LocalSolver

Operations Research subsidiary of the Bouygues Group (€31 billion, 118,000 employees)

- production planning
- vehicle routing
- project planning
- revenue management
- workforce optimization
- network design
- and many more...

SOFTWARE EDITOR
OR & IT SERVICES

10 PhD-engineers in computer science and applied maths
20 years of experience in operations research
Analysis of a painstaking OR project at Bouygues

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Optimisation problems

Scheduling (assignment wall → day)

Minimizing the set of formworks

Minimizing the number of junctions (formwork pairing)
Shuttering material (formworks)
Minimization of shuttering material

Subset sum

- Example 9,50m = 2 x 4m + 1 x 2m
- + restrictions
  - Stability constraints
  - Special models
  - Extremity models
- 3 x 3m + 1 x 1m
- 1 x 4m + 2 x 3m

Objective = minimize the necessary formwork stock
Handled as a constraint satisfaction problem
The user can limit the number of each kind of formwork
Dialogue of the deafs:
- Software: « No solution »
- Client: « Because of which wall ? »
- OR expert: « None in particular »
- Client : « ??? »

Stock = for each kind of formwork, the max over all days
Zero must be a solution!

-> new model = maximize the number of framed walls
(even if in practice we will have to frame them all)

- Software: « I framed 49 walls out of 50 »
- Client: « I see. On the remaining wall I will allow the special formwork kind number 5»
- Software : « Ok. Now I can frame all walls »
- Client : ☺
- OR expert : ☺
Autocad (delphi)

DLL Claire (c++)
IT Architecture

- DLL claire (formwork pairing)
- DLL c++
- Java (choco)
- Autocad (delphi)
IT Architecture

- Autocad (delphi)
- DLL c++
- DLL claire (formwork pairing)
- Java
- DLL GLPK (column generation)
90% of assistance requests were about installation issues, crashes between DLL, and so on.
Partnership

Contract:
• 12,000 euros for the first version
• And 10,000 euros per year for evolutive maintenance
• During 10 years! With a very slow rhythm, always considered as a prototype

Organization
• Graphical Interface developed by client
  • By method engineers (in addition to their normal activity)
  • Difficult to synchronize the few days spent by each party on the project
• No support of the client IT team
Comparison with another project in the construction field

Earthhaul planification on linear construction sites

• Minimize renting cost of engines (presence time)
• Minimize total traveled distances along the site

Jeanjean 2010, *Resource scheduling optimization in mass transportation problems*
## Conclusion

<table>
<thead>
<tr>
<th></th>
<th>Failure</th>
<th>Success</th>
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<tbody>
<tr>
<td><strong>Project</strong></td>
<td>3 tools</td>
<td>1 single clear goal</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>Too ambitious (too rich) 0 is not a solution</td>
<td>Minimum viable model 0 is a solution</td>
</tr>
<tr>
<td><strong>Planning</strong></td>
<td>10 years of “prototyping”</td>
<td>6 months with 2-week agile sprints tested</td>
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<tr>
<td></td>
<td></td>
<td>and launched</td>
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<tr>
<td><strong>Cost</strong></td>
<td>10k€/year 2001-2008</td>
<td>50k€ once (+ maintenance)</td>
</tr>
<tr>
<td><strong>Architecture</strong></td>
<td>Delphi/c++/java (+claire !)</td>
<td>.NET ⇔ .NET</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>OK: several real data sets, early in the course of the project</td>
<td>OK</td>
</tr>
<tr>
<td><strong>Partners</strong></td>
<td>Method engineer in addition to their usual activity (no IT support)</td>
<td>An expert developer from the IT department</td>
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<tr>
<td><strong>R&amp;D</strong></td>
<td>A scientific success: 4OR, RAIRO</td>
<td>R&amp;D after the project</td>
</tr>
<tr>
<td><strong>Usage</strong></td>
<td>Partially in production during a few years. Not used anymore.</td>
<td>A full success. Still in use.</td>
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