

Specifying Successful Standards

An industry enquiry into how standards and specifications can enable the UK to innovate, lower costs and improve whole life value of our infrastructure assets

This Industry Standards Group report has been prepared in response to the Infrastructure Cost Review programme (http://www.hm-treasury.gov.uk/iuk_cost_review_index.htm) and is supported by the Infrastructure Steering Committee (ISC), a group of leading clients, consultants, contractors and academics, chaired by ICE Past President Peter Hansford.

The ISC is the focal point for industry input into the work of the IUK Infrastructure Cost Review implementation programme.

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1. EXECUTIVE SUMMARY

For the UK's infrastructure assets to be built, maintained and operated effectively, client requirements must support innovation, drive best practice and improve whole life value. These client requirements are traditionally described in specifications and standards. However, too often poor specifications, a lack of asset management strategies and inconsistent approaches to the application of technical standards lead to inefficient, bespoke solutions that block innovation, add to whole life costs and fail to deliver the required performance and service improvements.

A Standard can be defined as an agreed, repeatable way of doing business. It is a published document that contains a technical specification or other precise criteria designed to be used consistently as a rule, guideline or definition. Standards help to make life simpler and to increase the reliability and effectiveness of many goods and services we use.

A Specification is a document used, by the Client or Designer of a specific project, to define the project requirements to a 3rd party, usually the contractor. The Specification may make reference to specific Standards or clauses in standards to address specific issues and can be performance based, which defines outcomes, or prescriptive which tells the 3rd party exactly what to do.

So the key question the Industry Standards Group has sought to answer is: what approach should clients take to set out their requirements through standards and specifications that will maintain high levels of operational effectiveness and safety, but deliver infrastructure assets with a reduced whole life cost?

The adverse impacts of the "traditional" approach to how standards and specifications have been used to set out client requirements are widely recognised by industry and clients alike. There is already evidence of a change in behaviour and process that is yielding significant reductions in duplication, redundancy and, quite simply, the sheer volume of "standards" that have been used in some sectors. The number of Railway Group Standards managed by the Rail Safety and Standards Board (RSSB) has been reduced by 46%, Network Rail has reduced their portfolio of standards by 80% and London Underground (LU) has reduced the volume of pages in their in house standards by 95%.

This is good news, but there remains much more to be done.

Whilst the group's investigation started by focussing on the high level standards, it quickly became clear that much of the inefficiency was not caused by British, European or other International Standards themselves, but by how these were interpreted by different clients. For example, Midland Quarry Products in Leicestershire produces asphalt for a range of local authority clients. Despite there being similar requirements, it has to produce 270 different asphalt mixes to meet the different clients' interpretations of the high level standards.

Providing industry with optimum simplicity, whilst not inhibiting innovation, must be achieved in parallel with protecting long term operational effectiveness and safety. Achieving the right balance between these parallel requirements is not straightforward, particularly where they can conflict with one another. Care must be taken to ensure that any process of simplification leads to reduced whole life costs.

Building on the success of change programmes in the transport sector, this report sets out a number of recommendations as to how clients can optimise their requirements, and suggests a number of pilot schemes to provide quantifiable evidence of the cost benefits through adopting a radically simpler approach.

This report makes four key recommendations to build on the progress made to date

1. Define Outcomes, not Inputs

Clients should clearly define their performance and output requirements and structure their specifications and standards to support this objective. For each standard or specification, the mandatory requirements should be clearly distinguished from text that is advisory or informative. Recognising that influence of safety, licensing, regulatory and levels of complexity will vary between sectors and projects, clients should assess, set and justify the level of optimum prescription that will deliver the lowest cost for each project consistent with whole life asset management best practice.

2. Enable Standard Assets, not Asset Standards

Different standards and specifications, or different interpretations of the same standard, that apply to the same asset class is uneconomic and can act as a barrier to standardisation. Clients should work together to enable standardisation of assets to deliver improved whole life cost and ensure that any interfaces between their assets/networks are made compatible and safe.

