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Glossary

Abbreviation/acronym	Description
M & R	Maintenance and renewal
IP	Interview Partner
LCC	Life Cycle Costs
EFRTC	European Federation of Trackworks Contractors
TRIS	Track Information System
PPP	Public Private Partnership
HSL	High Speed Line
EIM	European Infrastructure Managers
TSI	Technical Specification for Interoperability
IM	Infrastructure Manager
RU	Railway Undertaking
HLOS	High Level Output Strategy
ORR	Office of Rail Regulator
ITS	Integrated Technology Strategy
LICB	Long Lasting Infrastructure Cost Benchmarking - UIC project

1. Executive Summary

The interaction between contractors and infrastructure managers bears significant potential for increasing of the efficiency of track maintenance and renewal works. The performance of the contractors' works can be improved by a more collaborative, partnership-based approach with infrastructure managers, aimed at optimising the use of the possession times available, reducing the costs and/or delivering more for available budget and thus increasing the efficiency of providing railway infrastructure for operators in general.

European practices vary considerably between countries and benchmarking of unit costs (UIC project on 'Long Lasting Infrastructure Cost Benchmarking' – LLICB) indicates that there is considerable room for improvement. Adopting best practice is therefore crucial for reducing costs and increasing performance of track maintenance and renewal.

Maintenance and renewal activities, related logistics and processes are the focus of the presented studies, as they seem to be a major driver of railway infrastructure's life cycle costs (LCC). The variation in maintenance and renewal costs has been related to outsourcing, yet this is only one of many factors. One of the aims of Sub-Project 5 (SP5) was to see if standardisation and the use of a more collaborative approach to logistics can help achieve lower costs, among a very heterogeneous set of European railways.

To assist with this, WP5.1 produced two questionnaires to identify the current logistics practices of INNOTRACK Infrastructure Manager (IM) partners relating to maintenance and renewal. The first questionnaire was web-based (referred to in this report as the 'web questionnaire') and asked questions that were quantitative in nature. The second was designed for use in face-to-face interview situations (referred to in this report as the interview questionnaire) to gather qualitative data. The data collected was then analysed to identify the current state-of-the-art (benchmark) for maintenance and renewal logistics activities, and the constraints that apply.

In addition to the questionnaires this report presents the results of the EFRTC / BSL study on the interface between contractors and infrastructure managers based on a further set of structured interviews. In total, representatives of twelve trackworks contractors and seven infrastructure managers were interviewed. To ensure an open and critical approach, the interviews were carried out by BSL, an independent consultant with significant experience on the topic. The interviews have been analysed the findings discussed at workshop seminars both with contractors and infrastructure managers and finally processed in order to provide a consistent set of findings and recommendations.

The interviews were conducted bearing in mind that the records will be presented in an anonymous way in order to preserve an open-minded and critical approach and to get a truly objective and representative picture regarding current practices and potential improvements. The full records of interviews with each contractor and infrastructure manager are provided in the report D 5.1.6.

At the final stage a joint workshop was held with the involvement of all stakeholders concerned i.e. also all European infrastructure managers outside the project and in particular decision-makers. This action was taken in order to build up consensus with European coverage and to identify the most promising areas for the improvement. Key conclusions were tested and double checked during this workshop with representatives from both sides. The numerous findings resulting from the processing of interviews were finally grouped in the following seven clusters:

- A – Market strategy
- B – Long-term funding, planning and contracting
- C – Work programming
- D – Project management and logistics
- E – Contracting strategies
- F – Rules and Regulations
- G – Plant

There was a high degree of consensus that these clusters are success-critical areas for both Infrastructure managers and contractors. It should, however, be pointed out that there are various degree of commonality

due to some country specific aspects which may affect the efficiency of potential transfer/implementation of best practices and innovative proposals.

