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CONSISTEND: A tool to assess the impact of construction process quality on the performance of pavements and its implementation in tenders

Deliverable 4b: A guideline for implementation of the tool in the procurement process

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CEDR Call 2013: Energy Efficiency
CONSISTEND
A tool to assess the impact of construction process quality on the performance of pavements and its implementation in tenders

WP4 – Report 4.1b: Implementation of the tool in the procurement process

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Executive summary

Proper road maintenance contributes to reliable transport at reduced cost, as there is a direct link between road condition and vehicle operating costs. Internationally there is a strong trend towards outsourcing of road maintenance activities. The maintenance of various assets is being merged together into a single contract. Within the contract, instead of the specification of required inputs (maintenance works); the desired outcomes (condition of assets) are defined.

However there is a wide variation throughout Europe in the way that maintenance works are specified and the procurement models that are employed. Most countries practice pre-qualification of contractors for awarding a 'least price' or 'most economically advantageous' tender (MEAT). The report gives an overview of the state of the art procurements methods in four countries and possible implementation of the tool, developed in the CEDR project CONSISTEND, in the tender processes in these countries.

The CONSISTEND tool can be used as an objective quantifying tool for a tendering procedure based on the MEAT principle. The expected life span of the asphalt of the tenders of the construction companies can be calculated, priced and compared. The values will depend on the quality control measures proposed by the contractor. The tender with the best value will be contracted. After construction the actual figures can be checked, calculated with the CONSISTEND tool and the final payment can be settled according to a "bonus – penalty" arrangement in the contract.

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1 Introduction

Proper road maintenance contributes to reliable transport at reduced cost, as there is a direct link between road condition and vehicle operating costs. An improperly maintained road can also represent an increased safety hazard to the user, leading to more accidents, with their associated human and property costs.

Internationally there is a strong trend towards outsourcing of road maintenance activities. The maintenance contracts typically include winter maintenance, management of emergencies (such as flooding), on-going and up-dating of the Asset Management Plan etc. The scope of the work being outsourced tends to be expanded from pavement renewal works to bridges, tunnels, slopes, retaining structures, embankments, rest area facilities, emergency telephones, culverts, lighting, guard-rails, etc. The maintenance of various assets is being merged together into a single contract. Within the contract, instead of the specification of required inputs (maintenance works); the desired outcomes (condition of assets) are defined.

However there is a wide variation throughout Europe in the way that maintenance works are specified and the procurement models that are employed. The report gives an overview of the state of the art procurements methods in four countries and possible implementation of the tool, developed in the CEDR project CONSISTEND, in the tender processes in these countries.

2 Definitions

In general, road **maintenance activities** can be broken into four categories:

Routine works
These are works that are undertaken each year that are funded from the recurrent budget. Activities can be grouped into cyclic and reactive works types. Cyclic works are those undertaken where the maintenance standards indicate the frequency at which activities should be undertaken. Examples are verge cutting and culvert cleaning, both of which are dependent on environmental effects rather than on traffic levels. Reactive works are those where intervention levels, defined in the maintenance standard, are used to determine when maintenance is needed. An example is patching, which is carried out in response to the appearance of cracks or pot-holes.

Periodic works
These include activities undertaken at intervals of several years to preserve the structural integrity of the road, or to enable the road to carry increased axle loadings. The category normally excludes those works that change the geometry of a road by widening or realignment. Works can be grouped into the works types of preventive, resurfacing, overlay and pavement reconstruction. Examples are resealing and overlay works, which are carried out in response to measured deterioration in road conditions. Periodic works are expected at regular, but relatively long, intervals. As such, they can be budgeted for on a regular basis and can be included in the recurrent budget (operational budget - expenses that occur on a regular basis). However, many countries consider these activities as discrete projects and fund them from the capital budget (investments or expenditures for specific projects or purposes).

Special works
These are activities whose need cannot be estimated with any certainty in advance. The activities include emergency works to repair landslides and washouts that result in the road being eroded or made impassable. Winter maintenance works of snow removal or salting can also be included under this heading. A contingency allowance is normally included within the recurrent budget to fund these works, although separate special contingency funds may also be provided.

Development
These are construction works that are identified as part of the national development planning activity. As such, they are funded from the capital budget. Examples are the construction of new roads, by-passes, or the paving of unpaved roads.

