Review of UKPMS core functionality	
Conclusions and recommendations (PCMG 11/09).	
PCMG meeting date	2nd June 2009
Version number	v0.3 (01/06/2009)
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Conclusions and recommendations (PCMG 11/09)

Introduction

1) The DfT awarded a contract to a consortium led by TRL Limited, including Atkins and specialist sub-consultants, to review the UKPMS core specification in the light of the Halcrow and Ebert reports, to ensure that it addresses local authorities' future highways data analysis needs.

2) The objective of the commission was to produce a core specification for highways engineering software systems, which would replace the current UKPMS core specification as the minimum functionality that all PMS should embody.

3) There were three elements to the commission:

   a) determining the priorities for support and promotion;

   b) developing the core specification;

   c) mapping the agreed core specification to an indicative timetable and budget.

4) Annex A describes the project in more detail.

5) This paper identifies the issues for discussion.

Issues for PCMG discussion and decision

Recommendations of the draft project report

Recommendations of the project steering group

Recommendations to the UK Roads Board

Conclusions of report

6) The current UKPMS specification for UKPMS does not meet the needs of local highway authorities in a number of ways, and for a range of different reasons.

7) It is not simply a question of adding new functionality to the existing UKPMS specification to meet those needs, fundamental changes will be required in the overall architecture, as well as many of the details of the specification, and quite probably in the design of the commercial systems that deliver the functionality to local authorities.

8) However there are many elements of the existing specification that should be retained, either because they are a good way of delivering the requirements, or to enable local authorities to continue to use historic data and historic methods. Some elements will have to be replaced, either because they do not deliver the requirements or to enable local authorities to use new data and new methods.

9) The core requirements for the new specification (those things that must be done consistently between systems, and between local authorities) include:

- Network referencing
- Location referencing
- Section attributes
- Importing data
- Exporting data
- RCI processing (to support national reporting)
- Automatic pass processing (until replaced)
- National reporting
- Financial information to support asset management calculations

10) In order to deliver those requirements in a flexible and manageable way, and to create a framework for future development, a modular approach to the specification and accreditation has been proposed. Because there are local authorities and their service providers who use the current systems extensively or intensively, the change from the current UKPMS specification to a new modular core specification for PMS in the UK should be a gradual, evolutionary process that eventually delivers revolutionary change.

11) Therefore a phased programme of technical development is proposed, including some elements of research, that will transform UKPMS over the next four years into a tool that supports effective pavement asset management for local roads in the UK.

12) The direct cost of the technical development work will be of the order of £1.2 million (to be funded centrally), and the consequent costs to the current UKPMS suppliers will be of the order of £3.6 million (which would be recovered through charges to local authorities over future years).

13) To set these figures in context, the current (centrally funded) cost of supporting PCIS (UKPMS and SCANNER) is of the order of £450k per year, the current cost of using PCIS (to local authorities in England) is of the order of £9 million per year, and this is about 0.7% of the total investment in planned carriageway maintenance in England each year (estimated at about £1.3 billion).

14) If the new specification for PMS for local roads in the UK improves the efficiency, economy and effectiveness of planned carriageway maintenance by 1%, the annual benefit would be of the order of £13 million, and the cost of investing in its development would be recovered within the first year.

Recommendations of Project Steering Group

15) The report has identified a comparatively small list of core functions (defined as those things which MUST be consistent between systems).

16) The report has also identified a larger list of desirable functionality to support asset management plans, where central funding is needed to encourage the development of systems that meet UK requirements.

17) The project steering group recommends that the proposed reduced core specification for UKPMS be adopted, and the proposed developments to develop the desired functionality be supported, as offering good value for money in terms of a business investment.

Annex A

Review of UKPMS Core Functionality

Summary and Conclusions

Introduction

A.1) The DfT awarded a contract to a consortium led by TRL Limited, including Atkins and specialist sub-consultants, to review the UKPMS core specification in the light of the Halcrow and Ebert reports, to ensure that it addresses local authorities' future highways data analysis needs.

A.2) The objective of the commission was to produce a core specification for highways engineering software systems, which would replace the current UKPMS core specification as the minimum functionality that all PMS should embody.

A.3) There were three elements to the commission:

a) determining the priorities for support and promotion;

b) developing the core specification;

c) mapping the agreed core specification to an indicative timetable and budget.

A.4) A project steering group was set up, chaired by Chris Capps (Cambridgeshire), including Pete Burnham (Worcestershire), Steve Finley (Rotherham), Danny Rawle (Leicestershire) and Edward Bunting (DfT).

A.5) The project commenced on 14th November 2008, with the project inception meeting on 2nd December. A one day workshop was held with the UKPMS developers on 15th January 2009 and two workshops were held with representatives of local authorities and their service providers, UKPMS developers and survey contractors, on 17th February and 22nd April 2009. The draft final report was delivered on 19th May and the project completion meeting was held on 1st June 2009.

Determining the priorities

A.6) The aim of the first element was to produce a rationale for commonality of functions across local authorities and systems. In particular:

- the increasing importance of an asset management approach,
- the need for asset valuation,
- Scanner functionality,
- outstanding issues from the Ekins-Hawker report, and
- the potential for making better use of existing research

Asset management

A.7) Highway asset management is:

"A strategic approach that identifies the optimal allocation of resources for the management, operation, preservation and enhancement of the highway infrastructure to meet the needs of current and future customers." (CSS, 2004).

A.8) An asset management approach is likely to require five main changes:

- a strategic approach – taking a longer term view to planning and programming,
- whole of life – the introduction of life-cycle modelling to identify the best whole life option for the asset,
- optimisation – greater use of asset performance information to enable better informed decisions,
- resource allocation – the allocation of resources based on assessed need
- customer focus – explicit consideration of customer expectations and documentation of levels of service. (CSS, 2004).

A.9) Local Authorities are increasingly taking a planned asset management approach to their highway assets, influenced by the requirements and recommendations of central governments. This, combined with budget and resource pressures plus the need to demonstrate good value, means that they want to be able to make sound decisions and be able to make better decisions, by improving the decision making process at ALL levels:

- Operational (project or scheme level)
- Tactical (project selection or prioritisation level) which requires forward works programmes (3 – 5 year rolling programme) and
- Strategic (network level) which requires life cycle plans (5 to 30 year plans).

A.10) At the project level, the road maintenance manager has to determine the most economical maintenance treatment capable of satisfying the overall project requirements. Regardless of whether the project is an improvement or a maintenance scheme, the objective of project-level analysis is to select the most appropriate treatment option, assuming various constraints (including funding).