3. Empower Industry to Challenge and Innovate

Clients should seize the opportunity empower their supply chains in the early stages of projects, especially the procurement phase, by ensuring their requirements are clear, accessible and promote innovation. The client bodies should simplify their standards derogation process, work with industry to encourage challenge and make the resolution process faster.

4. Measure Benefits to drive Continuous Improvement

Client bodies should introduce a requirement in their in-house standards development process to demonstrate clear value for money in introducing new standards and requirements within standards. The value for money should be assessed considering safety, performance benefits, business risks and costs over the whole life of assets.

Below these four recommendations, there are 15 specific actions in Section 6 that set out a programme of activity for government, clients, standards bodies and industry. Through these actions, the Industry Standards Group believes that there will be measurable benefits to industry, clients and asset owners through optimising technical requirements to improve the cost effective performance of UK infrastructure assets in the transport sector. Many of these recommendations are also applicable to other UK infrastructure sectors. The ISG therefore recommends that the Infrastructure Steering Committee develop sector specific actions for all other areas of economic infrastructure to ensure that consistent and sustainable improvements can be delivered across all the UK's infrastructure assets.

2. INTRODUCTION

There is a widespread perception that in-house company standards in the UK for infrastructure construction can be complex, confusing and contradictory. There are too many standards, they overlap and conflict; and as a result this can lead to excessive cost and delay on projects.

The Infrastructure Cost Review Study, published by Infrastructure UK in December 2010, presented evidence that delivering infrastructure in the UK is more expensive than in continental Europe. A wide variety of issues contribute to this, and one of these is the application of technical standards and prescriptive client requirements which add cost and complexity to infrastructure delivery in the UK.

The need for and the opportunity to improve performance through a more consistent and risk based approach to setting technical standards is recognised by both industry and client groups. Consistency of engineering standards across client groups enables consultants and contractors to invest in developing skills, products and solutions to design, deliver and maintain infrastructure assets more cost effectively.

The Autumn Statement announced in November 2011 the formation of an Industry Standards Group (ISG), chaired by Terry Hill, Chair of the Arup Board of Trustees, to examine the case for simplification of procurement specifications and the removal of unnecessary technical standards in infrastructure; focussing initially on the transport sector.

The membership of the ISG was drawn from contractors, consultants, product suppliers and standards bodies. However, recognising the key role of clients, the group was supported by Department for Transport, Highways Agency, Network Rail, London Underground and the Rail Safety and Standards Board. The terms of reference for the ISG were to:

- Work with client groups to challenge any requirements for in house standards that drive additional cost or complexity above the requirements of national and EU standards.
- Ensure that any additional requirements can be demonstrated to provide a clear, quantifiable value for money, safety or operational benefit.
- Champion harmonisation of in house standards between client groups to promote greater efficiency and standardisation.
- Encourage client groups to simplify the procurement specifications and allow the supply chain to offer innovative and bespoke solutions where appropriate.

In their investigations, the Group analysed the different approaches to standards, specifications and client requirements across a number of representative asset classes in the transport sector, namely:

- Bridges and Structures
- Pavements
- Lifts & Escalators
- Track & Signalling

The Group explored the approaches transport clients in different sectors take to setting out their requirements and how they use standards and specifications to achieve their objectives. The review also investigated the approaches to derogations, departures and concessions and how such approaches can either support or hinder innovation.

The work of the ISG was informed by the recent Department for Transport Reforming our Railways Command Paper and the Value-for-Money Study in the rail sector, led by Sir Roy McNulty whose findings included:

- The problem is not always with the standards per se; standards were often used as an excuse for not thinking “outside the box”.
- Technical standards should match the need of the railway and its customers – not the other way round
- Standards were sometimes used as a defence mechanism to justify the development of traditional rather than innovative solutions.
- Where standards were not mandatory, decision-makers felt exposed if they did not implement them anyway. Decision-makers often use industry processes to “syndicate risk”, sharing responsibility for the decision. This makes the decision-making process long, costly and uncertain, which discourages people from offering innovative solutions that might involve derogations or changes to standards.
- The quantum of standards in total and those applicable to a particular project deterred new ideas.
- All standards were perceived to have the same weight rather than being categorised in order of importance or flexibility; and
- Duplication and overlap in the approvals process introduced cost and delay.