There are four different types of **contracts:**

Unit price contract
Unit rates for work items
Payments are based on quantity of completed work

Lump sum contract
Definition of total work
Payment based on single price for total work

Performance based contract
Performance Standards or Service Quality Criteria
Fixed monthly payments if performance standards are complied with

Hybrid contract
Mixture of performance contract and unit price contract

Several expressions are used to describe **Performance based contracts**:

- Performance-Based Management and Maintenance of Roads (PMMR)
- Performance Specified Road Maintenance Contract, PSMC (Australia and New Zealand)
- Highway Asset Management Contract (USA)
- Maintenance Service Level Contract (Latin America)
- Output- and Performance-based Road Contract, OPRC (World Bank)

In Performance based contract the specified Performance Standards define the minimum conditions of road, bridge, tunnel etc. and traffic assets as well as the management and operation of the assets during the entire contract period, leaving it to the contractor as to how to achieve them. The contractor is free to decide what to do, when to do it, how to do it and where to do it. The contractor performs the maintenance works himself or may subcontract (with certain restrictions) this out as long as he meets the performance standards during the contract period.

In Europe few countries widely use the performance based contracts. In Figure 1 is shown the application of performance based contracting across the world in 2006.

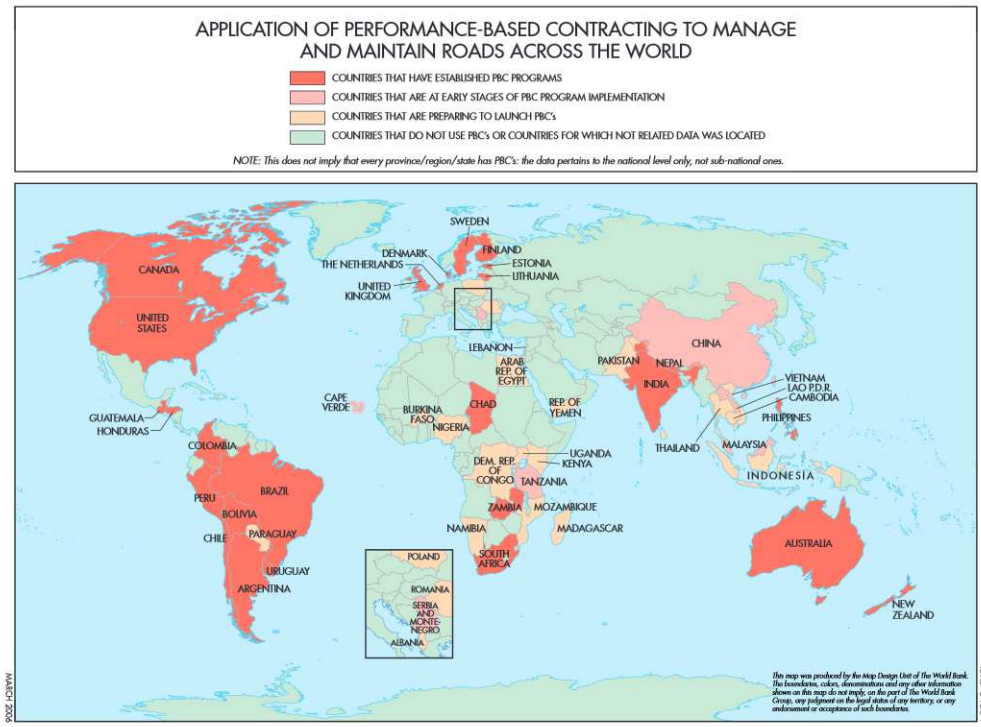

Figure 1: Performance-based contracting (World bank March, 2006)

International experience gained in performance-based contracting showed that:

- There should be a third party to
    - ensure that performance contracts have been negotiated freely and are fair to both parties, and
    - evaluate the actual performance of the contracts.
- To avoid ambiguity or uncertainty, the meaning of success and associated measures must be clear from the start; therefore, the performance contract document must clearly specify indicators of success and their relative priorities
- Adherence to performance contract commitments should matter, and there should be consequences for 'good' and 'bad' performance. Thus there must be an explicit system of incentives (financial or nonfinancial) to motivate people to take performance contracts seriously while at the same time mitigating the risks of counterproductive behaviour or consequences.
- The method and modality for collecting, reporting, and validating information should be agreed at the time a performance contract is signed.
- Performance contracts must deal explicitly with unknowns, specifying contingencies beforehand to make retrograde evaluation of performance fair.
- It is important to avoid ambiguity or uncertainty over roles, clarify agency accountability for the conduct of those roles or highlight the presence of conflicting roles, and suggest any need to relocate roles among agencies.
- When authority has been delegated, it may be necessary to specify the circumstances that would justify intervention by the contract principal in the management and operation of the agency