A.11) At the selection and prioritisation level, the local authority has to assess projects to establish a multi-year (typically 3 to 5 year) capital maintenance programme. Pavement management data, including inventory, condition and cost data, are evaluated to prioritise network needs and develop listings of recommended schemes and their respective treatments, based on budget allocations.

A.12) At the strategic level the local authority has to assess overall network need and develop longer term life cycle planning, typically up to 30 years ahead for long (or indefinite) life infrastructure assets, such as road carriageway pavements.

Asset valuation

A.13) HM Treasury and the Department for Transport commissioned a review of accounting, management and finance mechanisms for local authority transport infrastructure (CIPFA, 2008). The objective of the review was to evaluate the issues associated with implementing an asset management plan-based approach to accounting, managing and financing local authority transport infrastructure assets, including the best way to use such information to:

- Support good financial management locally;
- Provide good information to support policy development and resource allocations;
- Produce financial accounts complying with relevant International Financial Reporting Standards (IFRS) requirements; and
- Deliver consistent high quality information for Whole of Government Accounts (WGA) and National Accounts purposes.

A.14) The review identified that comprehensive transport asset management had the potential to deliver significant value for money benefits and improvements in the services delivered to users. The report concluded that an Asset Management Plan (AMP) based approach was the only one capable of delivering all the objectives of the review. In particular, it was the only one capable of fully supporting sound financial management decisions and effective long term stewardship of the asset base.

A.15) The AMP based approach should help authorities to take better informed decisions about spending priorities, by demonstrating the long term consequences of particular levels of investment, and help them to maximise the output that can be achieved for the chosen level of expenditure. Robust information about what authorities really need to spend to maintain transport infrastructure to defined levels could also better inform future national spending decisions.

A.16) The report also concluded that, if the benefits of an AMP based approach were to be realised quickly and in full, an early change would be needed in the relevant accounting guidance contained in the Statement of Recommended Practice (SORP). Changing the current SORP treatment to an AMP based approach would require local authorities to have good quality, consistent information that would be able to withstand audit scrutiny.

A.17) In order to meet IFRS requirements, local highway authorities will have to calculate:

- Gross Replacement Cost (GRC)
- Depreciated Replacement Cost (DRC) and an
- Annual Depreciation Charge (ADC)

A.18) Requirements for financial information to support asset management are currently evolving and consistent, reliable data about the relevant aspects of road carriageway condition will be at the heart of any meaningful calculations.

SCANNER functionality

A.19) In total, a SCANNER survey reports thirty nine parameters to the current specification. These measure:

- Position and geometry
- Longitudinal profile (ride quality and deformation)
- Transverse profile (ruts and deformation)
- Edge condition (edge deterioration)
- Texture and texture variability (surface deterioration)
- Cracking intensity (structural and surface deterioration)

A.20) The SCANNER Road Condition Indicator was developed over a number of years as a way of combining a number of different SCANNER measurements into a single figure, but it is only based on a limited selection of six parameters. This is produced using a "weighting set" approach, which can be run more quickly, instead of the "automatic pass" calculation.

A.21) As part of the introduction of automated surveys, a method of calculating treatment requirements from SCANNER data was developed and subsequently refined. This uses the "automatic pass" approach in UKPMS, with treatment rules based on a limited subset of SCANNER parameters. Although it is possible to calculate indicative treatments from these SCANNER parameters, the rules were developed through informed discussion in workshops and have not been calibrated against results on local roads. In practice, it appears that the very few authorities have attempted to use UKPMS to develop indicative treatments and budgets using SCANNER data.

A.22) Many authorities are unable to process SCANNER data to provide treatments (via the standard UKPMS processing routine – the Automatic Pass) because it simply takes too long (typically several days). There are several reasons for this unacceptable performance including:

- Larger volumes of data. The quantities of SCANNER data are very much larger than the other data sources (visual and machine) for which UKPMS was originally designed.
- The complexity of the Automatic Pass processing. While this is a powerful and flexible tool for processing many types of data together, it can be argued that firstly it is over complicated, and secondly, due to its generic nature, it was designed to deal with data behaving like those obtained in visual surveys, and not the continuous measurements provided by SCANNER surveys.
- Inadequate computing resources. Performance depends on the type and level of computing resources and these vary considerably from one authority to another.
- Lack of expertise. Many authorities lack the expertise, resources, or time to use UKPMS effectively.

Issues from the Ekins Hawker report

A.23) The TTS scoping study report (Ekins & Hawker) did not specifically consider the impact of the change from visual survey to machine survey condition data on how the data are used by local authorities. The recommendations of the TTS scoping study were reviewed in the "end of term" report from the SCANNER implementation project.

A.24) In summary, the main outstanding issue is the requirement for a third stage of review and revision of the overall "defects index" – which was delivered as the SCANNER RCI. The first stage developed the approach and specified the initial (original) set of parameters, thresholds and weightings. The second stage reviewed the working of the RCI on a wide range of local roads and recommended the revised set of parameters, thresholds and weightings. The third stage would have reviewed the working of the RCI and added additional parameters, thresholds and weightings for edge condition and surface variability, leading to an "enhanced" or "extended" RCI.

A.25) The SCANNER "end of term" report identified the need to use SCANNER data more effectively for:

- Treatment selection
- Asset valuation
- Deterioration modelling and condition projection
- National pavement condition reporting

A.26) It also identified the need for some specific tasks to develop and improve SCANNER capabilities.

Better use of existing research

A.27) The SCANNER research programme introduced a number of new measurements with potential to be used as part of local authority asset management; but without developing the tools to enable local authorities to use them effectively and with little practical guidance on how they could be used to enable system developers to develop the tools. There is hence a clear need to develop processes that would turn the wealth of data provide by SCANNER into information that local highway authorities can use to manage their pavement assets more effectively.

A.28) There has also been a considerable amount of other relevant research carried out for the Department of Transport and the Highways Agency which could potentially be implemented through UKPMS as it has already been implemented through the Highways Agency pavement management system (HAPMS) and Integrated Asset Management System (IAMS). The research has lead to the development of asset management tools in a number of areas:

- The HA SAS (scheme analysis system) tools for all the major highway assets (pavements, structures, drainage, geotechnics, etc.)
- The HA Whole Life cost tools – SWEEP.N and SWEEP.S, which form part of HAPMS

- The HA WLCM (whole life cost model) which has been used for analysing future budgeting requirements for the Annual Spending Reviews by HM Treasury over the past years.

