

ROADEF / EURO Challenge 2014

Trains don't vanish !

Final phase results announcements

François RAMOND

(SNCF / Innovation & Research Department)

Christian ARTIGUES, Eric BOURREAU, Vincent JOST,
Safia KEDAD-SIDHOUM

(ROADEF Challenge team)

Marc SEVAUX

(EURO representative)



IFORS 2014, Barcelona
13-18 JULY 2014



SNCF, a leading mobility operator

- One of the leading mobility groups worldwide
 - Train operating company
 - High-speed:TGV (2 billion passengers since 1981)
 - Regional trains
 - Suburban trains (3 million passengers per day in the Parisian area)
 - Urban transportation (Keolis)
 - Global logistics (Geodis)
 - Infrastructure management
 - Traffic control and regulation
 - Maintenance of infrastructure



Why this problem?

- Managing rolling stock units around stations is becoming more and more difficult
 - Fast-growing traffic
 - Less space for railway premises in cities
- Trains don't vanish !
 - Need to be managed between commercial trips



Challenge problem overview (1/2)

➤ Perimeter

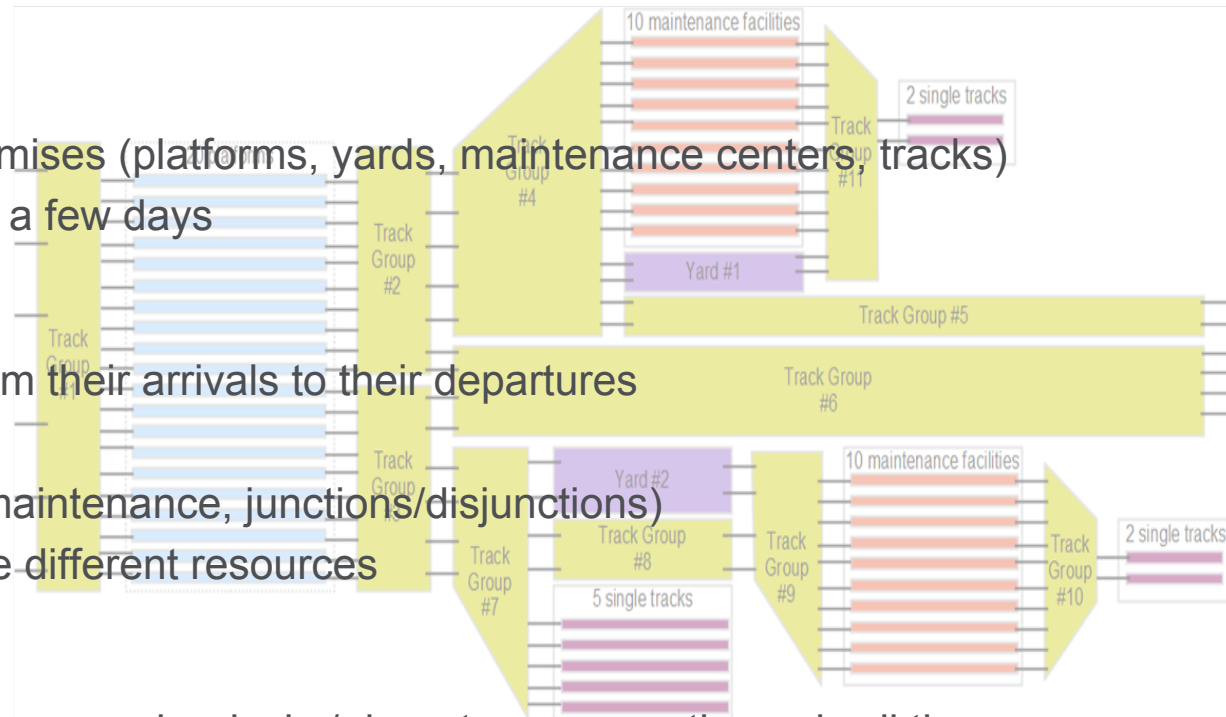
- Large railway premises (platforms, yards, maintenance centers, tracks)
- Planning horizon: a few days

➤ Decisions to make

- Manage trains from their arrivals to their departures
 - Assignments
 - Operations (maintenance, junctions/disjunctions)
 - Move over the different resources

➤ Objective function

- Weighted sum (uncovered arrivals / departures, operations, dwell time, preferences...)



