An engineering and operationnal challenge

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# Automation of Paris' oldest metro line

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# Summary – Operator's skill to automate oldest metro line

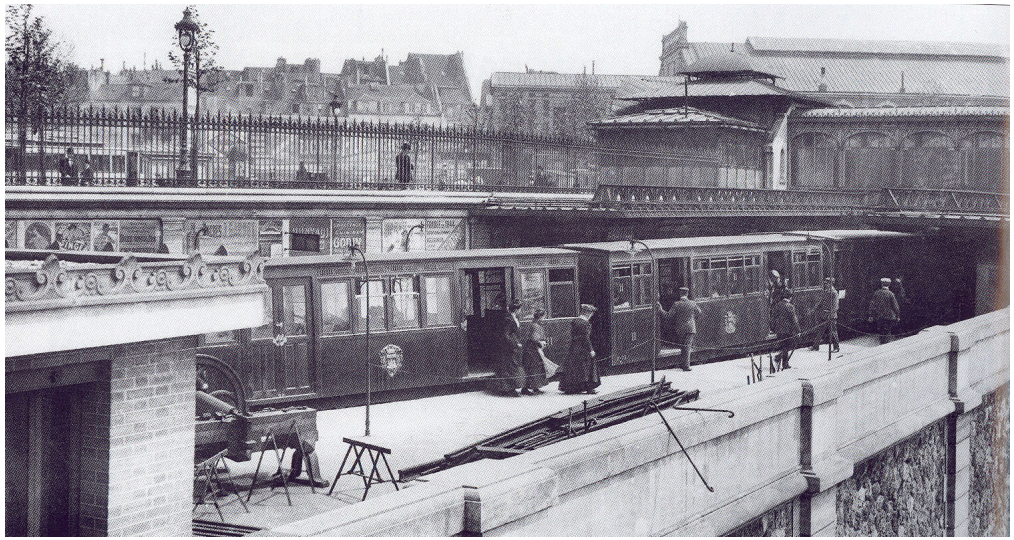
- An integrated operator and engineering approach
- Business case and opportunity
- Specifying and integrating technologic and social issues
- Operation during automation : a very specific skill

Paris Metro Line 1 Automation Program

# Integrated operator and engineering contract

# Paris Metro Line 1 – 1st line in Paris

- Oldest : commissioned in 1900
- CMP (RATP ancestor) was awarded in 1898 a design build finance operate maintain (DBFOM) contract.
- In 2005, STIF (Greater Paris Transport Authority) approved of an integrated scheme for RATP to DBFOM the automation of line 1.
- RATP pays for added investment through operation gains (till 2039)



# Part 1

## Paris Metro Line 1 Automation Program

## Business case and opportunity

# The known benefits of automation

Now mature technology (> 20 years)

Improved safety

Improved headway regularity

- From 1% down to 0,2% costumers waiting

Less lost production per year (UTO)

- From 2,5% down to less than 0,5%

Increased peak hour capacity

- About + 10% on Line 1

Service scheduling for unexpected events

- From 3 months down to 1 hour (UTO)

Improved social economic balance (UTO)

A service oriented / skilled staff

Reduction of cost per km.car -30% -> Return on added investment expected in less than 10 years

# Other expected benefits of automation – Paris Line 1

A technical leap for good reasons

Improving safety with PSD

Improving service quality

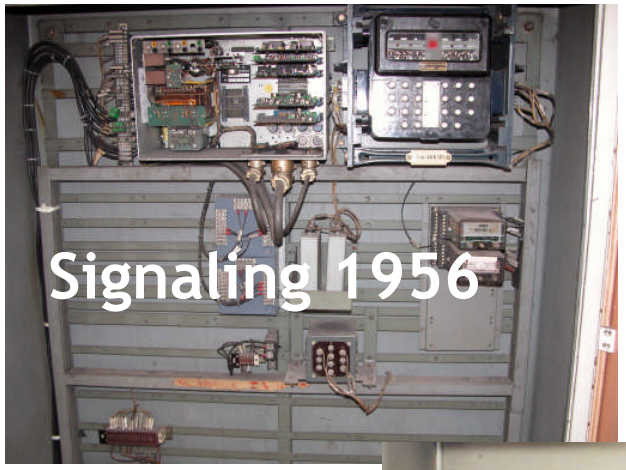
- A major line close to saturation
- Providing transportation for major events
- Facing recurrent regularity problems