A.29) Other areas of research which influence pavement asset management have included

- Highway Service Levels,
- Traffic Speed Deflection measurements,
- Smaller, quicker, cheaper automated carriageway condition surveys for local roads leading to a new specification for Surface Condition Assessment for Minor Roads (SCAMR) surveys.

A.30) There is a potential for future machine surveys to measure structural and other parameters such as the Traffic Speed Deflectograph (TSD) currently being developed on behalf of the Highways Agency. Other traffic speed techniques such as ground penetrating radar (GPR) may also be able to provide useful data to PMS in the future. This would again be likely to create large amounts of data for processing.

Developing the core specification

A.31) The aim of the second element was to develop the core specification. The review project specification stated:

"It is important that commonality is not suggested purely on the grounds that local authority engineers say that they would like it. Each component proposed for inclusion in the core should be grounded in a firm rationale..."

"It is important to distinguish between:

- things that a good PMS should do (the state of the art);
- things that all PMS need to do in the same way (the common core);
- techniques that would benefit from research being conducted centrally"

What a PMS should offer (the state of the art)

A.32) Pavement Management is a business-like approach to the management of paved highway assets, including roads, kerbs, footways and cycle-tracks. The overall aim of pavement management is to maintain and improve the paved highway asset to support its current and future use in an efficient and safe manner, through the systematic assessment of condition and the identification and prioritisation of maintenance need.

A.33) There is an important difference between "pavement management" and a "pavement management system".

- "Pavement Management" is a management approach used by personnel to make cost effective decisions, whereas
- A "Pavement Management System" is a set of tools used to assist managers in reaching those decisions.

A.34) At a network or strategic level:

- Identify the overall need for pavement maintenance
- Determine the level of funding needed
- Select feasible funding options and strategies
- Determine the impact of different options on condition and level of service
- Develop the preferred funding option and strategy, and
- Identify the road lengths to be considered for maintenance under the available funding

A.35) At a project selection or prioritisation (tactical) level:

- Define the relative priority of the road section lengths in the maintenance programme within the available budget
- Identify suitable treatments,
- Improve cost estimates by including project work items that are not part of the pavement cost,
- Rate priority relative to the authority's overall objectives, and
- Finalise the list of projects (schemes) and the allocation of funds

A.36) At project (operational) level:

- Assess the causes of deterioration,
- Identify practical maintenance options e.g. resurfacing or reconstruction.
- Analyse cost effectiveness of different treatments and alternative options,
- Define imposed constraints, e.g. cost, engineering, performance, environment, etc.
- Select the most cost effective option within the imposed constraints.

A.37) The main components of a PMS are illustrated in figure (1)

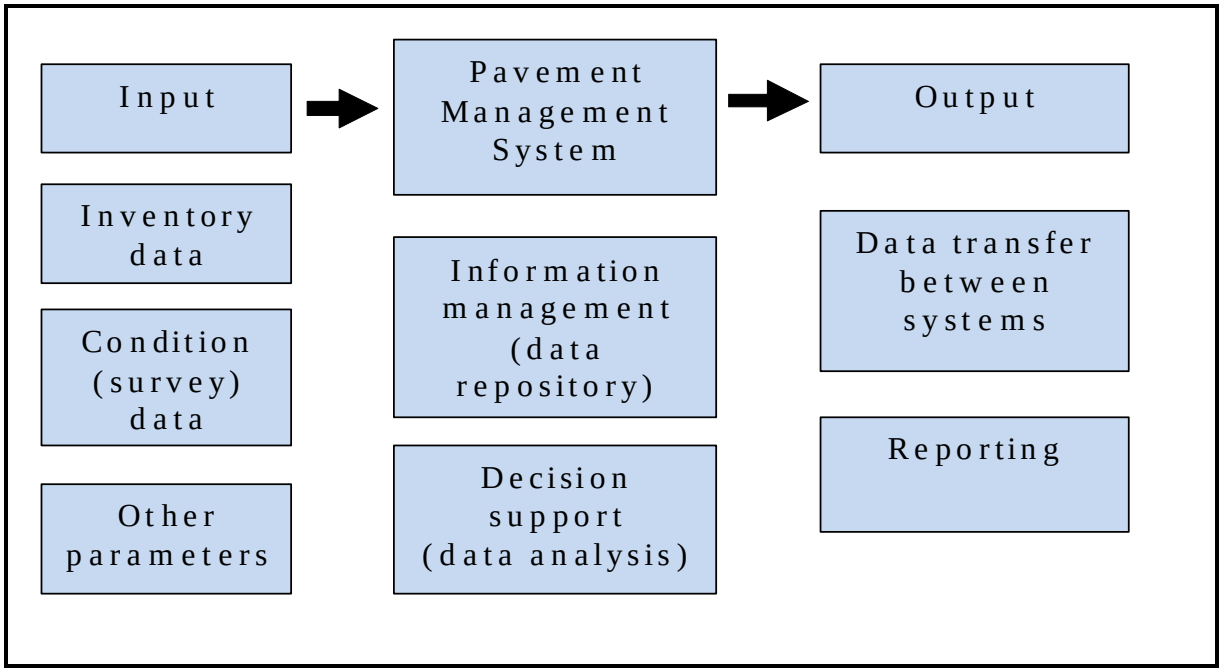

Figure 1 Components of a PMS

Rationale for consistency

A.38) There are a number of reasons why local authorities need a nationally consistent approach to aspects of pavement asset management systems.

A.39) The first applies wherever the results have to be compared between authorities, or combined across a wider area. For example:

- where a local authority is required to report a value as a performance indicator that will be compared with the performance of other authorities (such as NIs);
- where values are to be combined to form a national indicator (such as NRMCS);
- where values are used to determine the allocation of (scarce) resources, such as budget allocations (from Central Government, Regional Government, etc);
- where values are used as part of other statutory reports (such as financial accounts);

A.40) The second applies wherever local authority officers are required to justify their recommendations, decisions or actions, such as for public scrutiny. For example:

- when proposing budget allocations for highway maintenance programmes;
- when recommending maintenance programmes or schemes;
- when defending an authority's performance of its statutory duties against claims from third parties or in court proceedings

A.41) A nationally consistent approach is required to enable officers to demonstrate that they have applied their professional judgement in the context of nationally agreed guidelines and standards, with approaches

adapted to local needs, rather than in an arbitrary, idiosyncratic or untested way. Thus consistent and reliable systems are needed to support the approach set out in codes of practice, such as Well Maintained Highways

A.42) A third reason has to do with commercial and business efficiency. Local authorities should not be prevented from switching between service providers by artificial constraints. For example:

- not having different suppliers developing different and potentially contradictory approaches at the "core" level
- being able to easily transfer data from one system to another
- being able to easily implement best practice from other authorities using different developers UKPMS systems.