More information on experience gained can be found in

- Review of Performance Based Contracting in the Road Sector - Phase 1, Ben Gericke, Theuns Henning, and Ian Greewood; TP-42A (2014-03)
- Review of Performance Based Contracting in the Road Sector - Phase 2, Review of Training Materials and Resources, Ben Gericke, Theuns Henning, and Ian Greewood; TP-42C (2014-03)

(https://openknowledge.worldbank.org/handle/10986/16994)

After the eligibility of the proposals has been concluded, the most preferable among the proposed tender offers should be chosen. There are several different methods for contract awarding:

Least price
This method is the simplest and oldest of all. Under this the procurement contract is awarded to the best price. Some relevant methods are those of examining it in parts or in total with a possible discount in a given price list or on a given budget. This method is one proposed for Public tenders by the EC.

Most economically advantageous (MEA)
This is applicable to proposals of different quality within the limits set. Under this the proposals are graded according to their price and value and the contract is awarded to the one with the best grade. Similar to this is the grading of the proposals according to time,

making the proposals needing less time of implementation seem more valuable. This method is one proposed for Public tenders by the EC.

Mean value
The contract is awarded to a bid closer to the mean value of the proposals. This may apply to procurements where numerous proposals are expected and there is a need for a market-representing value.

Exclusion of the extremes
Under this method the proposals that are deviating the most from the mass of the proposals are excluded and then the procedure continues with one of the above methods.

There are also many variants and/or combinations of these main methods

3 Implementation of the tool

When a contracting authority (road authority) chooses to award a contract for paving works based on the principle Most Economically Advantageous Tender (MEAT) it must define clear criteria linked to the contract works in question, such as price and quality. The road authority must specify in the tender documentation the criteria on which it will base the evaluation of tenders and the relative weighting of each of those criteria. Apart from these obligations, the EU directives in the field of public and utilities procurement (directives 2004/18/EC and 2004/17/EC respectively) do not stipulate the evaluation procedure. Thus, a contracting authority or entity is at liberty to set the method for such procedure. In accordance with the fundamental principles of public procurement the evaluation model must be beforehand presented in a transparent and predictable manner.

The CONSISTEND tool for evaluation of the expected life span of roads should therefore be introduced during procurement stage. The principles of evaluation of main outputs of the tool 'Life span prediction' must be clearly defined and presented to the contractor as well as to the road agency.
The tool should be used during evaluation stage taking into account the expected quality of TLC and after the completion of maintenance works taking into account realistic quality of TLC.
The usage of the tool is not limited to maintenance works, but can also be used for the construction of new asphalt roads.

3.1 The Netherlands

Maintenance activities
In the Netherlands Rijkswaterstaat (RWS) is the National Road Authority. The interesting maintenance activities for the CONSISTEND tool are the periodic and special works. RWS is using a structured planning process for periodic works. Asphalt in the Netherlands needs to be renewed every 10 to 15 years. Rijkswaterstaat uses different methods, but most of the times at least the top layer will be replaced by a new top layer. The work is done by contractors; procurement is done by Rijkswaterstaat (RWS). Special works are planned in a different process and consists mostly of activities like periodic works, combined with other activities.

Contract types
Most contracts for periodic works are Lump sum contracts, although RWS has some experience with Performance based contracts for this works. For special works RWS always looks for the best contract for the job, so that can be Lump sum, Performance based or Hybrid.

Contract provisions
The technical requirements for the works are more or less standardised. The same goes for quality control measures and the information that needs to be send to RWS. Contacts often include a 7 year guaranty period for the pavement.

Scope of works
Most periodic contracts are focused on the pavement. In some cases other constructions are also involved, but mostly these are seen as special works.

Tendering of contracts
In the procurement process RWS uses MEAT criteria (Most Economically Advantageous Tender). The contract will be assigned to the contractor that will deliver the best value for money.
The tender process consists of 3 steps for RWS:

1. Set up the MEAT criteria for the project
2. Selection of tender that has the best score on the criteria
3. Control of realisation of the "MEAT criteria value" during construction

The MEAT criteria will in most cases lead to a (fictive) "MEAT bonus", expressed in a monetary value (€). The cost and the MEAT bonus will be combined to get the MEAT value for the tender. The best tender (tender with the best MEAT value) will be awarded.

