

LocalSolver

www.localsolver.com

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

- production planning
- vehicle routing
- project planning
- revenue management
- workforce optimization
- network design
- and so on.



SOFTWARE EDITOR
OR 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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*The wise man learns from his mistakes,
the wiser man learns from the mistakes of others.*



Context

Partnership since 1997 with the method department

Residential buildings

Carcass work = framing walls (and floors)

Identical levels: typically 100 walls per level
and 10 days per level



Optimisation problems

Scheduling (assignment wall \rightarrow day)

Minimizing the set of formworks

Minimizing the number of junctions (formwork pairing)



Shuttering material (formworks)



Minimization of shuttering material

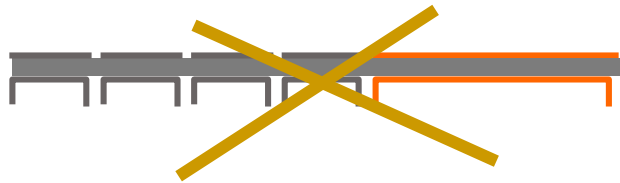
Subset sum

- Example 9,50m =

+ restrictions

- Stability constraints
- Special models
- Extremity models

2 x 4m + 1 x 2m
or 3 x 3m + 1 x 1m
or 1 x 4m + 2 x 3m



Objective = minimize the necessary formwork stock

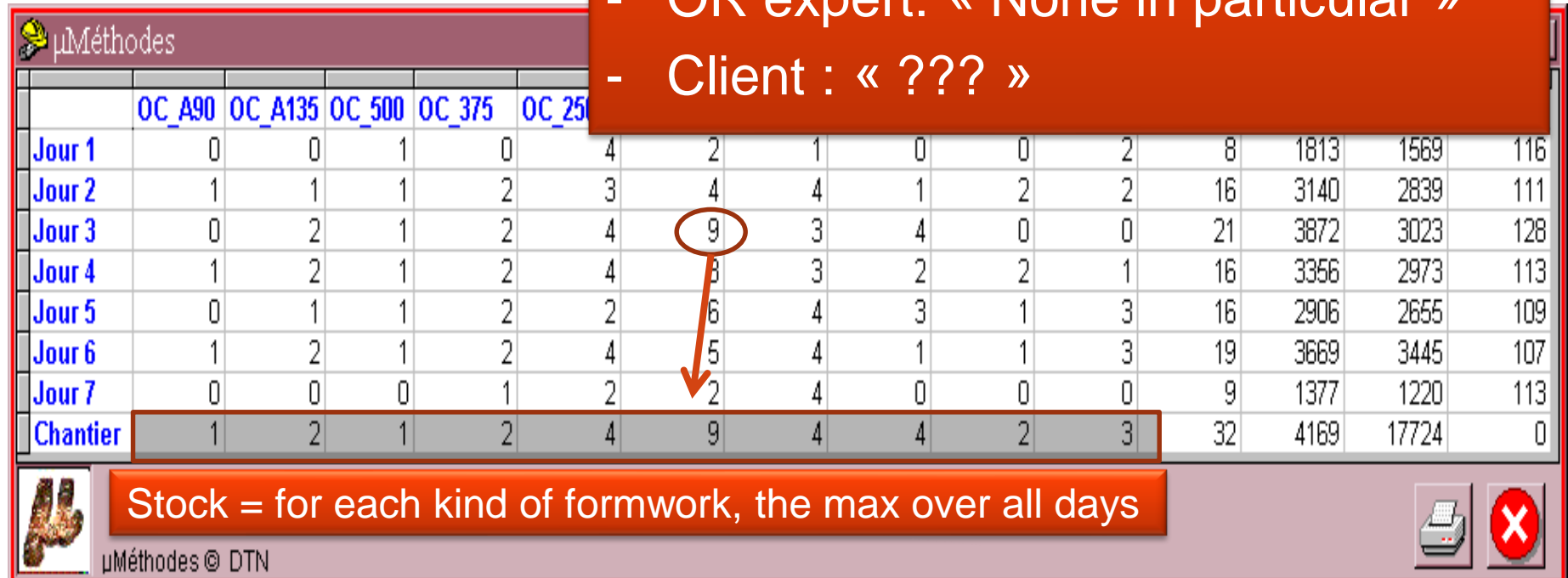
Listening to customer needs ?