What PMS need to do in the same way (the common core)

A.43) The following key areas were identified where consistency is paramount:

- National reporting including reporting financial information
- Regional reporting (e.g. benchmarking between regions or within regions)
- Data interfaces. (i.e. input and output data requirements and file formats)
- Enabling asset management, and Asset Management Planning

A.44) In addition to these key areas, those at the first workshop also identified a need for independent testing of some functionality to provide reassurance that national guidelines were being followed.

A.45) It was also considered that there is a need to accommodate historic data and allow this to be processed to maintain continuity with previous results. However, we believe this should be accomplished, as far as possible, without compromising or inhibiting the future development of PMS in the UK.

Current national reporting requirements

A.46) England:

- Classified roads – SCANNER RCI using the UKPMS weighting set approach (full coverage)
- Unclassified roads – UKPMS Condition Indices from CVI surveys using the automatic pass approach (full coverage) (Road Condition England survey)

A.47) Scotland:

- Classified roads – SCANNER RCI using the UKPMS weighting set approach (full coverage)
- Unclassified roads – SCANNER RCI using the UKPMS weighting set approach (sample survey)

A.48) Wales:

- Classified roads – SCANNER RCI using the UKPMS weighting set approach (full coverage)
- Unclassified roads – no national reporting requirement.

A.49) Northern Ireland:

- Classified roads – Deflectograph residual life plus SCRIM surface friction requirements (full coverage)
- Unclassified roads – UKPMS Condition Indices from CVI surveys using the automatic pass approach (full coverage)

Asset management requirements

A.50) In order to be able to produce the "high level" results from a PMS, there are a number of pre-requisites. The following paragraphs include them, as well as the ultimate requirements.

A.51) Reporting current pavement condition:

- Identifying the local condition (from place to place);
- Condition of parts of networks (by area, by road type or by road class); and
- Condition of whole networks of roads (within defined areas, by road type or class).

A.52) Reporting changes in condition between years:

- From one year to the next, or
- Comparing individual years or
- Comparing over several years to establish trends

A.53) Identifying current treatment requirements (and costs):

- Local maintenance requirements (from place to place);
- Parts of networks (by area, by road type or by road class); and
- Whole networks of roads (within defined areas, by road type or class).

A.54) Predicting future treatment requirements (and costs) profiled over time:

- From one year to the next, and
- Over longer periods

A.55) Assembling practical maintenance schemes or programmes from current and predicted treatment requirements:

- Identify and build schemes from treatment needs (at a local, project level).
- Assemble lengths into schemes, based on condition and / or treatments.
- Assemble schemes into programmes, based on types of road, types of treatment, etc.

A.56) Prioritising schemes by condition:

- Prioritise schemes based on current condition and / or treatment requirements.
- Prioritise schemes within programmes, based on condition / treatment / road type, class, etc.

A.57) Prioritise schemes based on whole life cost (WLC) principles (economic ranking).

- Prioritise schemes within programmes, based on anticipated future condition / anticipated future treatment requirements / road type, class, etc.
- Prioritise between years (from one year to the next, or comparing individual years), and over several years (trends)

A.58) Report financial information, to calculate

- Gross Replacement Cost (GRC),
- Depreciated Replacement Cost (DRC) and
- Annual Depreciation Charge (ADC).

Based on the extent, and condition of the whole road network (paved areas) including carriageways, footways and other paved areas (e.g. cycle tracks).

A.59) Scenario modelling and optimisation: Predict the consequences of investment decisions based on anticipated or defined budgets, identifying changes between years and over several years, in terms of their effect on:

- Future road condition and serviceability,
- Future maintenance requirements,
- Scheme delivery and prioritisation, and
- Asset value (Depreciated Replacement Cost)

Development requirements (techniques that would benefit from research being conducted centrally)

A.60) How road networks and data are referenced in the new PMS for the UK. UKPMS is currently based on “stand alone” sections, but the data gathered by machine surveys (such as SCANNER) are located using GPS. The current process of “fitting” the survey data to the network degrades the positional accuracy of the data, and hence its value for subsequent analysis and use in asset management. Local authorities increasingly use GIS to display information, including road condition, and to analyse information from their PMS. There are three aspects that need further investigation and development:

- the technical issues and barriers relating to the use of geographical referencing, and how these could be resolved,
- the organisational and data handling issues and concerns that would affect the implementation of geographical referencing, and how these could be resolved,

- a functional specification for the application of geographical referencing in pavement condition information systems.

A.61) How data are imported (loaded) and exported (reported) in PMS. The current data file format, HMDIF was specifically designed for visual survey data. It creates very long files when used for machine survey data, consequently loading machine survey data to (some) UKPMS can be very time consuming. There is a need for faster, simpler, processes for loading machine survey data, including techniques for identifying and dealing with "improbable" values. Currently no export file formats are defined in UKPMS. The is a need for basic, industry standard, file formats to enable PMS to export data to other information systems, such as financial information systems, geographic information systems, and business management systems.

A.62) Treatment selection, scheme identification and programme building. Currently UKPMS has quite complex rules for indicative treatment selection and very limited facilities for indicative scheme building, using visual inspection data (and to a limited extent Deflectograph and SCRIM data). There are also rules for using a limited selection of SCANNER parameters to generate indicative treatments, but no rules for combining SCANNER survey data and visual inspection data in treatment selection and scheme building. There are therefore several areas that require further research and development:

- To check the validity of the existing rules for developing indicative treatments from SCANNER data,
- To extend the rules to include other SCANNER parameters (in particular edge condition and surface deterioration measure by texture variability)
- To develop an approach and the rules for combining information from both machine and visual surveys.
- To develop a simple approach to indicative scheme building from either (or both) machine survey data and visual inspection data.

A.63) How to predict the future condition of the pavement or the network from readily available or affordable information. In the case of local road pavements this will mainly be records from standardised visual inspections (such as CVI and DVI) or from routine machine surveys. The future condition (and hence the future need for treatment) will be expressed in the same terms as the measurement of condition, be it visual inspection or machine survey.

- How to model the future condition of either an element of the network, or the whole of the network, from current and past measurements of condition, and
- What other data are required to enable reliable predictions over the short, medium and longer term (which might, for example, include construction type, traffic levels and maintenance history)

A.64) Whole life costing and life cycle analysis requires information on current and future treatment requirements and costs, as well as the effect of changing pavement condition on the extent and type of maintenance.