Supervision of works
During and after construction RWS (or an engineering company on behalf of RWS) will check the work done. Quality control is the responsibility of the contractor, the information needs to be in place so that RWS can check this information.
When it is concluded that the promised tender quality is not realised, the contractor will have to pay a penalty of 1,5* (fictive) "MEAT bonus" he received during the contracting period to prevent tenders with unreal promises.

Implementation of CONSISTEND tool
The CONSISTEND tool is able to calculate the added value of the use of measuring and quality control equipment in terms of the full life cycle. Extra life time will be favourable for RWS, because the period between the maintenance activities will increase. On the other hand extra quality measures will cost. Quantifying the extra value of these measures will help RWS to arrive at a consistent set of criteria that can be subjectively assessed with the CONSISTEND tool.

3.2 UK

Maintenance activities
Within the UK there are a number of agencies governing strategic roads, those covering England, Scotland and Wales shall be discussed within this section.

England
In England, Highways England is responsible for the management, operation, maintenance and development of England's motorway and trunk road network. Highways England (formerly Highways Agency) is a new government company tasked with modernising and maintaining around 4,300 miles of network. Whilst this network only represents 2% of all roads in England by length, it carries a third of all traffic by mileage and two thirds of all heavy goods traffic.
Highways England is held to account by two new bodies, the first to monitor performance of the highways which is run by the Office of Rail Regulation and the second is known as Transport Focus which is there to champion the needs of road users.
The majority of services delivered by Highways England are through third parties, in particular contractors, maintaining agents and consultants, good relationships through the supply chain is therefore fundamental to effective and successful delivery.

Scotland
The trunk road and motorway network in Scotland is maintained by Transport Scotland, the national transport agency tasked with delivering the Scottish Governments vision for roads,

their single biggest asset. The network is 2115 miles long and represents 6% of the Scottish road network. Similar to England insofar as it carries 37% of all traffic and 63% of heavy goods traffic.

Wales
The Welsh Government is responsible for maintaining 75 miles of motorway and over 1000 miles of trunk roads in Wales. Working with two trunk road agents (split North and South) they are responsible for construction, renewal and maintenance of the network. Many of the projects and improvement schemes are carried out through employment of consulting engineers, agent authorities and contractors.

Contract types
Contract types across England, Scotland and Wales are all very similar and for maintenance works are often long term and with principal suppliers who may on occasion subcontract some of the service provision out to other suppliers.
There are many types of contract available for use in the UK and include the following;

- Private finance contracts, which may include Private Finance Initiatives (PFI's), Public Private Partnerships (PPP'S), or Design Build Finance, Operate (DBFO's) which typically run for 25 years and have performance measures and targets in place for handing back the network to the client.
- Contracts with early contractor involvement whereby the contractor can provide input to a project prior to the submission to the planning process design and build contracts.
- Contracts for maintaining, operating and improving the network such as Managing Agent Contractor (MAC's) contracts. (TechMACs are also available to specifically cover the maintenance of technology)
- Framework contracts where by an agreement is made with suppliers to establish contracts which may be awarded during the life of the project, such as specific purchases or call-offs. Suppliers are likely to need to go through a pre-qualification stage and subsequent tender for selection on to a framework, see section on tendering of contracts.

Contract provisions
Contract provision is made for goods are services in six main areas the majority of which relate to the road contract, namely, technical and civil engineering consultancy, highways improvement, highways maintenance, traffic technology and auditing both in terms of assurance and advice. Across the UK contracts are split into areas or regional units.

Scope of works
Subject to the type of contract the duration of works will vary from small scale call off works to 25 year contracts. The performance targets are set at the beginning of the contract as are the conditions the asset must meet when it is handed back at the end of the contract. The contractor knows what he will be paid over the term of the contract so is incentivised to adopt the best practices in terms of whole life costing.