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 : « ??? »



	OC_A90	OC_A135	OC_500	OC_375	OC_250										
Jour 1	0	0	1	0	4	2	1	0	0	2	8	1813	1569	116	
Jour 2	1	1	1	2	3	4	4	1	2	2	16	3140	2839	111	
Jour 3	0	2	1	2	4	9	3	4	0	0	21	3872	3023	128	
Jour 4	1	2	1	2	4	8	3	2	2	1	16	3356	2973	113	
Jour 5	0	1	1	2	2	6	4	3	1	3	16	2906	2655	109	
Jour 6	1	2	1	2	4	5	4	1	1	3	19	3669	3445	107	
Jour 7	0	0	0	1	2	2	4	0	0	0	9	1377	1220	113	
Chantier	1	2	1	2	4	9	4	4	2	3	32	4169	17724	0	

Stock = for each kind of formwork, the max over all days

μMéthodes © DTN

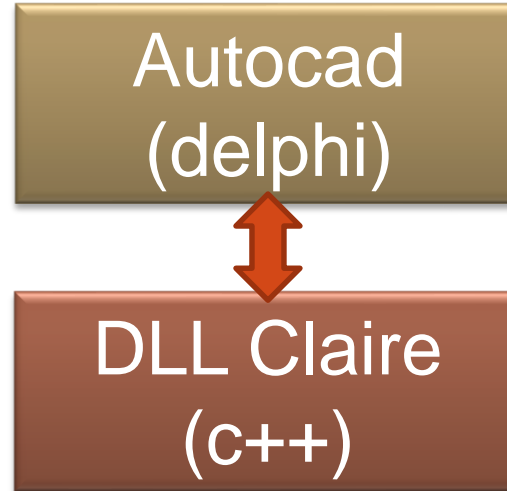
Listening to customer needs

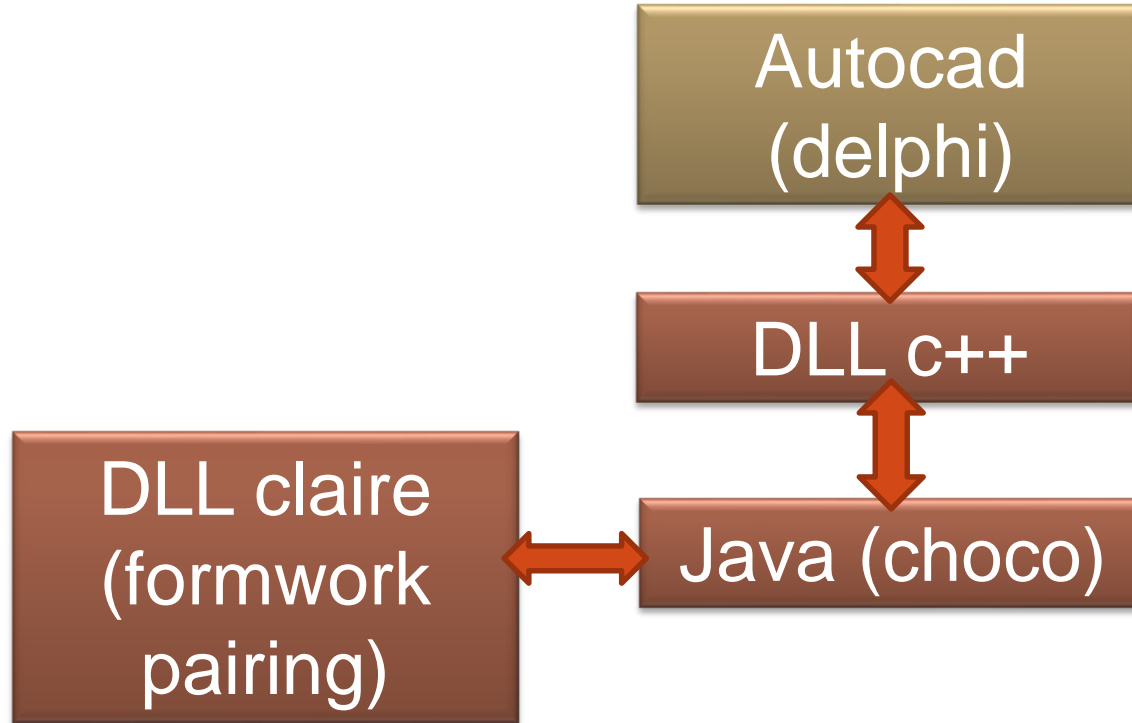
Zero must be a solution !