There are a number of asset management systems that currently include whole life costing and life cycle analysis functionality, some designed for use on roads (but none specifically designed for use on local roads in the UK) and some designed for use on other types of infrastructure asset.

A.65) One approach would be to identify the benefits and constraints offered by existing systems and, from that to develop a simple basic approach that would enable local authorities to carry out whole life costing and life cycle analysis, with functionality enabling them to enter different assumptions (based on local knowledge and experience) and see how they would affect investment decisions. Initially there would be two parallel approaches, using visual survey data, and using machine survey data, with the overall objective of developing a combined approach.

A.66) From a local authority perspective, one of the most important functions of a pavement management system as a network level (strategic analysis) management tool is the ability to do "what if" modelling. Rather than working from condition measurements to develop treatment requirements, maintenance schemes and programmes, and budget requirements, to be able to work from budget allocations to prioritise expenditure according to predefined criteria and calculate the effect on the overall condition of the network in future years (impairment of the asset), and the consequent requirements for investment in maintenance (investment optimisation).

A.67) Whilst there are a number of systems that purport to carry out scenario modelling and investment optimisation for infrastructure assets, this is perhaps the hardest and most testing application for a pavement management system. It requires the underlying information on deterioration modelling and condition projection, treatment selection and scheme building and whole life costing and life cycle analysis to be sufficiently detailed and reliable (robust) as an input to the scenario modelling functionality.

A.68) One approach would be to review the capabilities and limitations of currently available systems, and estimate the level of detail and reliability required from the input information to be able to make valid and useful predictions. This would then define the performance requirements for the system, leading to a detailed technical specification for a basic level of scenario modelling and optimisation capability, based initially on using visual survey data, and using machine survey data, with the overall objective of developing a combined approach.

Implementing a new core specification

What will have to change

A.69) The original logical design for UKPMS consisted of 30 modules that provided a blueprint that was later consolidated into a functional specification for a comprehensive integrated system containing the following functions:

- Engineering maintenance related from survey data collection to project optimisation.

- Data management including specification of the scheme for digital record storage
- Import/export for data interchange with an array of information systems for highway management - CSRWR, COMPARE, NRMCS
- Data visualisation and graphical representation including map generation

A.70) The original specification (Logical Design) was not offered to the marketplace directly; instead it was pared down, the requirements were revised to meet local authority needs, and applied to the development and accreditation of UKPMS through the comparability test process.

A.71) The requirements were broken down into three tranches:

- Tranche 1: network referencing, asset inventory and condition survey data.
- Tranche 2: defect rating, treatment selection, estimating and budgeting and works records.
- Tranche 3: condition projection, economic analysis.

A.72) Only developers with full accreditation were considered to be 'UKPMS accredited'; tranches 1 & 2 were simply steps along the way. As eventually specified, the Logical Design was incorporated into commercial systems that were intended to be developed, accredited and used by all Local Authorities for full Pavement Management. Pavement Management Systems incorporating the UKPMS Specification were developed from systems that already existed with other functions. Consequently, UKPMS now resides in systems with very different functionality, data structures, etc.

A.73) The functional requirements in the current UKPMS specification include:

- Location referencing: How data are located and identified in UKPMS.
- Loading and maintaining data:
  - Inputs: Loading data and the structure of the associated files.
  - Types of data.
  - Maintaining the network.
- Processing:
  - The Automatic Pass.
  - The Road Condition Indicator.
  - Parameters used when processing.
- Reporting:
  - National reports.
  - UKPMS reports.

A.74) A wide range of issues have been identified with the current UKPMS functionality and performance in previous reports, including:

- The UKPMS Strategic Plan (Robinson, 2004)

  - Some algorithmic modelling deficiencies
  - Inadequate reliability of input survey data
  - Excessive level of detail
  - High costs of operation (resources and data collection)
  - Lack of awareness and understanding of objectives and potential
  - Lack of proactive approach to pavement management
  - Limited resources to address problems
- The UKPMS Strategic Development Study (Halcrow, 2006) and
- Using SCANNER data for maintenance management on local roads (Mott MacDonald, 2006)
  - The perceived lack of usefulness and relevance of UKPMS to the regular business of local road maintenance management
  - The perceived difficulties of using UKPMS – resources and expertise required, time to load and process data
  - The perceived unreliability of the results due to both the inconsistency of input survey data and limitations of the (complex) processing algorithms

A.75) Other technical issues we have identified include:

- Technical documentation that has not been kept fully up to date, and information on development and change that is not readily accessible.
- Limitations of the approach to network referencing and its effect on the positional accuracy of machine surveys data.
- Impact of machine survey data on overall system performance.
- Limitations of algorithms for using machine survey data.

A.76) As a consequence, UKPMS is only being used effectively by relatively few local authorities. In many cases it is being used for little other than to process survey data to calculate national indicators.

A.77) We concluded that fundamental change will be required in the core specification of UKPMS, it will not simply a question of some minor adjustments. Major surgery will be required.

A.78) Some elements should be retained,

- Either because they are a good way of delivering the requirements
- Or to enable local highway authorities to continue to use historic data and historic methods is currently being used E

A.79) Some elements should be replaced:

- Either because they do not deliver the requirements
- Or to enable local highway authorities to use new data and new methods

A.80) Therefore the renewal programme is likely to require considerable resources and to be phased over several years.

A.81) There is a need to develop consistent basic methods of meeting local authority requirements, which implies considerable investment in research & development. But there is no point in starting the process of renewing UKPMS unless there will be sufficient commitment and resources to complete the process.

Developing a new core specification

A.82) There are a number of general principles governing the design of the core specification and how it is implemented:

- Flexible to evolve as requirements change
- Allows radical change to UKPMS within a framework which evolves from the current position
- Facilitates accreditation of other PMS where these are able to provide the required functionality
- Both the specification and the accreditation are manageable to maintain
- Describes the requirements as outputs wherever possible

A.83) UKPMS requires fundamental change (as opposed to a few minor adjustments) in order to meet the future business requirements of the local road network owners. However, the problem with instigating a complete overhaul is that it is high risk and very expensive. Therefore, we recommend a framework with the potential to deliver far-reaching changes but in a controlled and lower-risk way. The method for achieving this is to rewrite the core specification in a more modular way. This would place PMS for the UK on a new footing and would ultimately permit major changes, but within a well-controlled, affordable and lower-risk context.

A.84) The new PMS specification would be developed on a modular basis, with new arrangements for accreditation, element by element. As a matter of principle, it would divide the specifications for data from the specifications for processes. Input data will have to be consistent, to enable any outputs to be consistent. But not all analysis processes will have to be consistent – only those that lead, directly or indirectly, to outputs that have to be consistent.