Challenge problem overview (2/2)

➤ Constraints

- Train categories
- Resources capacity
- Maintenance of trains
- Traffic conflicts
- Junctions / disjunctions
- ...



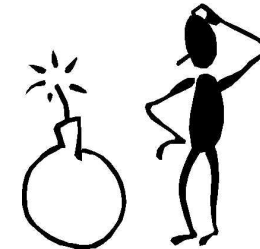
Objectives from the business perspective

➤ Prospective approach

- Completely new approach: mixture of individually hard problems
- What if all features were handled simultaneously ?
- Proof of concept

➤ Ultimate goal

- From algorithms to an industrial tool
 - Refine requirements
 - Users
 - Addressed time horizons
 - Adjustments
 - Adapt algorithms and plug into information system

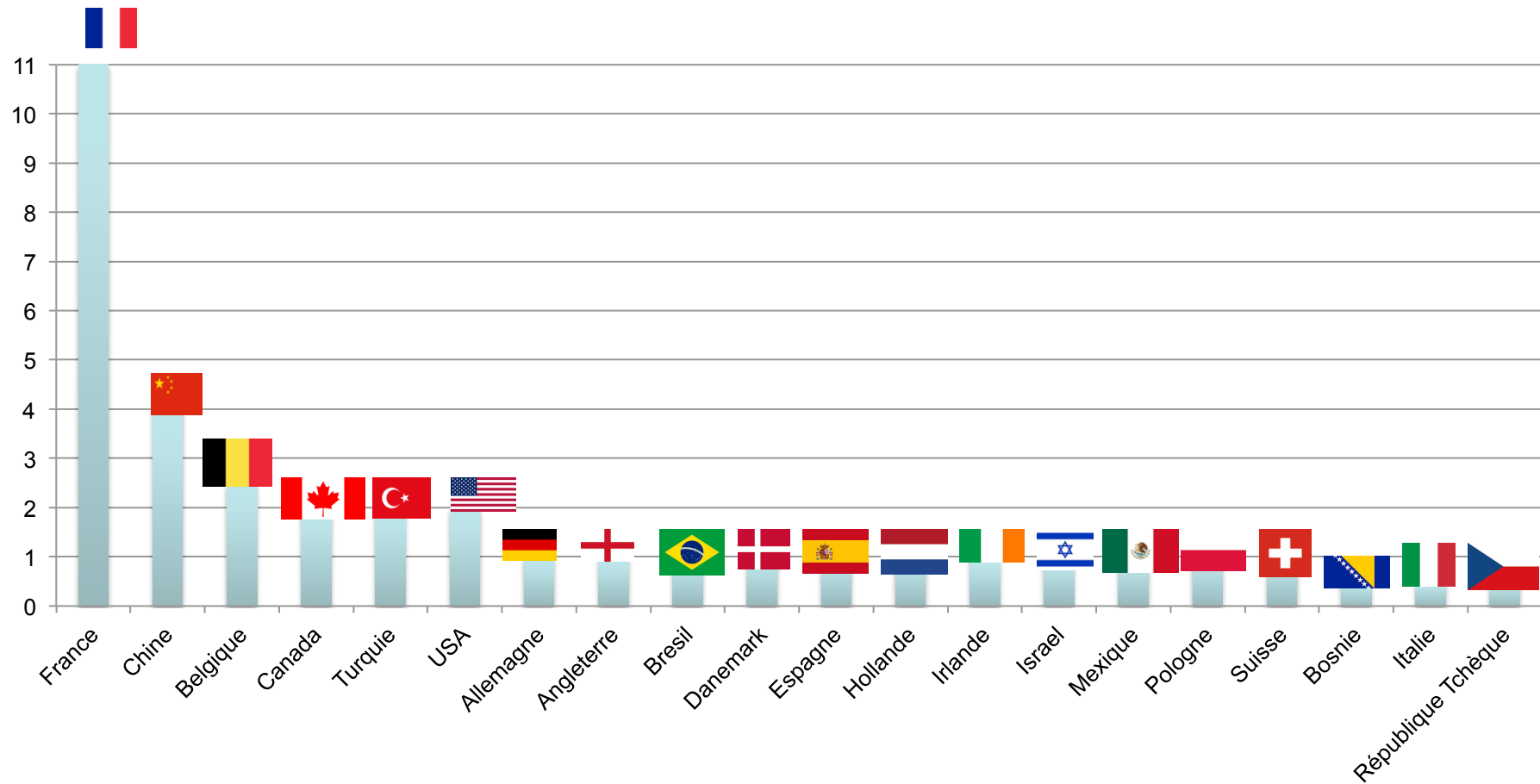


Challenge planning

- Sprint 1: 15th November 2013
- Sprint 2: 11th December 2013
- Qualification: 15th January 2014
- Final: 22nd June 2014
- Scientific: 29th June 2014