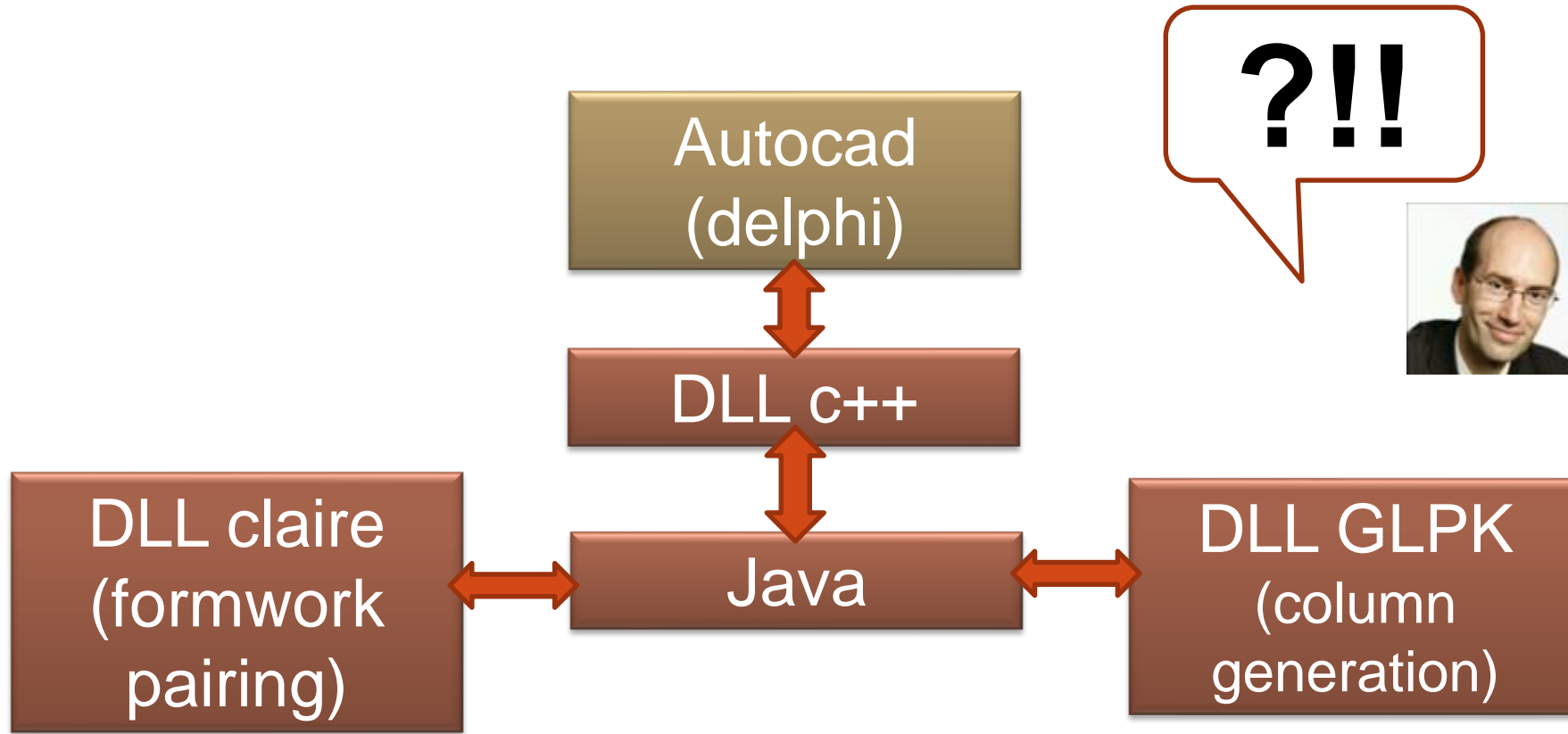
-> new model = maximize the number of framed walls
(even if in practice we will have to frame them all)

- 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 : 😊









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



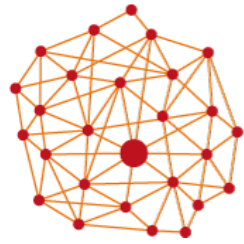
Jeanjean 2010, *Resource scheduling optimization in mass transportation problems*



Conclusion

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





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