

Scope

The possibilities to define the scope of a PPP project are as wide as the range of options available. For a given project, this scope can encompass some or all of the tasks implemented under a number of smaller contracts under conventional procurement.

Scope allows the integration of services under a PPP contract and the full benefits of private sector efficiencies (Module 1 -> Defining the Partnership -> Advantages). The Toolkit defines scope as the nature of the works, a definition of the performance indicators for maintenance works, packaging of tasks entrusted to the private sector ('vertical packaging') and packaging of projects included under the same PPP contract ('horizontal packaging').

Scope has a fundamental influence on competition and the interest of the private sector and its definition is thus highly country-specific and dependent on the maturity of the local PPP market. Notably in those countries with little PPP experience, the definition of scope shall be an interactive process in which the aim shall be to optimize private sector efficiencies and ensure their interest in bidding, whilst ensuring the compatibility of the project with local capacity of the public and private sectors. Scope will be constantly refined during the project preparation and tendering process (Module 5 Implementation and Monitoring).

Nature of Project

The initial element of defining the scope of the PPP project is to determine the nature of the project to be delegated to the private sector.

The nature of the project initially comprises the identification and description of the works to be performed.

In maintenance and operation contracts, the operator's role is either only to carry out operation and maintenance (using quantity-based and performance-based maintenance contracts), or to carry out, in addition, at the beginning of or during a contract, new reconstruction, rehabilitation, equipment and signing works, or general surfacing (surface coating, asphalt concrete, etc.). The problem of how to determine and describe the tasks entrusted to the operator arises differently in each case.

The consideration of the nature of the project will need to closely consider the selection of components which will produce the most favourable response from the private sector, and to the highest benefit to the public sector.

New construction

The private sector can produce considerable efficiencies for construction of new infrastructure under PPP. New construction needs to be described as for a conventional contract, although a more preliminary design level may be preferred with related performance indicators and design constraints and considerations.

Performance-based maintenance contracts

The nature of relations between the road authority and the operator is very different from a conventional contract, since the choice of the works to be performed is left to the initiative of the operator on the basis that “it is the result that counts”.

The responsibilities transferred to the operator are therefore very substantial. The pavement entrusted to him may have hidden defects likely to significant impact on the works which will need to be carried out to keep them to standard, especially for longer contracts. It is therefore necessary, especially for the longest contracts, to pay particular attention to the exhaustive nature and the quality of the information defined and provided to the operator.

The list of available information which needs to be defined and provided to the operator varies from one contract to another but generally comprises:

- **construction documents:** design memo and calculations, reports on the construction itself, handing-over reports, etc.,
- **documents relating to the equipment:** characteristics, dates of purchase, guarantee certificates, etc.,
- **maintenance log books,** road data bases, bridge and tunnel data bases, road management systems, bridge management systems, emergency and accident data, traffic data, historic and forecast spending, etc., if any, should all be handed over to the operator.
- It will generally be necessary to add to existing information by making a detailed expert appraisal of the road, its equipment and structures.

As far as possible, and with the possibility in mind of disputes arising, it would be advisable for this appraisal to be carried out by an entity quite separate from the road authority. As the winner of the contract will not have been designated at the time of making this expert appraisal, it cannot be approved by both parties. It is therefore very important to provide, at the start of the contract, for a period during which the operator may himself make a detailed inspection of the structures and request any adjustments/modifications to the contract.

Operation

The scope should also define precisely what operation tasks are to be performed. The operation tasks that can be performed by the private sector are the following:

- Traffic management in normal situations, during emergencies (events) and during works,

- Relations with road users,
- Co-operation with police and emergency services,
- Management of third-party claims, etc

There is a close relationship between the maintenance and the operation of a road network. For example, to reduce the impact on traffic, maintenance works are planned and grouped together as much as possible. Safety issues due to poor network condition and identified through analysis of accident data are addressed by carrying out the relevant maintenance works. Therefore, it is generally recommended to have a single contract for both maintenance and operation services rather than two separate contracts.

Like maintenance contracts, operation contracts can be quantity-based (time spent by the contractor's staff, number of road users' phone calls dealt with, etc.) or performance-based. Performance requirements are, for example, periods of traffic congestion per month, road user satisfaction measured through periodic surveys, emergency response, accident reduction, accuracy of road closure bulletins, etc.