A.85) Therefore the new approach would maintain accredited:

- Visual condition surveys (i.e. currently CVI, DVI, etc.)
- Machine condition surveys (i.e. currently SCANNER, Deflectograph/FWD, SCRIM/ & Griptester)

A.86) The modular framework would comprise a list of modules in the core specification, referred to as the core modules. Each of these would be defined by a specification and be verified via accreditation. Alongside and supporting the core modules, UKPMS would require parameters to drive the processes and these parameter modules would also be organised using the modular approach.

A.87) In addition to the core specification and accreditation regime, the modular framework would accommodate guidance modules. These would provide a way to offer good practice guidance on a range of topics and a way of

disseminating research information. The guidance modules would not be subject to accreditation and therefore would allow innovation by system developers and others who may wish to develop tools for use with the new PMS.

A.88) The catalogue lies at the heart of the new system. It pulls together and controls all the various documents and files which collectively describe the PMS specification. Defining the catalogue in detail should form one of the earliest tasks of implementing the new core specification.

What has to be consistent (the core modules)

A.89) The initial requirements for core modules include:

- Network referencing and location referencing
- Section attributes
- Importing data
- Exporting data
- SCANNER RCI processing and reporting
- Automatic pass processing and reporting (until replaced)
- Financial information (asset valuation) calculations

A.90) The first stage of the development of a new PMS for UK local roads will be to prepare the technical specifications. Although many of these specification modules can be defined directly from existing UKPMS documentation, there are others where some technical development will be required, and some where both research and technical development will be required.

Identifying the elements

A.91) These may be identified in two groups:

- Data management:
    - Network referencing and location referencing
    - Data interchange file formats for importing and exporting data
    - Archiving data (data file management)
    - Implementing new survey types
- Processing Algorithms:
    - National reporting (machine survey data)
    - National reporting (visual survey data)
    - Financial information to support asset management
    - Schemes and programmes of work
    - Deterioration modelling and condition projection
    - Life cycle planning
    - Scenario modelling

A.92) In terms of data management, there is a need to redefine network reference requirements to accept different methods of data referencing:

- BOTH by node and chainage (and cross section by lane), which suits manual survey techniques, and maintains continuity with historic data sets
- AND referenced to OSGR, which suits machine survey techniques, and allows data from other sources referenced by OSGR to be loaded as well development

A.93) Also to redefine network reference requirements to allow analysis on multiple overlapping networks. e.g.

- Road classification (A, B, C, etc)
- Carriageway hierarchy (1, 2, 3a, 3b, 4a, 4b, etc.)
- Footway hierarchy (1a, 1, 2, 3, etc.)
- NSG definitions
- User defined networks (e.g. cycle routes, bus routes, abnormal load routes, safe routes to school, etc.)

A.94) The HMDIF format will be retained to support visual surveys for the future and to enable use of historic data sets. In parallel alternative data transfer file format(s) are required to facilitate data loading from (e.g.) machine surveys and to facilitate data export to (e.g.) asset management systems. There is also a need to develop new rules for loading and validating survey data.

A.95) The requirements for archiving data, and the method of adapting the specification to accommodate new survey types (and new types of data) will also have to be defined.

A.96) In terms of the processing algorithms, the basic processing algorithms for converting the inputs into the outputs should be specified, to ensure consistency and comparability between authorities. The automatic pass functionality should be RETAINED in the short term to:

- Support visual survey data analysis for the (short term) future
- Enable comparison with historic analyses

A.97) In parallel with the automatic pass, a simpler analysis should be developed, using a weighting set approach to:

- Identify treatments
- Build schemes from condition or treatment
- Develop programmes from condition or schemes

These should be designed to combine data from different sources (i.e. visual and machine data)

A.98) Simpler condition projection models should be developed, in parallel with the automatic pass, to enable local authorities to:

- predict future needs for treatment and associated costs
- prioritise schemes on whole life costs

- optimise budgets by economic ranking

These should be designed to combine data from different sources (i.e. visual and machine data)

A.99) In parallel with the automatic pass, simpler asset valuation models should be developed to enable local authorities to

- Calculate Gross Replacement Cost (GRC)
- Calculate Depreciated Replacement Cost (DRC)
- Calculate Annual Depreciation Charge (ADC)

The financial information requirements will have to be specified to meet international financial reporting standards and national reporting requirements.

A.100) Budget scenario models and economic ranking of schemes will be needed to support life cycle planning. In parallel with the automatic pass, simpler budget scenario models should be developed to replace the current method.

These should be designed to combine data from different sources (i.e. visual and machine data)

The implementation plan (timescales)

A.101) The objective of the third element was to map the agreed core specification to an indicative timetable and budget. Taking into account

- to whom costs are likely to fall, and
- the ability of the market (not just those currently UKPMS-accredited) to deliver

A.102) The budget and timing proposals should also take account of where the industry is currently, and how it would be expected to migrate.

A.103) The overall objective is that UKPMS should evolve to a more flexible and dynamic system, designed to adapt and change in a controlled way. There should be incremental change, a smooth transition without a break in service. The changes should be both AFFORDABLE and ACHIEVABLE. But development funding is the key – there has to be both commitment and continuing support.

A.104) The current UKPMS arrangements, agreed with the system developers, include an annual update cycle:

- Specification of requirements (April to June)
- Initial development of specification and feedback (July to September)
- Final development and Annual Health Check (September to December)
- Issue to local authorities and implementing (January to March)

A.105) In effect this gives the developers several months to develop their systems (between June and December) and several months to test them (between September and January) as well as several months to deliver the systems to their clients (after passing the Annual Health Check).

A.106) As well as the time required to prepare the new technical specifications, the developers will need time to check that their systems comply with the new approach and any new requirements, and to carry out acceptance testing leading to accreditation. Therefore, it is practically impossible that the new approach could be introduced in time for delivery to their clients by March 2010, but it would be feasible to plan for delivery from March 2011 onwards.

A.107) Acknowledging that some of the specifications can be prepared from existing documentation, and others will require technical development, or both research and technical development, we have set out a programme in three phases:

- Phase 1 (by March 2011) – data and referencing
- Phase 2 (by March 2012) – treatments and budgets
- Phase 3 (by March 2013) – condition projection and scenario modelling

A.108) For the coming year we propose "business as usual". The Annual Health Check would be retained, as would the Automatic Pass. New requirements would be added, for the new Coarse Footway Survey (to be specified by the FCMG), for financial information reporting (to be specified by the CIPFA highway asset management financial information group, HAMFIG) and, if possible to introduce new SCANNER edge treatment rules.