Improving economical balance

- Social economic benefits
- Metro job skills base essential but to be improved

# Opportunity : Refurbishment needs

## Opportunities : the need for refurbishment of signalling and automation systems, as well as trains on Line 4





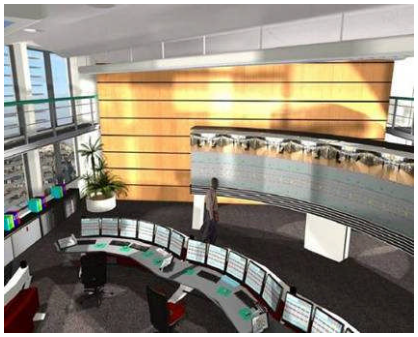

# Part 2

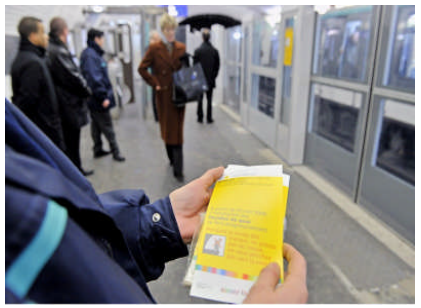
## Paris Metro Line 1 Automation Program

## Integrating technologic and social issues

# A complex program with multiple technologies

- Broad scope of work,  main fields :
  1. Automation, (Siemens)
  2. SSI Signalling, (Thales)
  3. OCC (Siemens, Cap Gemini)
  2. Communication and Passenger Information (Alcatel)
  3. Civil Engineering (TPI/Eiffage)
  4. Platform Screen Doors (Gilgen)
  5. Rolling Stock (Alstom)



- High level of complexity for integration of the various systems

# A complex program with major constraints

- Program management
  - Many suppliers implying contractual and financial risks
  - Multiple innovations and evolutions on a 100 years old line
  - Highest safety requirements :
    - → Better than the train driver in all fields (which implies complete analysis of the drivers' safety tasks)
    - → Safety software approved through formal demonstration (SIL 4 + standard)
  - Integration and interface management by RATP (up to 100 engineering staff on the project)

- Specific constraints
  - No traffic interruption
  - Limited shifts of 3 hours work period per night
  - Usual maintenance work to be continued

# Some good news however….

- Greater Paris Transport Authority (STIF) approved the whole scheme in 2005
  - Therefore RATP is Designing, Financing, Building, Operating, Maintaining the UTO line 1 (till 2039)

- No contract management issues between
  - Operation vs builders (possessions, etc..)
  - Maintenance and design specifications
  - Builders and bankers for financing
  - Safety processes every morning between builders and operators

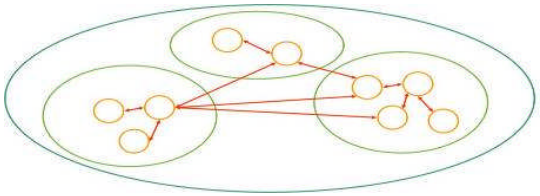
  →Integration and interface management "inside RATP"….

- Specific internal interface constraints
  - Scheme decided only if and only when social issues were solved
  - Safety assessment permanently and jointly assessed

# Program organization – 3 specific integration tools

Based on coordination and risks mitigation :

- Functional and technical interface : A specific interface risk management model



- Work organization : A specific night work management structure, adapted integration tools…

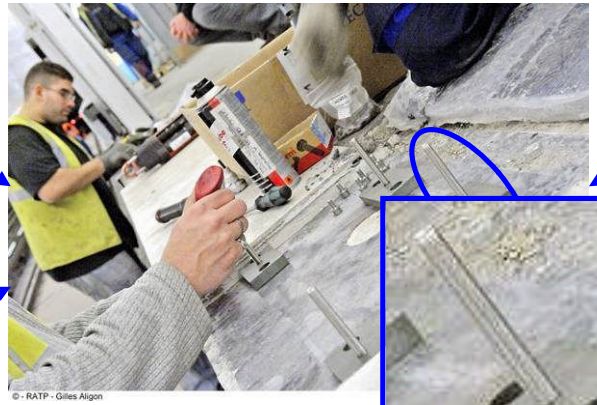
- Operation and social evolution : A specific social project

# Specific technical interface management : Reducing contractual constraints and risks for PSD

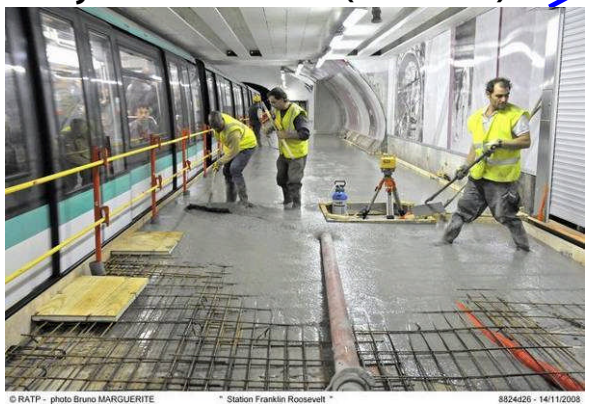
Old platforms

Redefining the interface and developing an interface brace implemented by the PSD industrial…