Challengers: 36 teams from 20 countries



Intermediary results

➤ Sprint 1: J4

- Luc Arnaud, Siao-Leu Phouratsamay, Guillaume Pataut, Grigori German
 - ENSIMAG, Grenoble, France

➤ Sprint 2: S18

- Mirsad Buljubasic, Michel Vasquez, Haris Gavranovic, Said Hanafi
 - Nîmes/Lille/Sarajevo, France/Bosnie

➤ Qualification winner: S1

- Sandra Huber, Ulrich Tüshaus, Martin Josef Geiger, Sebastian Langton, Marius Leschik, Christian Lindorf, Manabu Geiger
 - Helmut-Schmidt-University, University of the Federal Armed Forces Hamburg, Allemagne

➤ Qualified: 13 teams

- S1, S9, S11, S14, S18, S19, S20, S22
- J3, J4, J9, J10, J11

Subject modification

- Subject modification for the final phase
 - Anticipated from the start of the challenge
 - Motivations
 - Prospective approach
 - Industrial challenge reflecting industrial world
 - Organizations and requirements are constantly changing
 - Software need to be flexible to be easily adapted
- Improvements identified with sprint / qualification results
 - TrackGroup conflicts and yards capacity
 - Performance cost
- Some objectives turned into constraints, and weighted sum instead of lexicographic order

Instances B

Instance	Nb days	Arrivals	Departures	Resources	% covered arr	%covered dep	Nb maintenance operations	Junctions	Disjunctions
B1	7	1235	1235	56	81,0%	80,5%	202	0	0
B2	7	1235	1235	56	81,0%	80,5%	202	0	0
B3	7	1235	1235	56	86,3%	85,9%	341	0	0
B4	7	1780	1780	68	76,1%	73,5%	197	0	0
B5	7	2153	2153	62	74,7%	73,4%	222	0	0
B6	7	1780	1780	62	80,8%	78,5%	195	0	0
B7	1	304	304	88	80,3%	75,3%	24	0	0
B8	1	304	304	88	73,0%	68,8%	24	0	0
B9	7	1967	1967	88	72,2%	71,3%	287	0	0
B10	1	196	196	35	67,3%	67,3%	11	2	0
B11	7	1122	1122	35	55,7%	56,8%	119	36	30
B12	3	570	570	35	56,5%	58,1%	55	16	16
X1	7	1235	1235	61	76,5%	76,2%	197	0	0
X2	7	1499	1499	56	66,3%	70,2%	208	0	0
X3	7	1235	1235	56	80,0%	79,6%	202	0	0
X4	7	1780	1780	62	80,6%	78,1%	192	0	0
X5	7	1780	1780	62	80,6%	78,1%	192	0	0
X6	7	1780	1780	62	83,5%	80,7%	258	0	0
X7	7	1967	1967	88	64,3%	63,7%	241	0	0
X8	3	905	905	88	77,6%	75,0%	91	0	0
X9	3	905	905	88	66,2%	65,0%	75	0	0
X10	1	196	196	35	57,7%	60,7%	10	0	0
X11	7	1122	1122	35	62,9%	63,9%	130	28	36
X12	3	570	570	35	66,1%	67,4%	54	20	26



One final word...

- Problem was extremely difficult
 - Mixture of difficult problems
 - Large instances

- Amazing experience for us
 - Interactions on the forum

- You did a great job, thank you !
 - Hope you could get a taste of optimization in the railway industry
 - Hope you enjoyed it as much as we did

- Many thanks to ROADEF / EURO team !