3. OBJECTIVES OF STANDARDS

Standards are simply a means to an end. Put at its simplest, a standard is an agreed, repeatable way of doing business. It is a published document that contains a technical specification or other precise criteria designed to be used consistently as a rule, guideline or definition. Standards help to make life simpler and to increase the reliability and effectiveness of many goods and services we use. Standards are created by bringing together the experience and expertise of all interested parties such as producers, sellers, buyers, users and regulators of a particular material, product, process or service.

Therefore the objective of standards is to ensure safety, consistency and compatibility; and promote competition, efficiency and value for money.

The principal issues that the group sought to address with standards and their use by clients in setting their requirements were how to:

- Improve their ease of use
- ensure that the volume of standards is minimised
- provide the right balance between prescription and flexibility
- ensure there is an efficient system to manage derogations and change; and
- reflect the fact that one size does not fit all

Standards vs Specifications

The group debated at length the relative impacts of both Standards and Specifications on cost effective delivery of infrastructure projects. The evidence suggests that the key barrier to improvement is not “Standards” per se, but how standards and specifications are used to set out a client’s requirements.

There can be a wide inconsistency in how the requirements of projects are set out. Each project will have performance objectives to meet and legal requirements to comply with. These project requirements will usually be set out through a combination international, national, industry and in-house standards. However, it is not always made clear which are mandatory and which provide guidance (and are therefore open to interpretation).

The group concluded that it was only through taking a holistic view of the setting of client requirements – which will include both Standards and Specifications -that measurable and sustainable improvements could be delivered.

Role of Standards

Standards and specifications play an important role in any industry where the consistent approach to the management of assets or business processes is necessary to deliver business outputs on a lowest whole life, whole system cost basis. This is particularly true for the UK rail industry, in part due to the significant range and age of technologies in operation and the number of individual organisations that form the rail industry. Additionally, the increasing introduction of European rail legislation, with the potential for cost escalation if not carefully managed, further highlights the need for making sure that an optimal standards regime is in operation.

In some industry sectors, the move towards performance (goal) based standards is becoming more prevalent especially in the standards developed for reference in the building and construction

industries. The use of such standards, within the appropriate environment, can offer significant advantages. There also appears to be an increasing tendency to adopt a performance-based approach to regulation in general, and there are good technical and commercial reasons for believing this approach is often preferable to more prescriptive regulation.

A critical review of standards at the requirements level can deliver significant benefits in terms of innovation and efficiency as it encourages challenge of existing principles and historic practices. A review at this more detailed level also helps to identify the absolute minimum requirements that are needed to manage a safe and efficient railway infrastructure, whilst increasing (risk based) flexibility around controls that are more appropriate for local conditions.

Summary of Rail Standards

Scope and Force of Standards

Throughout Sir Roy McNulty's recent rail industry 'Value for Money' review, it seemed that some of the most senior people in industry and government believed that standards exist solely for the purpose of managing safety, and that standards are the sole means by which safety is managed. In practice, safety is only one of the outcomes that standards seek to deliver; and beyond standards, there are many other facets to safety management.

Each type of standard exists for a purpose, which is not delivered by other types of standard. The RSSB state *"the aim of standards is to provide for the most cost-effective, efficient and compatible means of rail system delivery, whilst providing for a safe railway. To meet this aim, standards define and record what has to be done or how something needs to be done. This avoids having to 're-invent the wheel' each time the same situation occurs."*

If standards are thought of as managing risk, it is important that this is seen holistically – 'risk' does not mean safety risk alone, it means the risk of not achieving all business objectives including cost control, service efficiency, etc. So for example, when Standards Committees are considering Railway Group Standards (RGSs), they will take into account this range of business objectives.

Figure 1 below illustrates the hierarchy and complexity of the scope of standards in the GB mainline rail industry. Even within this figure, there are a number of interdependencies that are not wholly reflected – for example, how voluntary observations, contain direct references to mandatory requirements, and how legal requirements make reference to national or European standards.