All information relating to existing equipment (variable message signs, sensors, transmission equipment, computer equipment, etc.) must be provided to the operator. All instructions, instructions for use, guarantees, etc., relating to this equipment must be handed over to the operator.

Packaging Tasks

Packaging tasks refers to 'vertical packaging' of tasks or activities within the PPP project.

Combining the tasks of highway maintenance, construction and operation

The scope of work to be entrusted to private firms is of paramount importance in the design of a road project. Most countries are used to contracting out design, construction and to a lesser extent maintenance to the private sector. PPPs allow not only to enlarge this scope of work to further responsibilities such as design, operation, management, revenue collection and financing the infrastructure, but also to package them into a single contract. Such arrangements directly influence the potential efficiency gains expected from the project but also have implications in terms of risk and competition.

For the Contracting Authority, the conventional way to build a highway involves:

- entering into a contract with an Engineer to whom it entrusts the preparation of a design under his direct supervision,
- with or without an Engineer providing assistance, signing a series of separate contracts with various contractors, who carry out their work in accordance with the specifications drawn up by the Engineer.

The contractors either sign a contract with the Contracting Authority individually or as a joint venture, the Engineer intervening periodically; to ensure that the works are being correctly executed, that the contract provisions are complied with by each contractor and to advise the Contracting Authority should any difficulties arise.

The tasks of design, finance, build or rehabilitate, operate, maintain are performed successively under the control of the Contracting Authority. Under PPP, these tasks may be packaged totally or partially. Almost all the arrangements are possible, each kind of packaging leading to a specific PPP scheme (BOT, BTO, DBFO etc). Financing (providing the investment cost and/or collecting user charges) may or may not be covered in the scope. An open question is also that of legal ownership: Is the infrastructure owned by the private sector (and for how long) or is it to be immediately transferred to the public sector?

Efficiencies and limitations of packaging

In order to ensure efficiency gains by the private sector and use of the most adapted technological solutions, contractors and operators must be able to work effectively within a PPP consortium.

By packaging the tasks entrusted to the private sector under a single contract, PPP encourages consolidation of the highways sector. This is all the more so in developing countries in which the highways sector is often fragmented, including separation of design and construction activities, absence of product manufacturers from the design process, absence of actors in highway operation, lack of private sector contractors in maintenance works (which often remain largely under the public sector) and disparate training and professional establishments which hinder professional exchange and development of synergies and processes.

Whilst such fragmentation of the highways sector constrains the development of PPP projects, reducing its potential scale and speed of implementation, it also provides the potential of PPP projects by encouraging these actors to communicate, cooperate and, eventually, consolidate in order to provide an integrated and efficient service to the Contracting Authority. PPP consortium shall thus develop interaction and collaboration within the highways sector in the search of improvements in products and processes.

From the perspective of the Contracting Authority, the packaging of tasks granted to a contractor or consortium under PPP (who may in turn subcontract under his own responsibility), by broadening the scope of tasks a contractor is in charge of, allows him to deal with only one actor who has the responsibility of delivering the entire project in conformity with the contract and all the regulations (including environmental). Coordination and management of the related activities thus become the contractor's responsibility which reduces the chances of misunderstanding among the various participants, the difficulties of exchanging information and the risks of contractual claims. Moreover, transaction costs are reduced even if, in fact, they are partly internalized by the general contractor.

When the tasks include maintenance (and operation), the potential efficiency gains are higher still; in particular concerning the balance between the initial investment and maintenance and between developing infrastructure and improved operation and traffic management.

Moreover, the risk of claims is again lower and the contractor shall deal with under-performing subcontractors, notably whenever guarantees are triggered.

The chosen solutions within a project and the operation and maintenance costs are directly linked to each other. As the tasks are broadened to include for operation and maintenance, the contractor is encouraged to produce work of high quality whilst adopting solutions which will meet the project's overall life-long requirements for the Contracting Authority. This broadening would be reflected in the tasks assigned within the PPP contract for the development process:

- **No design at all** - only needs are defined
- **Outline design produced by the Engineer.** The contractor is linked by functional provisions and offers the technical solutions which correspond to the performance required;
- **Preliminary design** and appropriate technical solutions produced by the Engineer.