Tendering of contracts
As a potential supplier, a stage of procurement known as pre-qualification questionnaire (PQQ) must be undertaken before an invitation to tender can be awarded, criteria for this stage will vary and be specific to each individual contract. However, all pre-qualification questionnaires assess the following criteria in a way that is relevant and proportionate to the contract requirements;

- criteria for the rejection of economic operators
- economic and financial standing
- technical or professional ability

In England there are three pre-qualification routes, namely;

- Full pre-qualification questionnaire for works contracts high in value and high risk; aligned to the revised PAS 91.
- Mini pre-qualification questionnaire for works contracts for works contracts lower in value and classed as lower risk; aligned to the revised PAS91
- Core pre-qualification questionnaire for goods and services contracts; based on the Cabinet Office core questionnaire mandated for use as stated in Procurement policy note 01/12: use of pre-qualification questionnaires (Highways Agency Tendering, 2016)

The British Standards Institute (BSI) was commissioned by the UK Government to develop a common minimum standard for construction procurement. From 2016, all public sector buyers will mandate the use of PAS91. PAS 91 is a standardised pre-qualification questionnaire which was created to harmonise the various and numerous question sets used between different buyers and making PQQs simpler for the supplier to complete. Figure 2 below shows how PAS 91 fits into the pre-qualification process (Construction Line, 2016)

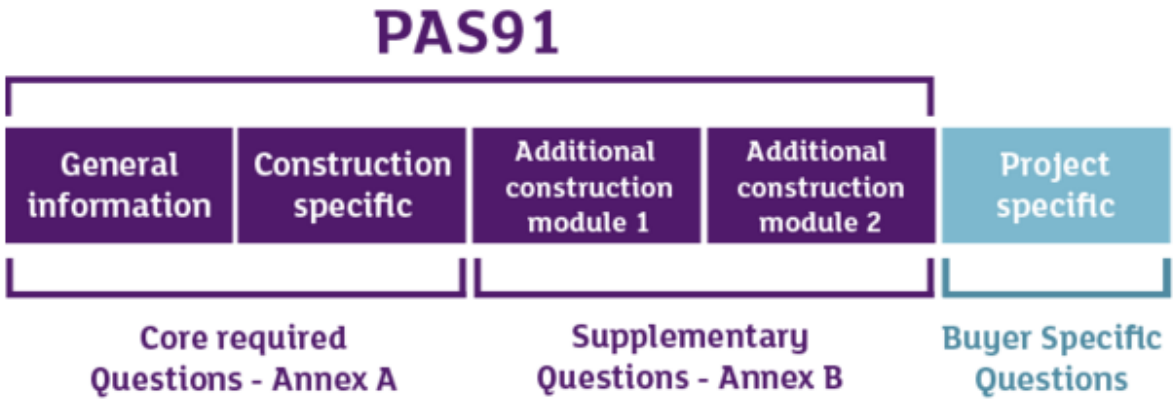

Figure 2: How PAS91 fits into the pre-qualification process

Once PQQ stage has been completed and invitation to tender has been received bidding for the contract can commence. Often contracts are assessed and weighted in terms of quality and technical, the proportions of which will be specific to the project.

Supervision of works

Prior to commencing the works the contractor will put forward and agree with the client method statements and a programme. The contractor is responsible for the supervision and execution of works on a daily basis. Normally a consultant engineer will oversee the works and act on behalf of the client.

Quality control is a significant part of the process of road maintenance and rehabilitation; this is undertaken by third party laboratories. The scope and frequency of testing is pre-defined by both contract and technical specifications. Contractor's records are also audited by third party consultants for compliance with specification.

Implementation of CONSISTEND tool

Quite often in order to achieve and maintain quality, testing is needed which is often done at the point of laying or completed after the pavement has been opened. Testing is not only expensive and time consuming but also offers little opportunity at the time of laying to make corrections. Use of more innovative techniques and increased technology whilst transporting, laying and compacting materials could thus improve quality of works as materials are monitoring more closely during the works.

In addition to technology the use of a predictive tool such as Consistend could also assist at PQQ stage allowing only those equipped with the technology to apply for the works. Evaluation of the parameters post construction using the tool may also be of assistance in developing a warranty or guarantee period and could therefore prove particularly useful for the client when using long term contracts such as DBFO etc. if financial incentives were to be implemented.

3.3 Ireland

Transport Infrastructure Ireland (TII) manages the National Road Network in Ireland. This consists of 1,224 km of motorway and dual carriageway and over 4,000 km of single carriage roads. Local authorities perform the day-to-day management of the network on behalf of TII and are responsible for the procurement of contractors when pavement renewal works are required. Prequalified contractors are invited to tender for such works. These contractors will have previously prequalified to be part of a framework agreement which is used when resurfacing works are required. There are different frameworks for different regions of the network and they are typically renewed every 4-5 years.

