LONG TERM PLANNING OF RENEWAL ON HIGH SPEED LINES

Infrastructure Manager’s necessity for Asset Management

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LONG TERM PLANNING OF HSL RENEWAL

Chapter 1 – Issues
Chapter 2 – The need for a system vision
Chapter 3 – Designing an objective “Renewal Guide”
Chapter 4 – Designing the “Real Renewal Planning”
Chapter 5 – Conclusions
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1 - Issues

- In the field of railways infrastructures, **Asset Management** tends to preserve and enhance the railway network in order to make the best out of it:

  - public policies underpin this scheme: which strategy for the network?
  
  - the time target is necessarily middle, long or even very long-term as long as the sustainability of the network - or a part of it – remains secured.
  
  - therefore Asset Management consists of driving the implementation of the network strategy under financial constraints, while minimizing the life cycle cost.

- **Asset Renewal** is a key point of the Asset management policy, regarding the strategy for the network.
1 - Issues

- The renewal costs of the infrastructure are strongly defined by:
  - topology of the network and access condition
  - technologies and their evolution (life time, obsolescence…)
  - increasing of the traffic and opening time of the lines
  - technologies of the rolling stock...

- For an Asset Manager, the question is: “What can I do to be able to satisfy the operation, to reduce the costs during all life cycle, including maintenance and renewal?”
  - It’s a “system problem” which requires to consider the track renewal program in its global railway context

- We will consider the different technological aspects of track renewal during the HSL infrastructure lifetime: track ballasted or not...

- We will see that the battle of the track renewal and the associated costs is won or lost at the design stage of the infrastructure, regarding the type of rolling stock used.
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Chapter 5 – Conclusions
2 - The need for a system vision

➢ The railway system is in “stable imbalance”
  ➢ All modification/evolution of one dimension has an impact on the others
  ➢ In particular the track technologies impact the renewal strategy

Men (organisation, skills, education, culture…)

Environment (economical and safety targets, traffic, track, possession politic…)

G

Rules (operation rules, laws, technical directives, track possession management…)

Infrastructure (track, signalling, overhead lines, monitoring…)

Rolling stock (speed, load, aerodynamics, acceleration, monitoring…)
2 - The need for a system vision

The railway system is in “stable imbalance”
- All modification/evolution of one dimension has an impact on the others
- In particular the track technologies impact the renewal strategy
2 - The need for a system vision

- How a manager of infrastructure can intervene to progress in the domain of the intervention conditions and, by there, on the LCC?
2 - The need for a system vision

How a manager of infrastructure can intervene to progress in the domain of the intervention conditions and, by there, on the LCC?

Objectives

Strategy

Safety, Costs, Punctuality

Need for Renewal

Governance

Organisation

Search for technical and organisational optima regarding the key parameters
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3 - Designing an objective “Renewal Guide”

Five main steps :

4 – Tools for renewal guide/program definition regarding the key parameters (track possession, unavailability costs…)

3 – Tools for the estimation of track maintenance needs and associated track possession time (with different renewal strategies)

2 – Assessing deterioration and failure laws of each the track components

1 – Databases (asset types and asset populations, maintenance operations, environment, condition of use…)

0 – Design stage → ballasted track Yes/No, with USP Yes/No...
3 - Designing an objective “Renewal Guide”

Step 1: Knowledge and visualisation of the asset states

- To represent the characteristics and state indicators in a synthetic form
- To facilitate the crossing of various data sources for each line kilometre
- To clarify the results of the theoretical strategic plan

\[
\text{Im}(N) = k \times 0.8 \times \delta \times \left( a + b \times \left( 2^\frac{N}{5} - 1 \right) \right)
\]
3 - Designing an objective “Renewal Guide”

Step 1: Knowledge and visualisation of the asset states
- To represent the characteristics and state indicators in a synthetic form
- To facilitate the crossing of various data sources for each line kilometre
- To clarify the results of the theoretical strategic plan