New PSD

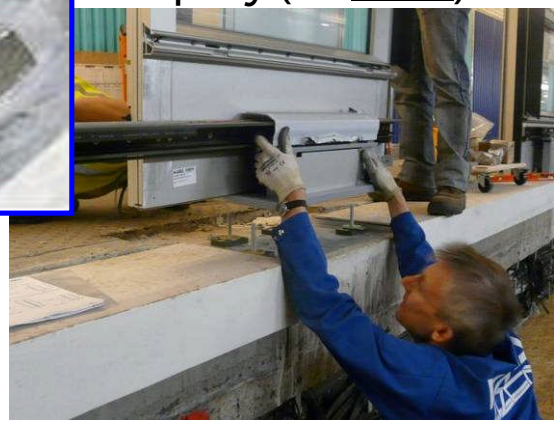


French civil engineering joint venture (+/- 1cm)



… to match civil engineering and mechanical precision, thus leading to reliability

Swiss mechanical company (+/- 1mm)



# Part 3

## Paris Metro Line 1 Automation Program

**Operation during automation a very specific skill**

# Specific organizational management : Enabling work and maintenance by night

- A major work issue
  - About 100 working sites per night
  - Maintenance work by night

    = High impacts on operation

- Solution
  - A work planning unit:

    + work planning expert

    + operation and engineering expert

    thus understanding, optimizing and providing new solutions for night work, balancing constraints and avoiding multiplication of incidents.

- Results (over the 2003-2009 period for Line 1)
  - Night work : + 350% (nb of works)
  - Impact on operation per work : -35% (total length of incident/nb of works)

# Specific social management : Strong operational involvement

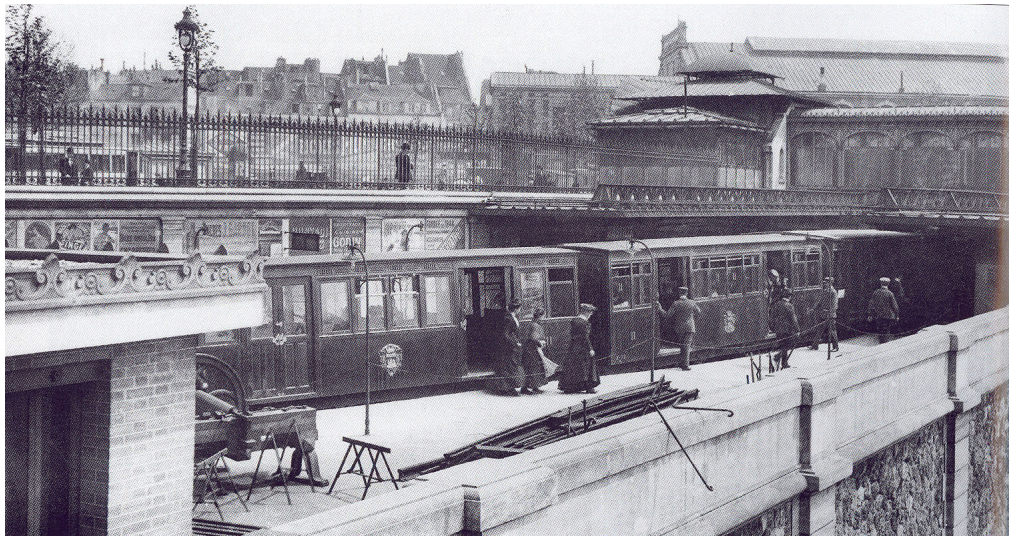
- A major social issue :Migration of a standard line to a fully automated line

- Some of the issues solved
  - Operational staff involvement
    - →A specific social project implemented by Line 1 staff, new kind of jobs
    - →"Show and tell" with training tools and specific meetings
    - →Same issues with operational maintenance teams
  - Head of Program involvement
    - →Former operational staff included in the head of program team
    - →Current Line 1 operational staff represented at each step in program cycle

- Results
  - A specific social agreement signed in 2007
  - Strong operational involvement and good results
    "The operation supports the program"

# Confidence and troubleshooting

- Devil comes with the details
  - How can a driver safely walk through the garage area to take his train amid automated shuttles ?
  - How to make sure a shuttle does not self run itself while final safety tests have not yet been all accomplished ? How to explain it to operators? (mad train syndrom)
  - How much flexibility and over booking of tasks is needed to overcome unavoidable surprises on a 100 year old line ?
  - What about somebody trapped between PSD and train ? (Gap User Detectors)
  - Over 165 Risks solved



# Line 1 – Main results to day

- Key figures March 2012
  - Achievement: 95%
  - Automated shuttles running since November 2011
  - To day 22 out of 50 trains are automated shuttles
  - Flexibility already very useful for unexpected service needs
  - Investment budget: probably + 5 % (addition of strong + and -)

  - Fully automated (100% shuttles) service end of 2012

- Our experience

  - Feasability studies and industrial choices essential
  - **Relationship between project and operation critical**
  - **Operator's skill and involvement is a key issue**
  - Next automation to be decided in 2013

# Thank you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