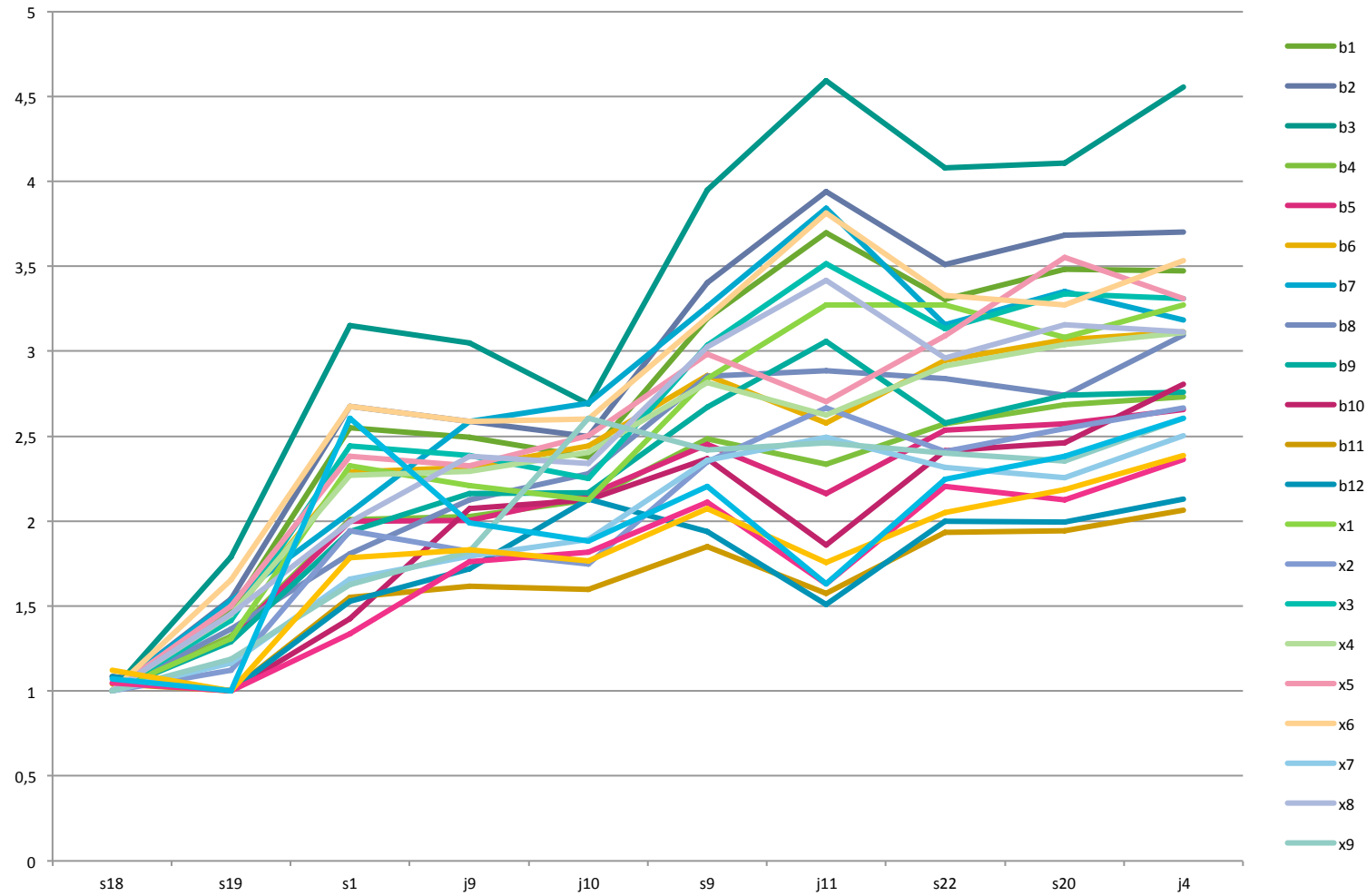


And now... the challenge results!

	Team	Total score	Award
S18	Mirsad Buljubašić, Haris Gavranović, Saïd Hanafi and Michel Vasquez	19 992 021	Winners !
S19	Nicolas Teypaz	25 730 692	
S1	Sebastian Langton, Martin Geiger, Sandra Huber, Marius Leschik, Christian Lindorf, Ulrich Tüshaus	41 173 480	
J9	Hugo Joudrier and Florence Thiard	41 842 837	1st Junior !
J10	Jørgen Thorlund Haahr and Simon Henry Bull	42 947 905	2nd Junior !
S9	Grégoire Spiers	52 124 835	
J11	Ahmed Kheiri and Mohamed Elsayed	53 146 957	3rd Junior !
S22	Szymon Wasik, Piotr Zurkowski, Wojciech Jaskowski	53 412 077	
S20	Lucas Létocart, Marco Casazza, Antoine Rozenknop, Emiliano Traversi, Roberto Wolfler-Calvo	55 094 611	
J4	Luc Arnaud, Siao-Leu Phouratsamay, Guillaume Pataut, Grigori German	57 199 217	