A.109) In phase 1, commencing immediately, retaining standardised survey data collection methods, but with the specifications outside the core PMS specification. Introducing new technical specifications for:

- Importing data
- Exporting data
- Network and location referencing

This would lead to a reduced list of core requirements and a new accreditation process

A.110) In phase 2, commencing immediately with technical development, introducing standardised processing rules (specifications) to

- produce condition information and suggested treatments
- identify schemes and build programmes
- provide financial information to support asset management (DRC and ADC)

These would be based on all available survey types, starting with visual inspections and SCANNER, leading to additional accreditation requirements.

A.111) In phase 3, commencing immediately with research and technical development, introducing standardised processing rules (specifications) for

- deterioration modelling and condition projection
- life cycle planning and scenario modelling

These would be based on all available survey types, starting with visual inspections and SCANNER, leading to further accreditation requirements.

Costs of implementing change

A.112) The total annual expenditure on carriageway maintenance on local roads in England is estimated to be of the order of £1.3 billion, over 300,000 km of road length. Of which approximately £400 million is spent on about 1,300km of strengthening treatments, approximately £350 million on about 2,300km of re-surfacing and approximately £550 million on about 11,000 km of thin surfacing and surface dressing.

A.113) The total annual expenditure of local authorities and their service providers in England on pavement condition information systems for local roads is of the order of £9 million (i.e. approximately 0.7% of annual carriageway maintenance expenditure).

A.114) The total funding required (in addition to the existing costs of the PCIS support contract and the SCANNER accreditation, QA and audit contract) to deliver the changes in the national specification will be about £1.3 million (i.e. about 15% of the annual expenditure on PCIS). However, the developers' costs (which would be recovered through charges to local authorities and their service providers) will be in the region of £3.6 million (over 3 years).

Conclusions and recommendations

A.115) The core requirements for the new specification (those things that must be done consistently between systems, and between local authorities) include:

- National reporting, including financial reporting,
- Data and data interfaces,
- Pavement asset management requirements.

A.116) The current UKPMS specification for UKPMS does not meet the needs of local highway authorities in a number of ways, and for a range of different reasons.

A.117) It is not simply a question of adding new functionality on the existing specification to meet those needs, fundamental changes will be required in the overall architecture, as well as many of the details of the specification, and quite probably in the design of the commercial systems that deliver the functionality to local authorities.

A.118) However there are many elements of the existing specification that should be retained, either because they are a good way of delivering the requirements, or to enable local authorities to continue to use historic data and historic methods. Some elements will have to be replaced, either because they do not deliver the requirements or to enable local authorities to use new data and new methods.

A.119) Because there are users in local authorities and their service providers who use the current systems extensively or intensively, the change from the current UKPMS specification to a new core specification

for PMS in the UK should be a gradual, evolutionary process that eventually delivers revolutionary change.

A.120) Therefore a phased programme of technical development is recommended, including some elements of research, that will transform UKPMS over the next four years into a tool that supports effective pavement asset management for local roads in the UK.

A.121) The direct cost of the technical development work will be of the order of £1.3 million (to be funded centrally), and the consequent costs to the current UKPMS suppliers will be of the order of £3.6 million (which would be recovered through charges to local authorities over future years).

A.122) To set these figures in context, the current (centrally funded) cost of supporting PCIS (UKPMS and SCANNER) is of the order of £450k per annum, the current cost of using PCIS (to local authorities in England) is of the order of £9 million per year, and this is about 0.7% of the total investment in planned carriageway maintenance in England each year.

A.123) If the new specification for PMS for local roads in the UK improves the efficiency, economy and effectiveness of planned carriageway maintenance by 1%, the benefits would be of the order of £13 million, and the total estimated cost of investing in its development (£4.9 million) would be recovered within the first year.

TRL

1st June 2009

Annex B

Review of UKPMS Core Functionality

Outline business case

Introduction

B.1) The DfT awarded a contract to a consortium led by TRL Limited, including Atkins and specialist sub-consultants, to review the UKPMS core specification in the light of the Halcrow and Ebert reports, to ensure that it addresses local authorities' future highways data analysis needs.

B.2) The project specification identified that:

"…..It is vital that engineers at all levels have the right tools to enable them to gather and hold the data that they will use to make informed decisions."

"A strategic review of UKPMS was recently undertaken by Halcrow. This recommended that a fundamentally revised UKPMS be adopted as the prescribed core of PMS in the UK."

"A follow-up inquiry by Mike Ebert established that development of this revised system could not be delivered purely through commercial channels, and that a degree of central funding and direction would continue to be required.

B.3) At the second workshop, it was suggested that a business case was required to support the recommendations of the report.

Principles

B.4) The Office of Government Commerce (OGC) recommends that the Business Case is used to obtain management commitment and approval for investment in business change, through rationale for the investment. It provides a framework for planning and management of the business change, and the ongoing viability of the project will be monitored against the Business Case.

B.5) The OGC recommends the Business Case should contain information covering five key aspects: strategic fit, options appraisal, commercial aspects, affordability and achievability.

B.6) Strategic fit: - the Strategic case: "This aspect of the business case explains how the scope of the proposed project fits within the existing business and IT/estate strategies (where relevant) of the organisation; and the compelling case for change, in terms of the existing and future operational needs of the organisation. Minimum content needed for this section: description of the business need and its contribution to the organisation's business strategy, objectives, why it is needed now, key benefits to be realised, key risks, critical success factors and how they will be measured; main stakeholders."

B.7) Options appraisal: - the Economic case: "This aspect of the business case, in accordance with HM Treasury's Green Book, documents the wide range of options that have been considered within the broad scope identified in response to the organisation's existing and future business needs. It aims to arrive at the optimum balance of cost, benefit and risk. Minimum content needed for this section: high level cost/benefit analysis of (ideally) at least three options for meeting the business need (where applicable); include analysis of 'soft' benefits that cannot be quantified in financial terms; identify preferred option and any trade-offs."

B.8) Commercial aspects: the financial case: "Where there is an external procurement, this section outlines the potential commercial arrangement. Most of this information will be produced for the Outline Business Case. Minimum content required for this section: proposed sourcing option, with rationale for its selection; key features of proposed commercial arrangements (e.g. contract terms, contract length, payment mechanisms and performance incentives); the procurement approach/strategy with supporting rationale."

B.9) Affordability: the financial case: "Assessment of affordability and available funding. Links proposed expenditure to available budget and existing commitments. Minimum content for this section: statement of available funding and broad estimates of projected whole-life cost of project, including departmental costs (where applicable)."