As a general rule, the broader the scope, the lower the overall costs of the infrastructure. This results from the streamlined procedures and enhanced cooperation even if the cost may initially appear higher since the contractor is responsible for more tasks and bears more risks than in the case of the conventional approach.

Autonomy (initiative) granted to the private sector

Autonomy is a key element for encouraging efficiency gains which stimulate innovation, thus allowing the flexibility for adapting to changing situations and the optimization of resources (e.g. allowing efficient trade-offs between initial and deferred investments).

The level of autonomy should be carefully adjusted to the capacity of the private players to handle greater responsibility. This implies clear rules in both legislation (standards) and contracts.

The main fields concerned by autonomy are:

- Design and technical definition of the project
- Project management

Design and technical definition of the project

Flexibility in applied technologies

Private firms can come up with innovative techniques and processes, equipment or material that would reduce the project cost or provide a better service for the user. Such initiatives should be encouraged.

However, all technology used should have reasonably proven efficiency and firms should demonstrate their ability to properly use these techniques. An adequate legal framework of laws, regulations and contracts shall clearly define responsibilities and protect the community.

Project Management

Investment planning and scheduling level of service

Autonomy in determining a balance between the initial investment, maintenance and operation costs may also allow a lower global cost to be reached and sometimes provide an advanced level of service. The Contracting Authority can demand that the contractor will implement good quality construction in order to avoid frequent rehabilitation and high maintenance costs since he will be the future owner of the road.

The private firm may prefer to spend less on the original pavement structure and carry out reconstruction at an early stage, when project finance is more favorable. Another example could be found in the use of electronic traffic management techniques which may succeed in improving the capacity of the existing road, resulting in additional investment being postponed and the delivery of upgraded safety and guidance services.

Commercial policy and tolls

This issue is mainly addressed in Module 2 -> Revenues. Nevertheless it may be of some help to stress that the private and public sector stakes are markedly different; indeed the private sector takes care of the financial issues of the infrastructure for which it is responsible, whereas the public sector is concerned about the economic and social issues of the transportation system as a whole.

This does not mean that the private sector is only concerned about short-term issues and the public sector only about long-term ones; e.g., the private sector is concerned by its public image and may choose a lower immediate return to save this image in the medium-term (using a commercial and pricing policy which does not provide higher turnover immediately but avoids congestion and even discomfort).

If there is a gap between the financial profitability and the socio-economic benefits of a project, it can be filled with a public subsidy. That is where the project has sufficient benefits to justify its use of public resources under public procurement but insufficient financial viability to meet the requirements of private financing.

Operating policy

When managing an operating policy, the same concerns are at stake for the private sector. It wants to be accepted and to increase turnover when direct user charges are being collected, and its public image and the perceived level of service are equally as important as the technical issues.

Furthermore, the private sector also shares the concern to maximize traffic in order to maximize its turnover and profits, which shall also improve the economic benefits of the road. For these purposes it will pay a great attention to optimize its operating policy. Once again, flexibility is required, which may allow innovative solutions to be found (e.g. during the construction phase).

An adequate legal framework of laws, regulations and contracts shall clearly define responsibilities and protect the community.

Organizational set-up

The allocation of risks between the different private players and regulation by the public sector lays strong obligations on setting up an appropriate organizational structure or scheme. Nevertheless the supply of public services by an autonomous entity, whether public, semi-public or private, rather than by a government department, has a number of advantages. A convincing advantage is that a company can design, build and operate a motorway more efficiently by having a time horizon which is greater than that of the annual budget and by operating with greater flexibility, taking global cost into account and optimizing investment, maintenance and operation costs alike.

This autonomous entity does not have to be private to be efficient. What is important is accounting discipline, protecting its image and know-how.

The contracting policy between administrative departments adopted in a number of countries, responds to the same concerns with incentives and identification of responsibilities.

Benchmarking

The creation of autonomous entities combined with contracts makes it possible to adopt a benchmarking procedure, either through a process of emulation between public or para-public entities, or through competition in a market context where the entities are private enterprises.

