200  
else 0;
```

Rave makes it straightforward to express business needs and priorities in the system, and have them automatically and immediately respected by both the graphical user interface used for manual work and by the optimizer.

2. Optimize

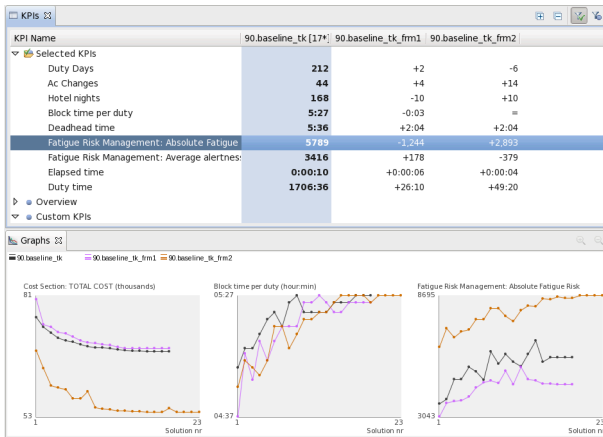
The planning optimizers in Jeppesen Crew Pairing and Jeppesen Crew Rostering will quickly find the solution that adds up to the lowest overall cost expressed in Rave, whilst limited by the hard constraints. These costs will be both real costs and 'penalties' for not fulfilling crew bids, missing robustness etc. Typically the objective function consists of a few hundred different cost elements. Together these elements reflect the priorities of the airline and points out a direction to the optimizer.

When a 'what-if' analysis is being conducted, it is not uncommon to produce ten, or even a hundred, different solutions while varying constraints, priorities and input data. This to fully assess the effect and validate the results. With the support of an optimizer, this is mostly just requiring extra CPU time, whereas a manual assessments on this level would be impossible due to time limitations.

3. ScAn

Jeppesen ScAn, the *Scenario Analyzer*, allows for scanning over and comparing solutions in detail using a multitude of different metrics that are calculated on the overall solution. These may be the amount of aircraft changes, overtime pay, duty days, fulfilled bids, absolute fatigue risk, or fair distribution of block time and other aspects between crew. All metrics (often referred to as KPIs) can be reported on and plotted in real-time side-by-side to see how they evolve during an optimization run. (see picture below).





4. Repeat? ↻

Finally, it is time to draw conclusions from the changes introduced and the outcome of planning your operation differently. Do you need to confirm the results using additional or different data? Will the benefits outweigh the costs? How can it be implemented, if forced to do so, with minimum damage? Can additional benefits be found? What would be the alternatives? Should we repeat the analysis with some modifications, incorporating new ideas based on our findings?

A word on Counter-intuitivity...

Surprisingly often, the effects of a change can be counterintuitive. Here are a couple of examples:

- You might think/feel that removing deadheads (positioning flights where crew are transported as passengers) would be good for efficiency and bring the overall cost down. The reality is that in a complex planning problem there is an optimal number (and selection) of deadheads needed. Reduce them and efficiency drops.
- Shortening the maximum allowed duty time for overnight flight duties should be good for flight safety by reducing fatigue risk, right? Not necessarily. What if it leads to 30% more night duties, each requiring a couple of hours of commuting before/after? Each duty by itself becomes better, but the overall fatigue risk is increased!
(Are you a regulator? Read the above at least twice! ;-)
- If you increase the monthly minimum days off for your crew with one day, it should become easier to fulfil their day-off bids, right? Nope, it might be the other way round, as the rostering problem becomes more tight.

All of us are unfortunately heavily biased in our decision making, and most of us deeply in favour of the quick and simple answers. Especially those confirming the opinions we already had before starting the analysis. However, our

opinions, although interesting, are irrelevant. A proper *quantification* is what is needed, and what better way to do it than using your production system on your production data?

Value

The additional value from a capable, fast and fact-based decision making process is no doubt significant, but still difficult to assign a tangible amount to. A detailed survey done among Jeppesen customers in 2013, probing deep into this topic, revealed a range for the additional value between **2.3% - 4.9%** on overall crew cost, depending on the nature and type of operation. Since the time of the survey, the volatility in the market has increased further, which is why this now should now be looked upon as a conservative estimate of the associated benefits.

Jeppesen has several in-depth training courses on modelling rules, incentives and using the built-in analytical capabilities in the Jeppesen Crew Solution suite. The full course schedule is found [here](#). Welcome!



Further reading:

- [Aligning Rules With Human Physiology](#)
- [Jeppesen Concert](#)
- [Assignment-centric Performance Indicators](#)