B.10) Achievability: the project management case: "This section addresses the 'achievability' aspects of the project. Its primary purpose is to set out the project organisation and actions which will be undertaken to support the achievement of intended outcomes including procurement activity (where applicable) or detailed study with existing providers. Minimum content for this section: high level plan for achieving the desired outcome, with key milestones and major dependencies (e.g. interface with other projects); key roles, with named individual as the project's owner; outline contingency plans e.g. addressing failure to deliver service on time; major risks identified and outline plan for addressing them; provider's plans for the same, as applicable, skills and experience required."

Business requirements

B.11) The overall length of local road networks is summarised in Table 1, based on data published by the Department for Transport (DfT, 2008) and the Department for Regional Development, Northern Ireland (DRDNI, 2008).

Table 1 Road lengths in the United Kingdom (2007)

Country	Number of local authorities (2008)	Trunk roads (km)	Principal roads (km)	Other roads (km)	Total local roads (km)
England	150	7,286	27,959	266,195	294,154
Wales	22	1,688	2,619	29,554	32,173
Scotland	32	3,227	7,481	48,870	56,351
Northern Ireland	23*	281*	n/a	n/a	24,684

Totals	227	12,482			407,362
* Local road service areas in Northern Ireland * Motorways and dual carriageway A roads in Northern Ireland					

B.12) Transport Statistics Great Britain (TSGB) reports that total public investment in road infrastructure in 2006/07 was £4,756 million, which included all "patching" (DfT, 2008a). The same source reports local government expenditure on roads in England, Scotland and Wales, divided into capital and current/resource expenditure. Northern Ireland Transport Statistics reports public expenditure on all Northern Ireland roads (DRDNI, 2008). This information is summarised in Table 2.

Table 2 Expenditure on roads in the United Kingdom

Country	Capital expenditure outturn (2006/07) £million	Current/resource expenditure outturn (2006/07) £million	Total expenditure £million
England	2,213	2,619	4,832
Wales	181	192	373
Scotland	299	373	672
Northern Ireland*	74*	30*	104*
Totals	2,767	3,214	5,981
* Structural maintenance 2007/08 in Northern Ireland, including reconstruction, overlay, resurfacing, surface dressing, patching, footways and bridges. * Routine maintenance 2007/08 in Northern Ireland, including verge maintenance, sweeping, gullies, signals, signs, markings, drainage, earthworks and fences.			

B.13) Maintenance expenditure on roads in England is also reported in a Transport Statistics Bulletin, Road Conditions in England (DfT, 2008c). This is summarised in Table 3.

Table 3 Maintenance expenditure by road class in England (2006/07)

2006/07	Structural (£million)	Routine and other (£million)	Total (£million)
Trunk roads and motorways*	504.6*	482.0*	986.6*
Principal roads	510.7	317.7	828.3
All other roads	1,203.3	722.3	1,925.6
Total, local roads	1,714	1,040	2,754
Total, all roads	2,218.6	1,522	3,740.6
Includes maintenance on bridges *Figures on an accruals basis			

B.14) From this, it would seem that local authorities in England spend of the order of £1,714 million on maintaining carriageways, footways and bridges each year. The relative proportions of expenditure on carriageways, footways and bridges vary between authorities. Typically, smaller urban authorities spend a higher proportion on maintaining

footways and figures up to 50% have been quoted. Whereas larger rural authorities spend a lower proportion and figures down to 5% have been quoted. Allowing for length, an approximate figure of 75% of maintenance expenditure on carriageways (i.e. excluding footways and bridges) would be of the order of nearly £1,285 million per annum, in England, over nearly 300,000 km of road length, or approximately £4,300 per kilometre per year.

B.15) The lengths of road receiving maintenance treatment by road class and type of treatment in England are reported in Road Conditions in England (DfT, 2008c). This is summarised in Table 4.

Table 4 Maintenance treatment lengths in England 2006/07

Treatment type	Principal roads		Other roads	
	% length	Estimated (km)	% length	Estimated (km)
Strengthening (reconstruction and overlay)	1.8	503	0.3	798
Resurfacing	2.4	671	0.6	1,597
Sub total	4.2	1174	1.0	2,662
Surface dressing and thin surfacing	3.4	951	3.7	9,849
Total	7.5	2,097	4.7	12,511

B.16) Annual expenditure on Pavement Condition Information Systems in England is summarised in Table 5.

Table 5 Estimated annual expenditure on PCIS in England

SCANNER surveys (minimum) Classified roads	≈ £m 2.686
CVI surveys (minimum) Unclassified roads	≈ £m 2.172
UKPMS licences (estimate)England, local authorities	≈ £m 1.0
Managing and using PCIS (rough estimate):	
Local authorities	≈ £m 1.0
Service providers	≈ £m 2.0
Total recurrent expenditure	≈ £m 8.85 (England)

B.17) It is difficult to find precise figures on pavement maintenance expenditure. However, taking 75% of "structural" expenditure in England (= £1,285 million p.a.) as estimated in paragraph B14, over nearly 300,000 km road length, this averages about £4,300 per km per year. However expenditure is actually concentrated on a very small percentage of the length each year. From tables 1 & 4 above, just under 5% of the network length, each year.

B.18) Making simple assumptions about the relative unit costs of strengthening, resurfacing and surface dressing / thin surfacing, it is possible to estimate the relative aggregate expenditure on the different types of treatment, summarised in table 6.

Table 6 Estimated treatment costs in England

Treatment	Length (km pa)	Unit cost (£ / km)	Annual expenditure (£m)
Strengthening	1,301	£303,426	£394,757
Resurfacing	2,268	£151,713	£344,085
Surface dressing	10,800	£50,571	£546,167
Total	14,369		£1,285,009

B.19) The scale of the potential benefits from a reliable PMS, able to deliver the asset management requirements for local authorities in England can be estimated approximately. Assuming capital expenditure can be targeted 1% more "efficiently, effectively and economically" than at present, the potential annual saving (or benefit) in England would be of the order of £12.85 million.

B.20) The costs of the proposed re-development of UKPMS as a new modular specification, including all three stages of implementation will be of the order of £6.38 million.

B.21) The potential benefits of the re-development, in the first year, would be of the order of double the investment in the re-development.

B.22) Over 10 years the potential benefits would be of the order of 20 times the investment.

B.23) Scaling the benefits to include the rest of the UK, pro rata by length of local road network, a 1% improvement would be of the order of £17.13 million, and the potential cost benefit ration would be of the order of 27 times the investment, over 10 years.

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1st June 2009