Performance Evaluation
Model of Railway Operators
Safety Management Systems

Cyril Legrand – October 22-25, 2017
IRSC 2017 – Hong Kong
Introduction

**SMS = a necessity to be authorised**

Main themes:
- Leadership
- Support
- Continual improvement
- Operation

**Aim:** to guarantee a coverage of all risk inherent to operator activities and to improve continuously the safety management
Outlines

Part 1: Context

Part 2: SMS performances evaluation

Part 3: Tool proposed

Part 4: Conclusions and prospects
Fact: SMS must be checked and controlled during authorisation validity (5 years max.)

Question: How to evaluate the performances of railways operator SMS all along its life?

- A conformed SMS is it robust?
- How to prove it? On the basis of which criteria? Is pure conformity sufficient?
- How to assess safety culture through a set of procedures?
- Human factors? How to consider them in evaluation phase?

Investigation of evaluation means (RESYGESS)
Context

SMS can be seen as:

1) Complex system (Systemics)
2) Management system (ISO standards)

Point of view

Tool/method

Petri networks
UML
...

Methodology

« Stress-tests »
Modelisation

Evaluation

Risk
Treatments

Controls
Safety-related events
SMS submitted
Evaluation

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Issues

➢ Issues about 1st point of view (SMS modelling)

☐ Important number (several thousands for a national IM) of procedures within SMS
☐ Interfaces and dependences between procedures
☐ Different SMS structures for each operator
☐ Human factors complex to model
☐ Inexistence of direct modelling tool for SMS

➢ Long-term research topic

Focus on 2nd point of view
Questioning about SMS evaluation

![Diagram showing SMS Robustness with Maturity at the center, connected to Suitability, Conformity, Efficiency, and Effectiveness]

- Suitability
- Conformity
- Maturity
- Efficiency
- Effectiveness

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Conformity

Evaluation based on lists of criteria (EU regulations 1158/2010 et 1169/2010)

Example of criteria:

“S. PROVISIONS FOR RECURRENT INTERNAL AUDITING OF THE SAFETY MANAGEMENT SYSTEM

S.1 There is an internal auditing system which is independent and impartial and which acts in a transparent way”

Remaining question: The conformity with these requirements does not prove that the process set up is effective, or how it is effective?
Effectiveness

Authorisation granted
Conformed SMS

Supervision activities

Noticed deviations

Existing tool in EPSF
« Performance matrix »
(presented in IRSC 2015)

Effectiveness evaluation
Maturity

- Make easier information exchange between each NSAs and NSA / EUAR
- Based on PDCA model and EUAR SMS Wheel
- Provide NSA with a simple model which allow them to make an opinion
- Model for RU/IM self-assessment
- 5 levels (from « Basic » to « Excellence »)

Radar Plot

Example: internal audits

No evidence of audits being carried out

Audits planned, coordinated, prioritised considering previous audits and compared with best practices

Maturity scale

Leadership...
Safety Policy...
Roles...
Risk...
Safety...
Operational...
Asset...
Contractors...
Management...
Internal Audit...
Monitoring...
Leadership...
Resources...
Documented...
Information...
Competence...
Continual...
Learning...
Management...
Monitoring

Maturity model coming from EUAR

A Safety Management Capability Model for use by NSA’s when forming views on the adequacy of an RU or IM Safety Management System

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### Overview of SMS evaluation

#### SMS performance evaluation

<table>
<thead>
<tr>
<th>SMS performance attributes</th>
<th>Indicator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conformity</td>
<td>- Number of criteria to satisfy (requirements)</td>
</tr>
<tr>
<td></td>
<td>- Non conformities detected during supervision activities</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>- Deviations from submitted SMS</td>
</tr>
<tr>
<td>Maturity</td>
<td>- Properties coming from EUAR maturity model</td>
</tr>
</tbody>
</table>

#### Safety-related events evaluation

- Occurrence
- Gravity
- Tendency on 5 years

Possible adjustments:
- Revision of conformity, effectiveness and maturity (on a part or on entire SMS)
- A warning point placed on concerned part of SMS

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Evaluation tool proposed

At the SMS submission

100 % ?

Yes

No

90 % ?

Yes

No

Safety railway authorisation not granted

Safety railway certificate (RU) or authorisation (IM) granted with remarks

Maturity evaluation

Application

Conformity evaluation

Maturity evaluation

Safety railway certificate (RU) or authorisation (IM) granted without remarks

Conformity evaluation

Maturity evaluation

Effectiveness evaluation

Conformity evaluation

Maturity evaluation

Supervision activities results

Immediate data flux

Data flux for next renewal demands

1based on previous authorisation and supervision activities performed during the validity of previous authorisation

2based on remarks
### Part 1: « Identity card » of operator

<table>
<thead>
<tr>
<th>Name</th>
<th>Operator name</th>
<th>Year</th>
<th>Nb cases</th>
<th>Nb audit</th>
<th>Deviations not cleared</th>
<th>Deviations not cleared / nb audit</th>
<th>Thousand km-train</th>
<th>Nb events</th>
<th>Events / thousand km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autörisation type</td>
<td>Safety certificate</td>
<td>2014</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9.2</td>
<td>4</td>
<td>0.435</td>
</tr>
<tr>
<td></td>
<td></td>
<td>09/12/2014</td>
<td>2015</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>94</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14/12/2014</td>
<td>2016</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>192</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Freight</td>
<td>2017</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>All national network</td>
<td>2018</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
</tr>
</tbody>
</table>
## Tool presentation (2/2)

### Part 2: Conformity / Effectiveness / Maturity

**Conformity, maturity and effectiveness results about a RU (freight and dangerous goods transport)**

**Consideration of safety-related events (gravity 3 to 6)**

### Possible notation adjustments

(no safety related events => revise upwards CEM?)

### Future audits on concerned part of SMS (leadership)

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**Table: Conformity, Maturity, Effectiveness**

<table>
<thead>
<tr>
<th>Process</th>
<th>Conformity</th>
<th>Maturity</th>
<th>Effectiveness</th>
<th>Nb safety-related events regarding gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>100</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2014</td>
<td>96</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2015</td>
<td>74</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2016</td>
<td>70</td>
<td>3</td>
<td>6</td>
<td>0</td>
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<tr>
<td>2017</td>
<td>74</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2018</td>
<td>70</td>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Tendency</td>
<td>90</td>
<td>3,333</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Ratio of satisfied criteria (%)**

**Conformity out of 5**

**Maturity**

**Effectiveness out of 5**

**Nb safety-related events regarding gravity**

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**Development of actions:**

- Investigators

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Another point of view of SMS performance evaluation

EUAR guideline

- Maturity

- Effectiveness
  - Operator criteria (specified in its SMS)
  - Effectiveness deviation noticed in supervision activities

- Conformity
  - Deviation with CSM
  - Non-conformity deviation noticed in supervision activities
Conclusions and prospects

SMS = the safety core of an organisation

Procedures within SMS are the common assessment basis between operator and NSA

SMS → complex to apprehend, model and assess because of its « organisational » nature

SMS → Human factors are omnipresent

PURE CONFORMITY IS NOT ENOUGH: NEED TO GO DEEPER

Model based on the combination of effectiveness and maturity in addition to conformity

A model remains… a model, so safety related events must be considered in mirror

BUT…

The tool helps the investigator by rationalizing data but can’t replace his opinion and sensibility

Current state: tool is in validation phase (real examples)

Future state:
- Shared tool with other NSAs and EUAR
- Self-assessment tool for RU/IM?
- Development of a formal tool
Thank you for your attention