The most economically advantageous tender criterion is used to award the contract as well to appoint contractors to the framework. A lump sum contract is used whereby the contractor is paid a single price for the total work. These contracts will have a defects period, typically one year, during which the contractor is obliged to undertake the repair of any defects which arise.

At the prequalification stage and when tendering for a project, contractors are required to provide details of the quality management procedures that they will employ during the works. They must detail the controls that will be used to achieve the required quality and standard specified for the work. Details are also submitted for any material testing that will be performed to show that the required material properties, as detailed in the specifications, are achieved.

Works are supervised by the local authorities or their consulting engineer. Consulting engineers are part of a separate framework and are appointed by the local authority to perform the design and prepare the contract documents.

Advanced quality control methods are not generally used. The Consistend tool could be used at tender stage to help the road authority assess the most economically advantageous Tender. This would encourage contractors to use advanced quality control methods during transport, laying and compaction of the resurfacing material. This would result in improved quality and reduced future maintenance costs for TII by increasing the lifespan of the surface course.

3.4 Slovenia

Maintenance activities
There are two National Road agencies, both affiliated to the Ministry of Infrastructure that mange the road network:

- Slovenian Infrastructure Agency (DRSI) manages main and regional roads with a total length of about 6,700 kilometres. DRSI undertakes some organizational and administrative tasks relating to the construction and maintenance of roads. DRSI outsources all maintenance works.
- Motorway Company of the Republic of Slovenia (DARS) manages the motorways and connection roads with a total length of 770 kilometres. On the motorway network the routine works (winter maintenance, mowing of verges, inspections, and emergencies) are performed by the motorway agency employees.

Management of motorway assets is outsourced to a consulting company. On-going and up-dating of Motorway Asset Management Plan is performed by the consulting company, which also performs all administrative and organizational tasks for periodic works, special works and development of motorway assets. Thus the consulting company manages the procurement processes – technical documentation for the call, tendering procedure, negotiations, contracting, and supervision of quantities of work performed. The periodic works (improvements and rehabilitation of road assets) as well as routine works (electronic tolling, monitoring of structures etc.) are outsourced by DARS through the consulting company.

For pavement maintenance works in the first stage a designer is usually contracted to deliver the maintenance works project for different assets on a specific road section (eg pavement renewal including replacement of guard rails and repair of concrete structures). The motorway sections need to be renewed every 15 to 20 years. Design includes investigations into existing assets, several options for renewal – strengthening of road or paving of the top layers (recycling, replacement, upgrading), estimation of costs and a detailed bill of quantities. The optimum maintenance procedure is finally selected by DARS experts.
In the second stage a construction company is awarded for a defined road section.

Contract types
Public procurement is performed according to European directives 2004/17EC and 2004/18EC. Tender documents – descriptions of projects are prepared for public procurement on motorway network by the consulting company.
'Unit price' contracting is used for routine, periodic, special and development works. The contracts allow some flexibility for payment of work quantities significantly beyond those originally estimated. Within the design, the designer defines quantities and the minimum quality of materials and executed works. The designer makes an extensive list of work items to which he assigns unit costs. The quantities are clearly defined, as well as the mandatory standards.

Contract provisions
The periodic maintenance operations, improvements and rehabilitation typically include paving, replacement of guard rails, and repair of concrete structures. The necessary scope of works is proposed by the consultant, approved by the motorway agency and during procurement process outsourced to contractors. Technical requirements for the works are mostly standardised or defined in the technical specifications for roadworks.

The road agency usually demands financial security for the tender (bank guarantees). According to the legal procurement procedures a road agency as a public body insists on two financial guarantees:

- financial guarantee for the proper performance of contractual obligations (maximum 10% of the contract value),
- financial guarantee for removal of constructional defects during the warranty period (maximum 5% of the contract value).

The guarantee period for roads is usually 3 to 10 years (for motorways). For the time being most of the existing technical requirements are not applicable for evaluation of road assets condition at the end of the guarantee period.

Scope of works

The maintenance contracts usually have a duration from a few weeks (short road section/scope of works) of up to two months (long road section, large scope of rehabilitation works).

The contractors express the need to expand the scope of maintenance works to several construction jobs in a longer time-period (several years)

- to be able to plan (optimize) the works,
- to allow for planning of company development (specialist workers) and for the acquisition of specialist equipment.

The contractors also express the need to reduce the warranty period time.