Where the private entity has exclusive rights, and the contract period is long (as is frequently the case in the field of road infrastructure projects), there is competition to enter the market, but none within the market place, and it is important to establish incentive contracts and restrict the economic rent which the private enterprise can extract as a result of the information advantage in its favor.

It is therefore extremely useful, if not essential, for the regulator to have a set of reference points from a number of independent operators for benchmarking purposes.

Packaging Projects

The packaging of projects serves to determine the “horizontal scoping” i.e. the composition of the sections of highways and/or works to be included in the PPP project.

Pooling of road sections

Pooling or packaging of projects within a PPP involves entrusting one firm with the construction, rehabilitation and/or operation of a package of road links or structures instead of a single link or works. The package may be grouped together on the basis of geographical parameters (all in the same area) or on the basis of functional characteristics (e.g. parts of a motorway network).

Pooling systems can generally be politically or economically justified by two reasons. The first one is that there is a “network effect,” whereby network expansions provide added

value to users of the initial network who then accept to pay for the network extensions. The second one is that road users feel sufficiently united and interdependent so that users from one part of the country accept to pay for the financing of an infrastructure in the opposite part of the country, even though the likelihood for them to drive on those roads is very low.

Pooling is particularly relevant for brownfield operational and maintenance concessions which may be composed of a number of sections which are financially unviable independently to rehabilitate and/or maintain but financially viable collectively. This is largely since there is a “cut off” length under which maintenance activities are not attractive for Contractors due to the cost of the equipment needed.

It may also be possible to combine existing infrastructure facilities and infrastructure facilities to be built or rehabilitated in the same package. Moreover, the package may consist not only of roads, but of a global transportation system, especially in an urban area or in transport corridors.

The incentives for pooling of road sections are:

Planning flexibility. Beyond the decision concerning which roads should be built and/or maintained, the sequencing and organization of such operations is essential to optimize their function within the network.

- Transaction costs are high and can be offset in larger packages by reducing the number of contracts to be prepared, negotiated and awarded.

Improved efficiency. This may be achieved, as large packages allow the following: construction and operation to be standardized, technology and economies of scale in the supply of materials and the use of equipment.

A road system is at its most effective when the entire network is complete (“network effect”). Moreover policy-makers can have an active road management policy, led by general planning objectives such as:

- connecting remote regions to the network to boost their economic development;
- opening connecting routes between major road links and increasing the general efficiency and economic return of the network;
- proposing alternatives to mitigate negative impacts on environmentally sensitive areas;
- anticipating economic growth in order to extend the network.

Tolls may be harmonized. If a contractor’s remuneration is based on tolls, when projects are considered on a case-by-case basis, toll rates have to be fixed according to traffic levels and project cost, leading to substantial differences from project to project or region to region. Pooling allows toll rates to be harmonized in the concerned “pool” area, usually resulting in less confusion or feelings of unfairness for road users.

Cross-subsidization

Pooling systems have been widely used, particularly in Japan, Italy and France on toll roads to allow cross-subsidization, i.e. resources to be drawn from a profitable section to

compensate a lack of revenue on a less profitable one. For economically viable projects with weak financial potential, pooling is a powerful alternative for Governments wanting to implement a toll system. It allows decisions to be made on a network-wide rather than a route or segment basis.

However, such a pooling system internalizes cross-subsidy between road sections, rather than leaving it external by government transfers from increased tax payments from profitable sections and to subsidies for unprofitable sections. They thus require complex accounting and financial mechanisms to manage and regulate the transfer of resources from one infrastructure to another. Setting up these mechanisms could lead to hidden, extra (not due) subsidies that would decrease the economic benefits of the project. Moreover, during the project lifetime, unforeseen circumstances often lead to project restructuring and subsequent negotiations between public and private parties. A pooling system makes evaluating the situation even more complex and difficult.

If spread to the entire road network, a pooling system would be equivalent to a general tax-based funding system, but penalized by the additional costs of toll collection (tolling often leads to an economic sub-optimum). Pooling should be limited with clear objectives.

On account of such issues, Japan has instituted a 50 percent limit on expressway development costs that may be paid from revenue pooling cross-subsidies.

Pooling and risk

Large lot sizes and pooling are an efficient way to mitigate risks:

Setting up a mix of risky and less risky projects allows an average level of risk to be reached. Moreover, work planning may be improved based on the results of the first phase of the works.