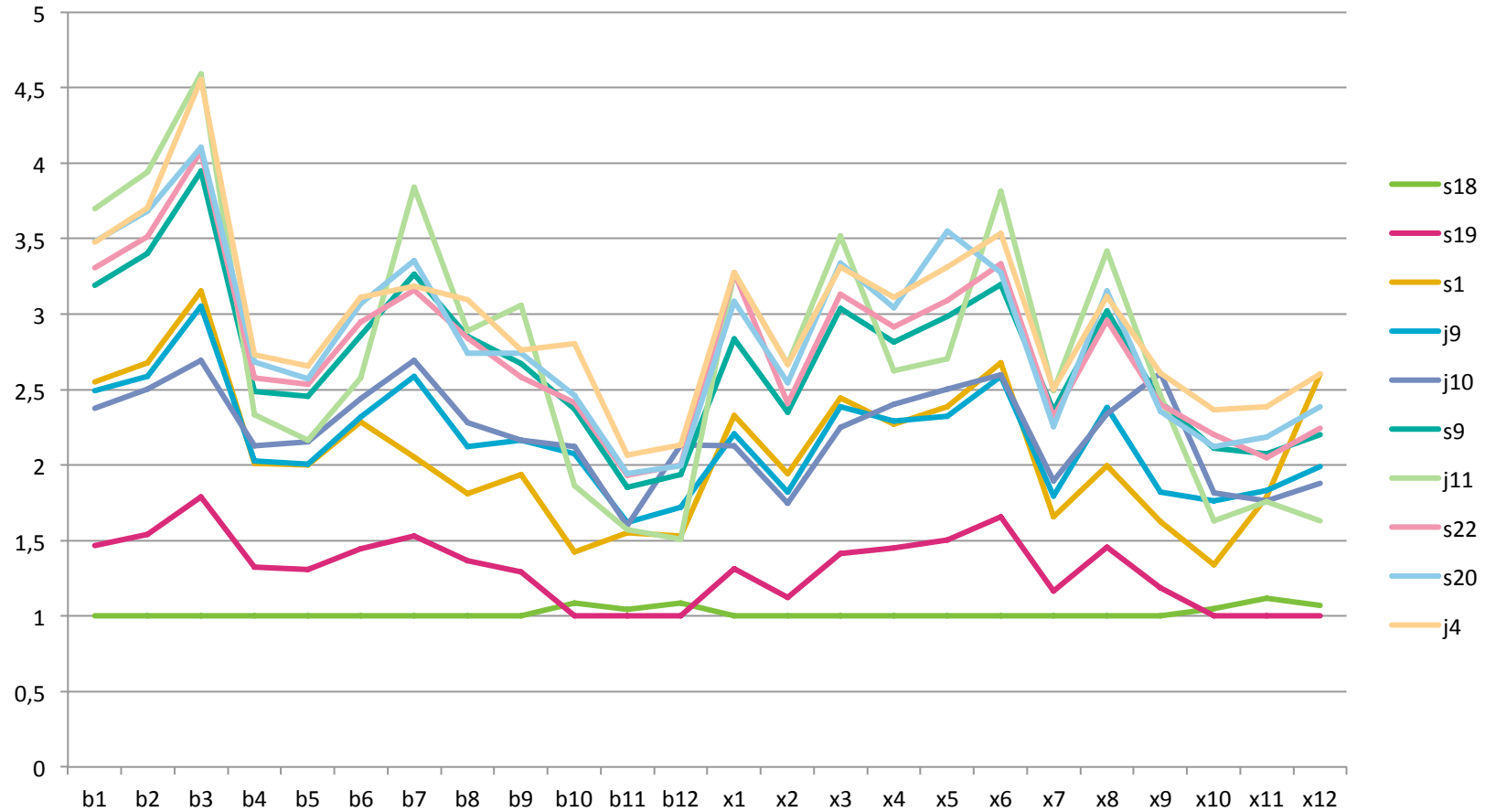
Scores relative to best solutions

Per team (1 = best solution)



Scores relative to best solutions

Per instance (1 = best solution)



Congratulations and thank you all!