Tendering of contracts

Competitive bidding among pre-qualified contractors is generally used to tender design and road maintenance contracts. Pre-qualification is based typically on financial capabilities and technical skills, as demonstrated on previous contracts (reference works done). Modern methods for Transport, Laying and Compaction (TLC) control are not required in pre-qualifications.

Competitive bidding among pre-qualified contractors is also used to tender third party supervision and quality control contracts. The contract is awarded for several construction jobs (for a period of more than two years). Pre-qualification is based on expertise of specialist workers, laboratory equipment and the impartiality of company.

All stakeholders (Client, Consultant and Contractors) identified the need for performance specifications at the end of the guarantee period (after 5 and 10 years). All stakeholders would like to encourage the use of innovative techniques (not yet standardised), as well as more efficient modern equipment and quality control methods.

For the time being the contracts are awarded to the ‘least price’ offer. All stakeholders (Client, Consultant and Contractors) identified the urgent need for the change of contract awarding procedure to ‘Most Economically Advantageous’. The awarding of tender should most of all focus on the quality of the offers based on performance characteristics of materials and structures and not on lowest cost.

Supervision of works

The contractors accept the responsibility for works scheduling and execution (within the limits defined in the contract) of the weekly plans are supervised by the Consultant.

Before the commencement of works a ‘technological report’ is put together by the contractor that includes description of techniques employed, declarations of performance for materials,

Contractor's Quality control plan, general time schedule etc. The works should be executed as described in the approved 'technological report'.

The Consultant's supervision comprises controlling the quantity of works performed, billing and overview of results of quality control. The scope of Contractor's and third party Quality control (type of tests and number of tests) is defined beforehand according to technical specifications. The third party Quality control comprises controlling the quality of works performed and the compliance with technical specifications and design specifications.

Based on positive findings of third party supervision of executed works and positive quality control tests, the contractor is entitled to full payment for the job. Still the contractor must provide financial guarantee for removal of constructional defects during the warranty period for the executed works (usually 5 to 10 years). Furthermore currently the existing technical specifications are not applicable for evaluation of road assets condition at the end of the guarantee period.

Implementation of CONSISTEND tool

The scope of necessary quality control tests is defined in technical specifications. The tests on paved road are made locally and it is therefore difficult to detect possible weak spots, which in most cases determinate the lifespan of the pavement. Testing is usually performed at paving, the results are available after the road has been open to traffic. Use of new advanced techniques and specialist equipment during transport, laying and compaction will improve quality of works and pavement lifespan.
The construction companies are not urged to use any additional proof for quality. In cases when the innovative techniques are used, the outcomes are not presented to the Client.

Therefore it is strongly recommended that the usage of modern TLC quality control methods is demanded in the pre-qualifying process. The execution of works will be continuously monitored and the possible invisible weak spots (e.g. low compacted areas) will be identified at the time of completion of paving works.
The use of a predictive tool 'during the contract stage' will show the expected lifespan of the road section taking into account the applied technologies and expected seasonal weather conditions (temperatures).
The use of a predictive tool 'after construction' will show the expected lifespan of the road section taking into account the realistic weather conditions and detected weaknesses during TLC process.
The tool evaluation of the 'predicted lifespan' may then indicate the possible shortening or lengthening of the warranty period.

4 Conclusions

Public procurement practice in paving works differs considerably throughout the EU. Most countries practice pre-qualification of contractors for awarding a 'least price' or 'most economically advantageous' tender (MEAT).

When a road authority chooses to award a contract for paving works based on the MEAT principle, it must define clear criteria linked to the contract works, such as the price and quality criteria on which the evaluation of tenders will be based. The relative weighting of each of those criteria must be specified in advance in the tender documentation. Apart from these obligations, neither of the EU directives 2004/18/EC and 2004/17/EC specifies any evaluation procedure. Road authorities could therefore choose to use the results of the proposed CONSISTEND tool for the weighting of tenders in public procurement in the case when an evaluation model is presented in advance, in a transparent and predictable manner.

The CONSISTEND tool can be used as an objective quantifying tool for a tendering procedure based on the MEAT principle. The expected life span of the asphalt, including the uncertainty, of the tenders of the construction companies can be calculated, priced and compared. The values will depend on the quality control measures proposed by the contractor. The tender with the best value will be contracted. After construction the actual figures can be checked, calculated with the CONSISTEND tool and the final payment can be settled according to a "bonus – penalty" arrangement in the contract.

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