Adding a new infrastructure onto an existing one (phasing of road development) allows the risks involved in the construction and operation of the initial infrastructure to be avoided and the level of aggregated risk to be reduced.

However, in the event of cross-subsidy, the political issue with respect to people in one region not wanting to subsidize the other regions may be a potential source of problems as regards the acceptance of user charges (willingness-to-pay).

Stand-alone projects

Many PPPs focus on the construction and operation of a single road linking point A to point B. In this case a balance must be found between the length of the infrastructure to build, the traffic and the tariff.

PPP for single link may be unsuccessful when they are the first to be tolled in the country and/or when a toll free alternative is possible for roads users. In order to be attractive for road users, toll roads must enhance the level of service: i.e. reduce travel time, increase road safety, provide users with services, etc. But the road user is more

likely to benefit from these improvements when they are available all along his itinerary and not restricted to a limited part of it.

For instance, the perception of benefit for a tolled 50 km motorway stretch may be reduced if the journey also includes an additional 300 km of unsafe road, with half the driving speed of the motorway or in congestion. The time saved and the comfort gained on the toll road may be a small proportion of the time needed for the other 300 km. Therefore, toll roads should ideally comprise a complete itinerary between major cities or be integrated in an existing toll road network. However, this notion is a guiding principle rather than a rule: experience with the M6 toll in the UK shows that drivers are willing to pay considerable amounts to drive along a relatively short piece of uncongested new road.

Bridges and tunnels

Stand alone infrastructures like bridges or tunnels can be more easily tolled since most of the time there is no free alternative. Therefore the traffic risk for the private partner is considerably mitigated and makes these contracts particularly attractive for private investors. Moreover, the cost to build such an infrastructure is very high and private finance of such infrastructure allows the public authority to use available budgets for the rest of its national highway program.

Bridges or tunnels also offer a clear improvement of infrastructure, whether replacing a lengthy ferry crossing or deviation or a mountainous crossing, and a significant economic benefit. Whilst they are very expensive per km, they are limited in length so that the actual toll charged is low in absolute terms (but high per km) and therefore more politically acceptable. However, approach roads to the bridge or tunnels built with public funds may be considered as a gift in kind.

Many countries have no or very few toll roads when many bridges or tunnel are tolled (eg UK).

Influence on Competition

The scope of PPP projects, through packaging of tasks and projects, is a key component in providing the extent of competition required to deliver effective PPP projects. In general:

- The broader the scope of tasks in a PPP project, the weaker the competition.
- The size of a PPP project directly impacts on competition, both positively and negatively.

Broadening the scope of tasks may be an efficient way of mitigating risk (at least for the public authorities). The main contractor, whilst accepting a larger share of the risks and remaining responsible to the public authorities, allocates risks among the sub-contractors. A broad scope of tasks shall require a well-established contract framework and skilled public authorities to manage and regulate the PPP contract.

The number of contractors who are able to manage large contracts may in some countries be relatively low, in which case there would not be much competition in the market.

Moreover, the general contractor may have a dominant position vis-à-vis other contractors as well as vis-à-vis subcontractors with the associated risk of abuse of power in taking unfair advantage of such a position. However, a small project size may discourage large efficient contractors, not encourage economies of scale and lifecycle cost benefits and be inefficient under PPP due to transaction and management costs.

A PPP project is always a subtle balance between competition and cooperation. Basic principles should be applied within the very specific nature of each country, market and project. The government, through its advisors, should consider each project individually and draw from the experience of other countries and advice from multilateral/bilateral agencies to plan their approach to PPPs.

Unsolicited Proposals may be acceptable to government in some cases if the project is eventually tendered out (Module 5 -> Procurement -> Unsolicited Proposals).

Brownfield and PBC contracts

Packaging of tasks for Brownfield Operational and Maintenance concessions

PPP may not only concern new highways but also highways already existing and operated (Brownfield operations). In this case the project mainly comprises the transfer of maintenance operations to the private sector. These kinds of PPP are the so called Performance-based Maintenance and Management Roads contract (PMMR).