Among the many aspects that were consistently raised in the interviews and underlined by empirical evidence, the major areas for the improvements can be summarized as follows

- Contracting strategies of infrastructure managers are vital for efficiency, e.g. long term planning, dependability, economies of scope and scale, output orientation (innovation, LCC-aspects), terms of employment/build-up and continuity of skills
- Track possession policy is an “*efficiency-critical*” issue; re-orientation is necessary to better use of possession windows by exploring vast potential for process-innovation
- Industrial engineering of processes and worksites to be a prime area of management attention (good practice knowledge management),
- Fleet utilisation for heavy plant is often too low i.e. high capital cost with resulting immediate consequence on initial direct costs of track maintenance and renewal; as a consequence fleet size of some very expensive machinery is often far above real needs
- Rules and regulations, particularly in safety and logistics (worksite protection and material supply), have a massive impact on productivity and LCC. In a number of cases there is already much room for the improvement on the national level.
- Process efficient friendly European harmonization will add further value for the opening of the market and true standardization resulting in cross acceptance of equipment and works.

With regard to LCC and in the situation where more and more railway networks get squeezed with capacity requirements it is important to emphasize that not only the direct cost of maintenance intervention can be reduced, but also the opportunity costs to train operation can be decreased. Through better utilization of track possessions, some capacity can be released for train operation through the higher process efficiency and performance of the contractors.

Results of interviews and workshops as presented in key findings clearly demonstrated that there is enormous potential for savings in the improvement of the overall process of track maintenance and renewal. The examples from the comparison of the current practices in the various countries proved that savings between 10 to 30 % are realistic and in some cases these savings may be even higher.

1. Approach and Methodology

The project followed a twin-track approach. The University of Birmingham (UoB), with the assistance of the members of WP 5.1, developed two questionnaires to gather data on the logistics processes and practices of infrastructure managers and contractors: one gathered quantitative data and was web-based; the other gathered qualitative data and was used for face-to-face interviews. In parallel to this work, EFRTC's sub-contractor (BSL - an independent consultant with professional knowledge of the topic) performed interviews on the **conduct of interfaces** at a senior level between contractors and infrastructure managers, to identify major cost and performance drivers and potential for improvements.

The UoB questionnaires focused on logistics processes and practices relating to the following areas:

- Rail;
- Sleepers;
- Ballast;
- Switch and crossings;
- Machinery; and
- Maintenance and renewal planning.

Seven infrastructure managers and three contractors took part.

The EFRTC interviews covered the principal managerial interfaces between IMs and contractors and addressed questions like:

- What is the main product/services spectrum of your company?
- In which countries and with which type of contracts are you typically working?
- What are the typical volumes or durations and the risks of your contracts?
- In real life, what are the key discriminations between profitable and loss-making projects for your perspective?
- What are the main issues in the entire cooperation process with infrastructure managers
 - that make it unnecessarily difficult to deliver good value-for-money ("could be improved")
 - that are very helpful in optimising the process ("lesson to learn from", "good-practice").

Thirteen contractors and seven major Infrastructure Managers took part.

2. Results

2.1 UoB Web Questionnaire Results

The results of the web questionnaires are summarised below.

Rails

- 60% of IMs place orders for rail more than three months in advance of required delivery date.
- 60% of the IMs use framework contracts for rail supply: contract duration is between one and two years.
- 60% of the rail supply call-off contracts do not have volume guarantees.
- IMs use an average of three rail suppliers each.
- Bulk distribution of rail is generally carried out by the IMs, perhaps because the rail distribution market is seen as not very competitive. Delivery of rail to site is 100% by train
- The stock of rail held by IMs at any one time is generally no more than 10% of the annual tonnage used
- The market for rail welding seems under-developed, with approximately 80% being carried out by the IMs
- Recovery of rail from renewal sites is greater than 50% of available tonnage. Of this, 100% is re-used

Sleepers

- All IMs use framework contracts for sleeper supply, with 60% having duration of five years.
- All of the framework contracts have a volume guarantee
- IMs use an average of three suppliers each.
- Sleepers are ordered between three and twelve months in advance of required delivery date.
- The stock of sleepers held varies between IMs: between 10% and 30% / 40% of annual requirement.
- The cost of sleeper distribution is up to 10% of the cost of the sleepers themselves. 80% of distribution is by rail.