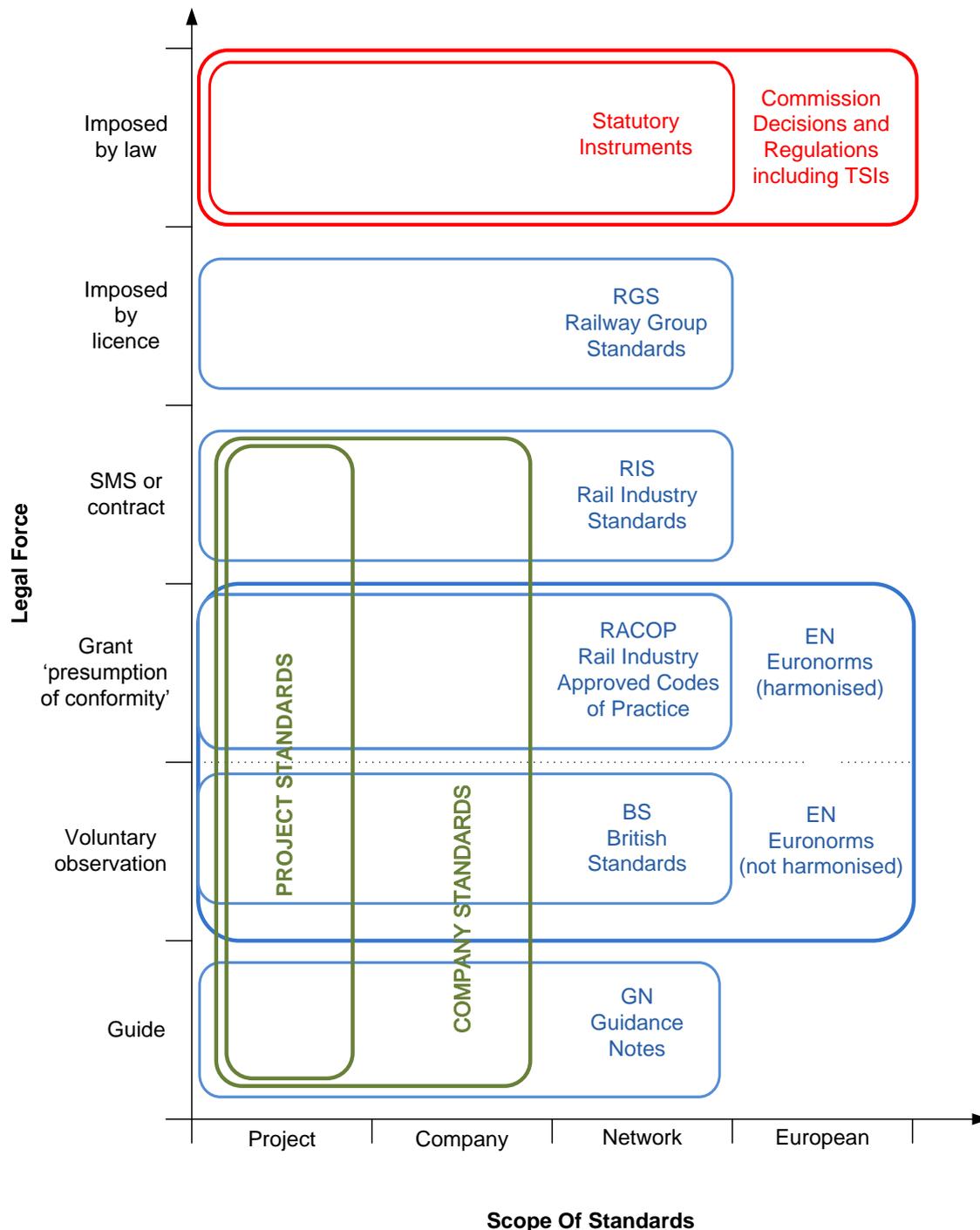


Figure 1- Scope and Force of Standards in the Rail Sector

Within the rail sector, the question of 'performance based versus prescriptive' standards is often raised. RSSB commented that the industry recognises that there must be clear reasons for having standards, and that each standard must deliver against those reasons. For RGSs, the reasons can be summarised as: Railway Group Standards are the documents in which the industry collectively defines how the different parts of the industry cooperate across interfaces. Standards can be performance based or prescriptive, and in the case of RGSs the correct approach for each situation is decided on by the industry itself through the Standards Committees, depending on which method will deliver the most cost effective results.