If in addition to the Management and Maintenance tasks, the tasks are expanded to include the rehabilitation, reconstruction or upgrading of the existing road there such PPP are called Output and Performance-based Road Contracts (OPRC).

In the last years, OPRC contracts have been replacing PMMR mainly because they make Road Maintenance a more attractive business for contractors.

These kinds of PPP are mostly service contracts because the contractor has to ensure that road users get a certain level of service. The larger the length of the road network in the PMMR/OPRC contract, the more attractive the contract is. For Brownfield operations the packaging task focuses on the selection of roads with similar characteristics or functions in order to improve efficiencies and improve the chances of success of the contract.

Introducing PBC to developing countries

Where maintenance has not been previously undertaken under a PPP type contract, many local contractors will be new to the business and will need training on the issues. There are examples of countries where there have been few bidders for maintenance work because many contractors feel they cannot manage the work and so will lose money. Contractors will need to understand that productivity of staff and equipment will be less (compared with road construction) and that operations can be very spread out in time and location, which are also certainly going to be more expensive to supervise. Contractors also need to understand the basics of road deterioration and the timing of

maintenance. Technical assistance to support highway agencies can be complemented by focused, initial assistance to the private sector where this is needed and this can also encourage the private sector to continue training under either joint or individual funding.

Some countries demand a detailed maintenance management plan to be submitted for performance based maintenance bids– often based on modelling by HDM.

Since payment is based on performance standards rather than on work done, there can be a mismatch in the time profile between expenditure and revenue for the work. This often results in the contractor either pre-financing the work at a greater rate than a normal contract (and he will charge a higher price as a result) or receiving funding earlier to perform work later (e.g. periodic maintenance). Seasonal factors are often strong drivers of such cycles (eg periodic maintenance after the rainy season).

Performance-based contracting relies on penalties being applied in the case of poor quality work or of the contractor refusing to implement the required works to improve the level of service. They can thus only function effectively if the contractor is at times earning profits whilst at other times subsidising higher costs, i.e. absorbing the variable requirements for maintenance work whilst maintaining a constant level of service to the user. On their side, the Contracting Authority must ensure prompt payments for contractors who provide the required level of service. However, in many countries, there is a poor history of applying penalties to contractors, for example, in not cashing the bonds supplied by the contractor.

Within weak enforcement for such contracts, the contractor will be unlikely to seek to lose money to maintain the required level of service, thus weakening their ability to deliver the required level of service and value-for-money to the road user.

It is sometimes argued that performance based contracts lead to less corruption. In fact, the incentives for, and nature of, corruption will change compared with other arrangements.

Performance indicators for maintenance works

The choice of the performance indicators should take two concerns into consideration:

- provide an adequate level of service to users
- preserve the road heritage.

This choice should also take into account the use which will be made of them. Depending on the contracts, not respecting the required performance levels may be penalized in different ways e.g. through;

- Financial penalties
- Formal summons to carry out improvement works, and in case of default, having the works carried out by a contractor chosen by the road authorities, at the operator's expense,
- Financial penalties up to a certain level, then formal summons to carry out the works.

As far as possible, performance should be quantifiable and measurable. Even if the measurement method is not standardized and even if it is not very easy to carry out, the fact that the engineer can appraise it at a glance and that it can be confirmed by an estimate, is already a major advance to provide a legally solid basis for applying penalties. Concrete examples of qualitative indicators are given at the end of this section.

Some imperfections are impossible to measure. They are qualitative and fall into the field of the art of the engineer. They should however not be ignored in contracts.

Two types of indicators are used:

- **Global indicators**, combining several elementary indicators, which aim to provide global information on the quality of the road. Even if they are used as performance indicators in some contracts, these indicators are better adapted to the global assessment of the quality of the networks, useful to the public authorities for determining the means to be devoted to them.
- **Elementary indicators**, relative to certain specific characteristics (evenness, skid resistance, cracking, etc.), which, if not respected, incur penalties or formal summonses to carry out the necessary improvement works. This second category of indicator should be given priority in contracts.

According to the chosen contractual modalities, one or two levels may be determined for each indicator (example of this second case: penalty if a first level is exceeded, obligation to carry out improvement works if the second is exceeded). The World Road Association (PIARC) and the OECD Transport Research Board have published reference documents on road networks.