Ballast

- All IMs use framework contracts for supply of ballast. Contract duration is generally one year and the contracts do not have volume guarantees
- IMs order ballast between one and three months in advance of required delivery date
- The number of suppliers used is high; one of the IMs uses up to fifty
- Less than 10% of annual ballast requirement is held as stock at any one time
- The cost of ballast distribution is high at up to 100% of the cost of the ballast itself
- 70% of ballast is distributed by rail
- Recovered ballast is reused, sold for other purposes, or disposed of. The cost of disposal varies
- Approximately 20% of re-ballasting is carried out using high-output machinery. 50% is done using standard equipment and 30% is done using mechanical excavators

Switches and Crossings

- All IMs use framework contracts for the supply of S+C. Contract duration varies from one to five years and the contracts do not carry volume guarantees
- S+C for renewals is generally ordered between six and twelve months in advance.
- S+C for maintenance is generally ordered between three and six months in advance

- IMs use on average two S+C suppliers
- S+C is not held in stock by IMs
- 95% of S+C for renewals is distributed by rail
- Less than 15% of S+C renewal is of the modular type. 70% is assembled by the side of the line, while a further 15% is renewed piecemeal

Track Machinery

- There were no responses from IMs to these questions

Renewal and Maintenance

- There were no responses from IMs to these questions

2.2 UoB Interview Questionnaire Results

The results of the interview questionnaires are summarised below:

- The majority of IMs purchase centrally the rails, sleepers, ballast and S+C they require
- Most materials are supplied by rail
- The majority of IMs make use of call-off contracts for supply of rails, sleepers and S+C. In some countries where crushed stone is widely available, ballast is bought on the 'spot' market from the supplier nearest the work site
- The majority of IMs use 'just-in-time' supply techniques and hold low levels of component stocks as a result
- The majority of IMs try to balance planned work against available resources
- The majority of IMs recover used track components and use them again, but with differing degrees of enthusiasm. It can be difficult to make the financial case for recovery
- All IMs have responsibility for identifying and specifying the maintenance and renewal work required
- The great majority of maintenance and renewal work is done in 'white periods', when there is no train service. Long blockades of the line do not seem to be common
- After work has been completed the normal practice seems to be to open the line to traffic with a temporary speed restriction
- The majority of IMs work with their contractors to decide what method of work should be used
- The majority of IMs will use a track renewal possession to carry out maintenance work as well
- The majority of IMs use programmes of rail grinding and rail lubrication to extend track life
- The majority of IMs carry out maintenance in-house
- The majority of IMs use private contractors for renewal work
- The majority of IMs use training courses and examinations to improve and test the competence of their staff

2.3 Key findings from interviews performed by EFRTC and from the workshops

The findings made during the interviews have been discussed at contractors' workshops and at final stage with infrastructure managers involving also all European infrastructure managers outside the project in order to identify the most promising areas for the improvement and build up consensus. The numerous findings resulting from the processing of interviews were finally grouped in the following seven :

A – Market strategy

- B – Long-term funding, planning and contracting
- C – Work programming
- D – Project management and logistics
- E – Contracting strategies
- F – Rules and Regulations
- G – Plant

There is consensus that above clusters are success-critical areas for both Infrastructure managers and contractors but it shall be pointed out that there is a various degree of commonality due to some country specific aspects which may affect the efficiency of potential transfer/implementation of best practices and innovative proposals. The key findings for each area have been summarized as follows:

2.3.1 A – Market strategies

The overarching importance for the contractors is to know overall strategies of infrastructure managers to exploit the market for maintenance contracts and renewal projects.

IMs are responsible for make-or-buy decisions i.e. to decide which parts of a contract they wish to perform in house and what parts they want to outsource/subcontract. However, there are various approaches of infrastructure managers in this regard with less clarity about make or buy decisions. It creates an environment where contractors cannot tailor their capacity to the market until there are clear decisions of IMs to what extent they will use their own staff and which parts of a contract will be out-sourced.