Ballasted HSL V300 track with USP → different renewal time
3 - Designing an objective “Renewal Guide”

ÏStep 1: Knowledge and visualisation of the asset states
- To represent the characteristics and state indicators in a synthetic form
- To facilitate the crossing of various data sources for each line kilometre
- To clarify the results of the theoretical strategic plan

Ballasted HSL V320 track with USP → different renewal time
3 - Designing an objective “Renewal Guide”

Step 2: Lifespan of the components based on their conditions of use
3 - Designing an objective “Renewal Guide”

Step 3: Estimation of maintenance needs and associated track possessions

Tools for estimation of maintenance needs and track possessions:

1 – Cyclical or programmed operations:
   → Fixed charges determined by the standards for track surveillance, programmed maintenance, structure...

2 – Preventive conditioned maintenance:
   → Levelling maintenance charges: Interventions conditioned by the information coming from track surveillance. Probabilistic estimation of the intervention needs for a specific route, for a UIC group of routes...
   → Asset replacement charges: Interventions conditioned by asset failure detection… Probabilistic estimation of the failure laws of each asset

⇒ Determination of the optimal renewal time to minimise the LCC Track regarding the average evolution of the maintenance need, the track possession conditions, the operation costs...
3 - Designing an objective “Renewal Guide”

Step 3: Estimation of maintenance needs and associated track possessions

Examples of LCC calculations:

Case 1: Ballasted track (without USB)

Case 2: not Ballasted track
3 - Designing an objective “Renewal Guide”

Schéma directeur 2021/2060

➡️ Step 4: Renewal guide minimizing LCC including the costs associated to the track possessions and unavailability

Tools for theoretical renewal planning

- Different homogeneous lines sections
- Multiannual planning for different renewal operation type
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4 - Designing the “Real Renewal Planning”

- Planning principle for renewal works and track possessions

Analyze for each HSL

- Annual Cycle
- Indicators and maintenance effort
- Realization

Theoretical planning

- Director planning
- Program planning

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4 - Designing the “Real Renewal Planning”

Example of directory planning 2019-2020

<table>
<thead>
<tr>
<th>HSL A</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>JANVIER</td>
<td>FÉVRIER</td>
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- **HSL A**
  - 2019: RB+RT km x-y
  - 2020: RB km x-y

- **HSL B**
  - 2019: Switches a,b
  - 2020: RR km x-y

- **HSL C**
  - 2019: RB km x-y
  - 2020: Switches a,b

- **HSL D**
  - 2019: Switches c,d.
  - 2020: RR km x-y
4 - Designing the “Real Renewal Planning”

- New renewal techniques to reduce the impact of the traffic
- Permanent improvement of the renewal organization, tools and techniques

**Rail Renewal**

<table>
<thead>
<tr>
<th>Solution 1 (reference)</th>
<th>Solution 2</th>
<th>Solution 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed limit 170</td>
<td>Speed limit 230</td>
<td>Normal Speed</td>
</tr>
</tbody>
</table>

**Ballast renewal**

<table>
<thead>
<tr>
<th>Solution 1 (reference)</th>
<th>Solution 2</th>
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</thead>
<tbody>
<tr>
<td>Speed limit 120</td>
<td>Speed limit 160 or 230</td>
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</tbody>
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**Conclusion**

The maintenance costs of the infrastructure are strongly defined by the access and renewal conditions. 
→ more and more the case in the future due to the increase of the traffic and expanding of the lines opening time.

An asset manager has to manage this problem with a “**system**” point of view which requires to consider the track renewal in a global and long term railway context.

He has to consider during all the life time different aspects: 
→ Design choices of the assets,  
→ Manage by preventive maintenance the ageing of the assets,  
→ Manage by a long term planning process the renewal operations,  
→ Improve the techniques for maintenance and renewal operations.

The battle of the track renewal time and they associated costs is won or lost at the design stage of the infrastructure.
Thanks for your attention

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