Integration of Performance Indicators, PIARC, 2008



The Quality of Road Service, Evaluation, Perception and Response Behavior of Road Users, PIARC, 1999.



Development of Tools for Performance Measurement, PIARC, 1998.

As far as qualitative indicators are concerned, the best reference works are the following:



Road Maintenance Handbook, Practical Guidelines for Rural Road Maintenance, PIARC, 1994

Originally produced for Africa, it may in fact be applied in a large number of countries, excepting those subject to severe winter conditions. It also has the advantage of existing in English, Spanish, French, Portuguese and Khmer.

It gives very precise information both concerning defects in pavements and ancillary areas and on how to correct them.



Road Monitoring for Maintenance Management, Volume 2:
Damage Catalogue for Developing Countries, OECD and World Bank, 1990

This catalogue, which provides photographs of the defects along with a description of their causes and remedies, is an interesting tool.

In what follows, pavement performances of earth and paved roads and those concerning the ancillary areas will be distinguished.

Pavement

Unpaved Roads

The wide variety of local situations, depending on the nature of the soil, the climate, and the road environment, the characteristics of the convoys likely to travel on the pavement, etc., mean that the performance criteria will inevitably be very different from one country to another.

The main types of deterioration are as follows:

- Deformation, due to materials being worn away under traffic (gravel loss), rutting or subsidence/settling.
- Potholes.
- Corrugation.
- Ravines forming due to water flowing down the pavement.

These may be characterized by direct or indirect measures through their consequences on traffic conditions. Performance-based maintenance contracts for earth roads in Chad are a very good example. They use the following indicators:

- Traffic usability in all weathers for light vehicles, at an average speed depending on the season (dry or wet) to be specified in the contract,
- width of corrugation (e.g. maximum < 4 cm; average, per 50-m section, < 3 cm),
- depth of rutting (e.g. maximum < 5 cm; average, per 100-m section, < 3 cm),
- total pavement distress surface area, such as potholes, sandy pockets and gravel pockets (e.g.: < 60 m² per km; and unit surface areas of these distresses < 1 m²),
- tolerance over the useful pavement width for traffic (e.g.: 20 cm less than the pavement width specified in the contract),
- tolerance on the height of the pavement axis (e.g. 3 cm less than the theoretical vertical alignment, except during the period when regravelling work is no longer possible).

Paved Roads

Quantitative Indicators

Internationally, there is fairly wide agreement on the choice of the main indicators which should respond to the dual objective of maintaining the quality of service to the user and preserving the road assets. The measurement methods have also been subjected to many comparative tests (particularly concerning evenness and skid resistance) which are the basis of a fairly wide international consensus. Despite this, the contract will have to be very precise in determining tests and measurement methods.

Of course, the precise choice of these methods as well as that of the thresholds to be set is for the specialists to decide.

The following table lists the most frequently used indicators for flexible pavements;

FREQUENTLY USED INDICATORS FOR FLEXIBLE PAVEMENTS		
Unit Indices	Surface/Quality of Use	Asset Preservation
Evenness	✓	
Skid resistance	✓	
Macro texture	✓	
Rutting	✓	
Raveling	✓	
Potholes	✓	✓
Cracking	✓	✓
Deflection		✓

For concrete pavements, evenness, skid resistance, macro texture, cracking, faulting, and pumping are the most frequently used indicators.

- Other quantitative indicators may be added.
- Maximum height of water accumulation after a storm.
- Maximum level difference between the pavement edge and the shoulder.
- Qualitative Indicators.
- Those most frequently mentioned in contracts are the following:
- Pavement cleanliness, free of gravel, debris and slippery matter.
- Rapid treatment of areas made slippery by accidental spills.
- Acceptable wear of marking products (paint).

Roadside ancillaries

A few examples of quantitative indicators can be given: maximum height of grass on the verges, top of the embankment and ditches; minimum height between the road surface and the lowest branch of any tree; maximum water flow of a drainage system.

- The other indicators are qualitative and generally concern the following points:

- Efficient drainage systems both on the surface and underground channels.
- Shoulders in good condition, with no signs of erosion and with a sufficient slope.
- Preserving the grass cover in grassy areas.
- Caring for plants and trees in planted areas.
- Pruning trees overhanging the pavement and felling those likely to fall down.
- Keeping signing, reflectors and safety barriers in good condition.
- Cleanness of roadside and amenities.
- Good condition of safety equipment.