Current statutes of market openings and degree of out-sourcing is of great importance to contractors. It differs very much from country to country, with some IMs out-sourcing almost all track renewal and maintenance works, while others still execute a great volume of the works, in particular the maintenance, by in-house resources. The opening of market for contractors in Europe is in its infancy and needs a decisive push. Functioning and competitiveness of markets, handling of market-entry barriers are other issues limiting the contractors' ability to respond with high productivity and efficiency. As suggested by some interviewees, system partnership business models could improve the current situation.

Active supply market development among equipment suppliers is the other issue which may contribute to the cost reduction of heavy machinery used for track maintenance and renewal.

Finally, from the discussion with IMs and contractors and the joint workshop, it becomes evident that there is a strong need for strategic steps in structuring markets. There is no point in IMs and contractors competing for position. A relationship where tasks are done by those who add most value needs to be established. Both IMs and contractors expressed needs for openness of dialogue for a true understanding of long-term costs and thus improve the overall efficiency and performance of track maintenance and renewal works.

2.3.2 B – Long-term funding, planning and contracting

In a back-to-back approach, infrastructure managers need long term funding commitments from governments :

- to be able to invest efficiently into the development and maintenance of the infrastructure
- to meet the demands of the operator / railway undertaking (RU) for availability of efficient and reliable infrastructure.

IMs for provision of infrastructure to RU, and contractors to deliver services to IMs because simply "planning stability is at the heart of efficient processes" for all parties concerned.

Long-term planning is fundamental for contractors and infrastructure managers to determine their capacity / machinery and staff for the anticipated market needs It is extremely important to avoid over-sized fleets of costly machinery (sometimes by a factor of two) and to assure that highly skilled and trained staff are available when needed, because recovery of this staff or resourcing for peak capacity may be very costly with serious impact on the costs of works.

It is also vitally important that plans are reliable: they need to be realistic, and accurately delivered.

Current financial planning and budgeting cycles in the most of European countries are inappropriate for efficient work programming.

2.3.3 C – Work programming

Understanding of basic economies of resource deployment (machinery and staff) is fundamental to the optimisation of the supply chain. Optimisation of the supply chain interface with contractors, including project risk analysis is crucial to avoid surprises ("money wasted in early decision-making can never be recovered later"). Hence, transparency and dialogue between IMs and contractors needs to be established at an early stage to develop programmes together with the objective of

- building the foundation for the most efficient use of the most important cost drivers
- addressing risk before it arises rather than resorting to lawyers afterwards
- in order to optimise the industry's long-term cost

The fundamental building blocks for good economics of resource deployment with a substantial impact on unit cost are

- plant and staff deployment during track possessions
- well programmed project pipeline and sequencing of plant and staff deployment (logistics from work-site to work-site)
- minimum disturbance strategies and procedures for assessing the overall costs of the intervention into the track

It is therefore vital that framework plans are translated into dependable mid-term work programming. This shall include

- consistent sequencing of all works over time and geographically
- coordination of activities and bundling
- "a clockwork" approach to worksite logistics and work execution (mutual programme management)
- a well programmed pipeline of major projects leading to a "clockwork" approach to worksite logistics and work execution
- avoiding large programme changes resulting in increase of costs both for supply-side and the execution of work
- careful attention to all details in planning process and work programming

Infrastructure managers' approach in this regard is a key to create a cost efficient framework, for the execution of works by contractors primarily by

- mid-term planning and work programming
- consistent sequencing of work
- logistics and execution dependability
- an even workload distribution over the year

According to contractors the great majority of mistakes occurring during performance of work are the result of failures occurring at planning and can be avoided if above principles of work programming are jointly followed both by IMs and contractors.

There is a high commonality between contractors concerning the above statements on Work Programming because the proper planning and programming is at the heart of all efficiency of contractors' works.

