Tidewell Labs

SEPTEMBER OPS-RESEARCH MEETUP

Scheduling 400 berths with a constraint solver

Mira Castellane · Developer Advocate, Tidewell Labs · 22 September 2026

THE PROBLEM

A small port, a normal week.

12
berths, three of them tidal

1
approach channel over a bar

2
tide windows a day for deep-draft calls

~400
berth assignments incl. shifts

3
pilots on shift, two tugs

1
whiteboard, rebuilt most mornings

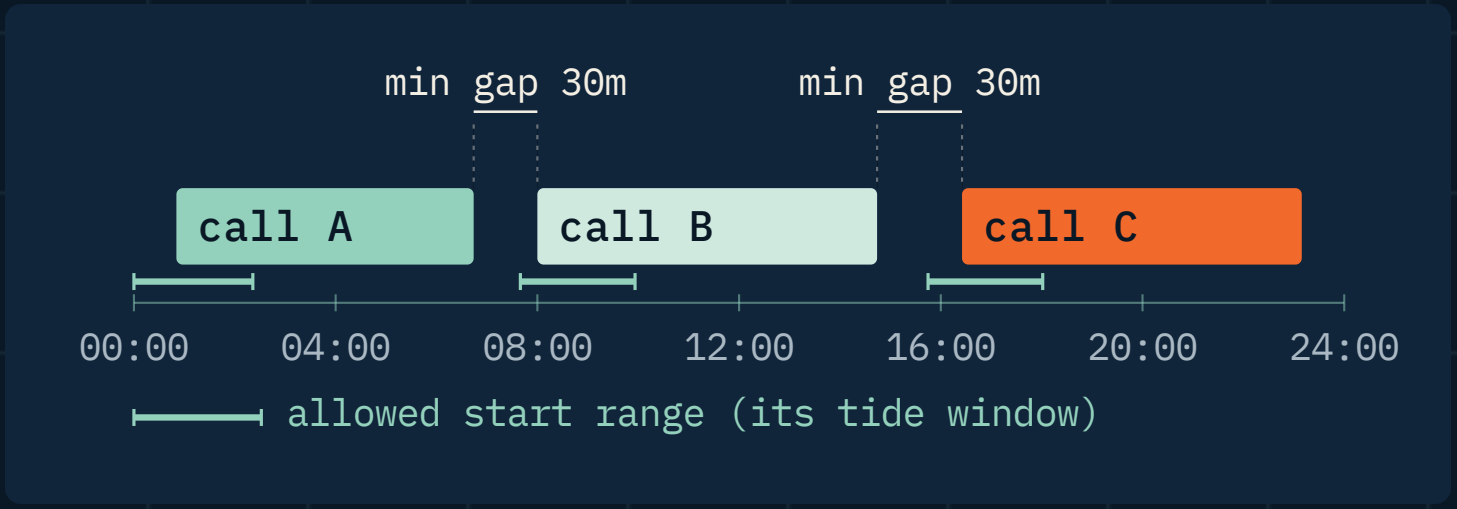
WHAT THE HARBOUR MASTER KNOWS

Every rule is already written down somewhere.

- **Length:** the ship fits the berth, with room for lines
- **Tide:** deep-draft moves only inside a tide window
- **Pilots:** every deep-draft move needs one on shift
- **Draft:** the berth is deep enough at low water, or the call is tidal
- **Gap:** at least 30 minutes between calls on one berth
- **Tugs:** big ships need two, and there are two

THE MODEL

A port call is an interval.