Bridges, Tunnels, Retaining Walls, Drainage Structures

Routine maintenance can be performance-based according to quantitative and qualitative indicators (condition of safety equipment, aesthetics of retaining walls, efficiency of drainage systems, etc).

In most cases, the interval between two sets of major maintenance works is longer than the usual term of a performance contract. Thus, these works can not be generally included in the contract, except as initial rehabilitation at the beginning of the contract or as additional services at the public authority's request during the contract.

For long contracts, these works are usually included. In this case, it is desirable to stipulate in the contract the frequency of inspection visits which the operator should make (e.g. a brief visit every year and a more detailed visit every five years). The observations collected during these visits should be described in detailed reports available to the road authorities.

Performance indicators for operation

The choice of these indicators should of course be adapted to the road characteristics (motorway or ordinary road, toll road or free road) and to its function (urban or inter-city road, for example).

It should be underlined that the requirement level should remain reasonable as any extra expense will in the end be paid by the user or from the budget.

The requirements most frequently encountered in contracts are as follows:

- Maximum rate of road unavailability, this indicator may be combined with other conditions relative to road availability, for example: the obligation for a motorway to maintain one lane in service in both directions, except under exceptional circumstances; the obligation, in case the road is completely closed, to have planned and prepared temporary replacement route markings, etc.

These requirements, whose object is mainly to encourage the operator to maximize organization of maintenance sites, may be differentiated between depending on traffic levels, or according to the season or the time of day.

- Maximum rate of unavailability of equipment, such as lighting, variable message panels, emergency telephone network, traffic surveillance camera, etc.
- Maximum time for repairing faulty equipment.
- Maximum time for warning of and arriving on the scene of an accident. Time allowed for setting up warning devices for users and signing to protect damaged vehicles and emergency service staff.
- Quality of information to users, which comprises two components: Forecast information, concerning, by definition, what is foreseeable, i.e., construction/maintenance sites, demonstrations, traffic conditions, etc. It may use many supports: press, radio, information panels, etc. Internet plays an increasingly important role in this type of information. Real-time information, available to users through variable message panels or specialist radio, whose performance can be measured by the relevance, precision and frequency with which this information is updated.
- The considerable progress already made should be underlined, and that is likely to be made in the coming years, in the field of real-time information, mainly due to on-board information which enables the condition of the network to be visualized at any time from within a vehicle. Such possibilities will only be fully effective if the operators provide relevant information at all times. This is a totally new category of performance which may be required of operators.
- Performance relative to winter service, which very much depends on a country's climate (or on the altitude of the zone under consideration). Depending on the case, this results in aiming at roads totally cleared of snow, or considering it normal to drive on flattened snow. These performances are generally characterized by the time it takes to raise the alarm, the time it takes for machinery to arrive (salting machine for black ice or blade for snow-clearing) and the throughput of the machines. The maximum time imposed generally varies during the day.
- Countries with a rigorous climate are used to dealing with these problems and have frequently formalized the conditions for carrying out winter service depending on the importance of the roads.
- In an effort to preserve the environment, the road authorities are encouraging operators increasingly to reduce the quantities of salt spread, which requires revising traditional strategies and eliminating preventive salting, combined with paying greater attention to weather forecasts.
- Toll-related performances, which may concern the flexibility with which collection systems adapt to users' requests (payment in cash, by credit card, by special card, non-stop tolling, etc.) the maximum length of queues, graft levels, which are a permanent worry to toll motorway operators, and the reliability of electronic payment systems. The best guarantee of good performance is when it is to the operator's advantage to increase toll receipts. An operator paid on the amount of receipts will use as much imagination to find a way of defeating graft as the fraudsters (whose imagination is boundless!). It is essential to have this in mind when determining contractual arrangements.

- Traffic congestion, the operator must facilitate traffic conditions and reduce the average duration of traffic jams. An indicator could be the average transit speeds of a light vehicle on given road sections, for example.
- Safety, indicators could be the average number and seriousness of accidents per km of road.