2.3.4 D – Project management and logistics

Multiple interfaces on site between IM, IM's suppliers and contractors introduce cost and undermine responsibility to deliver efficiency. Maintenance and renewal work is often carried out by various parties (e.g. staff of the infrastructure manager for worksite protection, contractor's staff for work execution). That increases the number of the interfaces and the effort required for coordinating work. Great variability in working time per possession / output can be improved by step change both in processes and technology.

Due to the fragmentation of work without clearly defined responsibilities for project management, the contractors cannot sufficiently influence the overall efficiency of the project. Moreover, they often have to take the risk for delay in the execution of the work and thus cost due to the disturbances in the logistics which are beyond their control.

It is therefore vital that project management is clearly defined and assured by a body/person authorised by client and agreed with contractor. Logistic has to be also carefully designed in overall programming of the work jointly with contractors at a very early stage. All changes in project management and logistics have to be agreed with contractors and risk properly allocated.

2.3.5 E – Contracting strategies

Current contracting mechanisms (such as "cost plus", "ad-hoc") often do not include incentives to increase efficiency. Long-term output oriented contracts are a way to enable contractors to dimension their capacities accordingly and to increase efficiency as a result of a steeper learning curve.

Formal, complex and sometimes unrealistically short tender procedures drive cost into the supply chain. Communication between the contracting parties can be improved so that the scope of work and the risk allocation is facilitated ("open partnership in competition").

Risk allocation and reward sharing is a major area of concern, which can be tackled and improved by appropriate contracting strategies.

The most efficient contracts for IMs and their contractors will tend to be:

- longer term
- output oriented
- incentivised to drive efficiency
- share risk and reward allocation equitably
- based on open and honest communications
- based on fair tender procedures that include sensible timescales and documentation of adequate quality depending to some extent on individuals markets.
- As quoted both by IMs and contractors the contracting strategies may have an important impact on the overall costs of the works resulting up to 10 to 30 % reduction.

2.3.6 F – Rules and regulations

The differing rules and regulations across Europe are a key entry barrier for contractors to market their services internationally. Cross-acceptance of certifications for machinery (technical and process) and for innovations would enhance competition and ensure that efficiency gains are rolled-out more easily.

Market opening also positively affects current over-capacity. A more open market would produce more efficient prices, more efficient sizing of capacity and better utilisation

Sometimes very rigid rules for worksite protection and logistics can have a very substantial impact on productivity and costs. Moreover, requirements may be specified to the highest technology, safety and staff qualification criteria hindering the cross-acceptance and market opening. They can be also onerous in proportion to benefits. So there is a need for a harmonisation of rules and standards based on 'good practice' which would lead to a simplification and added-value

Furthermore, long-term standardisation is an obstacle to innovations so there is also a need for processes that encourage innovations rather than obstructing them.

Final objective shall be to assure the wide-ranging cross-acceptance of machinery, works and staff based on simple and efficient certification processes with far lower costs as at present and reduced time-scales.

2.3.7 F - Plant

The cost for moving equipment (logistics) is often very high; it consumes considerable time, often as a consequence of improper planning

Coordination between infrastructure managers and contractors in purchasing and specifications of heavy equipment is essential for "avoidance of over-sized, over-specified fleets".

There are only few manufacturers of heavy machinery on the market which may also have an impact on costs of contractors' plant.

Some other important issues partly covered by previous key findings under A to F, but very relevant in interface with use of plant and machinery are as follows:

- Cost not just of plant alone but of specialist labour force shall also be considered
- Rules and regulations, especially strong ones, should reflect/be adopted with regard to both variability of work-site and appropriateness for various conditions
- IMs and contractors competing for production capacity are unlikely to secure best value from a limited number of producers
- Client specifications may also inhibit use of valuable existing plants

The way to further cost reduction of heavy machinery may lay in drafting the joint specification for future fleet, improving in planning of the needs, purchasing policy and homologation/cross acceptance of machinery.