Because RGSs are about cooperation and compatibility, it is often the case that the content has to be prescriptive in the limited sense that it says something like “the distance between defined points on the rails will be X and the distance between defined points on the wheels will be Y” – with X and Y being mutually compatible. Without such ‘prescription’, the purpose of an interface standard would be defeated. However, RGSs are definitely not ‘prescriptive’ in the sense of specifying products or materials. Also, it should always be remembered that a deviation process exists for all RGSs, so even the prescription of parameters in the standard can be varied if an alternative approach is proposed that has the agreement of affected parties.

Figure 2 below illustrates Network Rail’s and RSSB’s approach to managing their respective hierarchy of requirements, in particular trying to categorise those requirements that are mandatory through to those that represent guidance based on good practice.

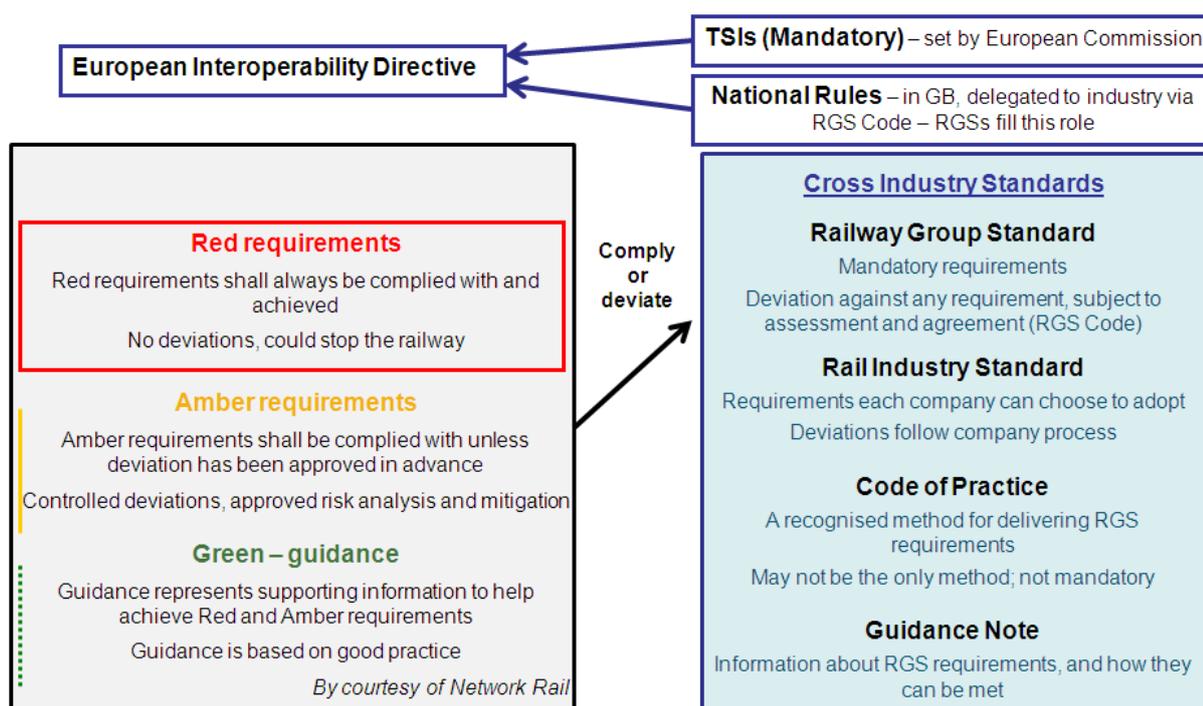


Figure 2: Railway hierarchy of requirements

Because of the work done over the past few years (particularly that which has focused RGSs on interfaces), the GB rail industry is in a strong position: it has a suite of cross-industry standards which are already quite well matched to what is required under the European legislative framework. However, to build on the work done to date to improve performance, there is still more to be done to amend requirements and communicate to industry, in the following areas:

- Amending the scope of RGSs in a revised RGS Code and Standards Manual, so that it aligns fully and explicitly with the European framework.
- Building on recent analysis, which established that requirements in RGSs are necessarily either national technical rules (NTRs) or national safety rules (NSRs), to develop and deliver a programme of work to ensure RGSs correctly reflect this status. For example, any remaining requirements in RGSs that should not be NTRs or NSRs will need to be withdrawn. Also, given that NTRs and NSRs fall into several categories, standards users will need to be advised as to which RGS requirements fit into which categories.

- Ongoing input to European Standards, often in parallel with work on RGSs, to make sure that a common European approach can be used in GB wherever this makes economic sense.
- Reducing the need for separate requirements in RGSs by using or referencing the requirements in TSIs and Euronorms wherever appropriate.
- Offering the capability of 'Rail Industry Standards' (RISs) to provide cross-industry but non-mandatory standards where this is more efficient than having multiple company standards.

All of these issues are covered in the Industry Standards Coordination Committee's Strategic Plan, and the work being done by RSSB and the Standards Committees in support of that plan.

Network Rail is articulating a similar philosophy in respect of its current initiative to rewrite Network Rail company standards. Some recent developments, such as the deepening of alliances between TOCs and Network Rail Routes, may strengthen the movement in this direction if they reveal the existence of multiple company standards covering similar issues.

Harmonisation with European standards is a key theme for all GB cross-industry standards. This is a two-way process: RSSB feed ideas from RGSs into European discussions, which makes it easier to achieve harmonisation of UK standards with the European ones when they are finalised.

One specific initiative is the current work on the industry's operational rules. The New Approach to the Rule Book (see www.rssb.co.uk/RGS/pages/rulebookandnational.aspx) is an important enabler for large scale operational changes that reduce industry costs and improve performance and efficiency. This will be achieved by:

- Introducing a streamlined operational change process leading to more effective industry decision making
- Bringing into company control those things that ought to be under company control (and not the collective control of the industry)
- Enabling Rule Book users to use, understand and navigate the Rule Book more easily
- RSSB supporting the industry to implement the New Approach in the most efficient way.

There is a very positive business case for this work even in terms of the direct costs and benefits – and of course the benefits it enables by streamlining operational change are substantially greater.

In respect of safety, it is noted that there really does need to be a shared understanding across the industry and the relevant government bodies, including DfT and ORR about what makes a good risk assessment, and how to make judgements about what is reasonably practicable. On the first of these points, the industry still has some way to go but RSSB is helping by providing training and guidance on risk assessment as well as the Safety Risk Model. On the second point, RSSB has provided substantial assistance to stakeholders in developing the guidance 'Taking Safe Decisions', which emphasises the need for proportionality.

Arguably one of the most useful things that could be achieved in the regulatory sphere is greater integration between the safety and economic regulation functions, which would place the focus firmly on a proportionate approach.

Summary of Highways Standards

Applicable standards for pavement design and construction

The key standards for pavement design and construction are produced by the Highways Agency (HA) and also endorsed and adopted by the other three trunk road authorities; namely Transport Wales, Transport Scotland and the Department for Regional Development Northern Ireland. There are no CEN or BSI standards for road pavements and hence the HA standards are effectively seen as “national standards”.

The HA standards (set out in the Design Manual for Roads and Bridges) and specifications (set out in the Specification for Highway Works) apply to the trunk roads network and are commended for use by local highways authorities where appropriate. The local authorities have also adopted the HA standards although there is no legal requirement to use them. The local authorities do make appropriate departures from the HA standards for use on local roads. To ensure consistency and to avoid burdensome bureaucracy the UK Roads Liaison Group (RLG), which includes all local highway authorities in the UK, has produced a document titled: *Departures from Standards: Procedures for Local Highway Authorities*. This document sets down the procedure to be followed in initiating, approving and documenting departures from the “declared standards”.