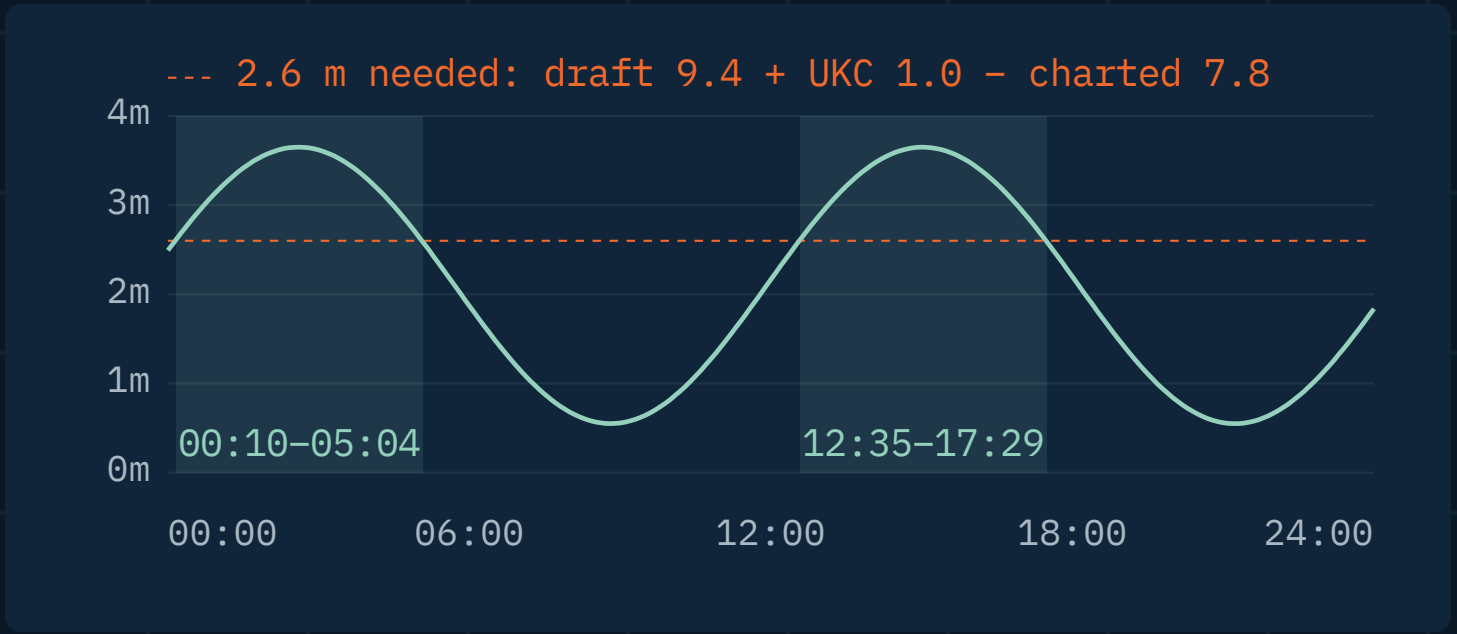


A **start** that may move, a **duration** we can estimate, and a **berth**.

Everything else is a rule about intervals.

THE TIDE DECIDES THE START

Compute the windows first.



required tide = draft + clearance − charted depth

Hand the solver only the starts that are physically possible. Impossible plans are never explored.

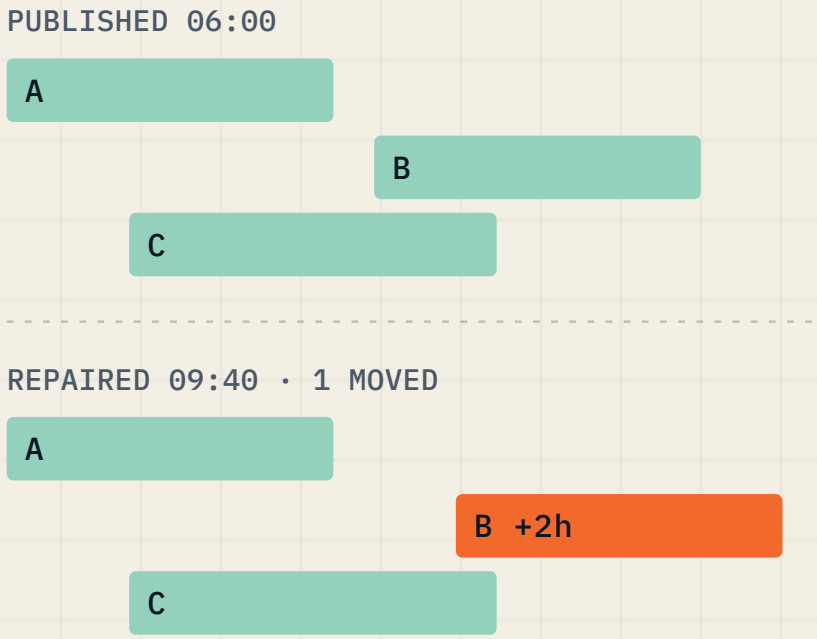
IN CODE

The whole idea fits on a slide.

```
for call in week.calls:
    start = model.new_int_var(domain=call.tide_windows)
    iv    = model.new_interval(start, call.duration)
    by_berth[call.berth].append(iv)

for ivs in by_berth.values():
    model.add_no_overlap(ivs, gap=30)   # minutes

model.add_cumulative(pilot_moves, pilots_on_shift)
model.minimise(waiting + 10 * moved_announced_calls)
```



Repair beats re-solve. Moving an announced call costs more than a little waiting.

WHAT WE LEARNED

Four things we got wrong first.

01 **Tighter domains beat bigger servers.**
Most of our speed-ups came from better tide windows, not hardware.

02 **Penalise change, not just cost.**
A plan that reshuffles every hour is a plan nobody trusts.

03 **Springs and neaps move everything.**
Neap tides shrink the windows. Plan a fortnight ahead, not a day.

04 **If the harbour master can’t read it, it’s wrong.**
However clever the solver was.

Tidewell Labs

THANK YOU

Questions?

hello@tidewell-lab.xyz · tidewell-lab.xyz