3. Conclusions and recommendations

The responses obtained from the web questionnaires and interviews indicate that the state-of-the-art for European railway maintenance and renewal logistics practices is as follows:

- The majority of IMs purchase centrally the rails, sleepers, ballast and S+C that they require
- Most materials are supplied by rail
- The majority of IMs make use of call-off contracts for supply of rails, sleepers and S+C. In some countries where crushed stone is widely available, ballast is bought on the 'spot' market from the supplier nearest the work site
- The majority of IMs use 'just-in-time' supply techniques and hold low levels of material stocks as a result
- The majority of IMs try to balance planned work against available resources
- The majority of IMs recover used track components and use them again, but with differing degrees of enthusiasm. It can be difficult to make the case financially for recovery
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- The majority of IMs use private contractors for renewal work
- The majority of IMs use training courses and examinations to improve and test the competence of their staff

IMs identified the following constraints affecting logistics:

- Fluctuating levels of funding from governments, adversely affecting the ability to plan long-term
- The loss of skilled staff through retirement and a shortage of suitable new people willing to come into the industry
- The variability of track condition resulting in relatively small and inefficient packages of work unsuitable for high-output methods of working

A limited number of component suppliers resulting in resource shortages and poor competition.

The interviews carried out by EFRTC consultant and resulting outcome from subsequent analyses and workshops as presented in key findings clearly demonstrate that there is enormous potential for savings in the improvement of the overall process of track maintenance and renewal. The examples from the comparison of the current practices in the various countries prove that savings between 10 to 30 % are realistic; in some cases these savings may be even higher.

With regard to LCC and in the situation where more and more railway networks get squeezed with capacity requirements it is important to emphasize that not only the direct cost of maintenance intervention can be reduced but also the opportunity costs of train operation can be decreased. Through the better utilization of track possessions some capacity can be released for train operation through the higher process efficiency and performance of the contractors.

Among the many aspects that were consistently raised in the interviews and underlined by empirical evidence the major area for the improvements can be summarized as follows

- Contracting strategies of infrastructure managers are vital for efficiency, e.g. long term planning, dependability, economies of scope and scale, output orientation (innovation, LCC-aspects), terms of employment/build-up and continuity of skills
- Track possession policy is a hot and “*efficiency-critical*” issue (re-orientation is necessary, vast potential for process-innovation to make better use of windows)
- Industrial engineering of processes and worksites should be a prime area of management attention (good practice knowledge management),
- Fleet utilisation for heavy plant are often too low i.e. high capital cost and immediate consequence for initial direct costs of track maintenance and renewal; as a consequence fleet size of some very expensive machinery is often far above real needs.
- Rules and regulations, particularly in safety and logistics (worksite protection and material supply) have a massive impact on productivity and LCC. In a number of cases there is already much room for the improvement on the national level.
- Process efficient friendly European harmonization will add the further value for the opening of the market and true standardization and cross acceptance regarding equipment and practices,

All the key findings and conclusion as summarized above originate from the interviews from both sides: infrastructure managers and contractors. Key conclusions were tested and double checked in joint work sessions with representatives from both sides. There was high degree of consensus on these conclusions which is a good starting ground for joint efforts to pursue the implementation.

The pan-European approach launched within the INNOTRACK project also provides the unique opportunity to promote cross-disciplinary learning as an untapped source for the knowledge and innovation.

These areas as identified in the report and the approach as taken by BSL Consulting as an independent adviser gives an impulse for the future joint work of IM and contractors to achieve the objective of optimising the supply chain with project target of achieving 30 % LCC reduction.

Infrastructure managers, members of EIM and CER and EFRTC contractors have agreed on the follow up of the INNOTRACK conclusions and recommendation. The following priority area from the report findings were put forward for the future work

- Market, long term funding, strategic planning
- Contracting strategy including harmonisation of procurement
- Review of current rules and regulations for cross acceptance of machinery, staff and works, proposal for harmonisation including qualification of contractors
- Review of the existing safety rules and regulation, current practices, proposal for harmonisation in particular with the focus of the protection of the staff working on the track