The County Surveyors Society (now ADEPT) has published – *ENG 6/94: Pavement Design Manual, 1994* which provides guidance for the design of pavements on local authority roads. A number of local highway authorities have published their own specifications for the design of roads within residential developments and industrial estates. However, for the design of primary roads the HA DMRB standards are used with suitable adjustments to account for traffic density and design life.

In a study commissioned by the Department for Transport in 2010, Atkins collated several standards, specifications and guidance documents produced by local highway authorities in the UK. These were reviewed, categorised and have been posted on the Chartered Institution of Highways and Transportation Transport Advice Portal: <http://www.tap.iht.org/>

Performance requirements, design parameters and material specifications

Performance Requirements

The standards should allow a highway authority to specify performance requirements for pavements that are consistent with their business requirements and asset management strategy.

The principal performance parameters for pavements are:

- **Safety:** while not directly related to the design of the pavement structure, the provision of a skid resistant surface is essential. The HA standard HD28/04 ‘Skidding Resistance’ covers the measurement of skidding resistance and specifies values to be achieved according to a risk-based site categorisation. HD36/06 ‘Surfacing Materials for New and Maintenance Construction’ specifies aggregate properties related to skidding resistance for the same site categorisation regime. The local highway authorities are likely to set their own criteria for skid resistance, principally due to the risk of legal liability in the case of an accident.
- **Traffic loading:** the ability of the pavement to carry the anticipated traffic loading over the required service life is the focus of pavement design; see ‘Design Parameters’ below. A highway authority may choose to specify different levels of design loading depending on anticipated traffic growth and affordability considerations.

- **Serviceability:** the in-service performance of pavements is monitored to identify the timing of maintenance required to prolong service life and measure the service levels experienced by road users. The HA standard HD29/08 'Data for Pavement Assessment' presents criteria for acceptable levels of rutting, surface texture and longitudinal profile. An equivalent survey regime has been developed for local roads which supports a condition indicator derived from measured rutting, surface texture, longitudinal profile and cracking.

Design Parameters

Pavement loading is considered as the cumulative loading from vehicular traffic over the desired service life of the pavement. The concept of the 'standard axle load' is widely accepted and used. The HA standard HD24/06 'Traffic Assessment' covers the assessment of design loading by providing a methodology to equate a spectrum of vehicle loading to an equivalent number of standard axles which also takes account of other factors such as traffic growth rates and lane distribution of commercial vehicles.

The properties of the natural subgrade have a strong influence on pavement design. HA standard IAN 73/06 (Draft HD25) 'Design Guidance for Road Foundations' provides both a prescriptive approach to selecting a suitable foundation based on subgrade properties and also (subject to departure approval) a performance-based approach which allows the designer to take direct account of the specific site conditions and materials to be used in construction.

The design of the main structural pavement layers is covered by HA standard HD26/06 'Pavement Design'. Based on a combination of analytical principles and observed performance this standard presents a chart-based approach to determining pavement thickness for a limited range of pavement material options. This approach includes implicit criteria and assumptions for desired state at the end of service life, probability of achieving service life and material properties. This standard does permit (subject to departure approval) the option to follow a more analytical methodology but places constraints on design philosophy and assumptions for material properties.

Material Specifications

The HA's Specification for Highway works and the Manual of Contract Documents for Highway Works (MCHW) Volume 1 provides specifications for pavement materials and construction processes.

As a policy, the specification of materials within MCHW 1 is by reference to the relevant harmonised European standards (BS EN). The UK paving industry – clients, designers and contractors – has participated actively in the harmonisation programme over a number of years with the aim of developing a suite of standards to remove barriers to trade across Europe. A basic tenet in achieving this has been the aim to move from a prescriptive specification to a performance-based approach, though the extent to which this can be realised is limited by the facility to characterise long term performance.

For example, the various parts of BS EN 13108 'Bituminous mixtures - Material specifications' present specification criteria while the parts of BS EN 12697 'Bituminous mixtures - Test methods for hot mix asphalt' cover the various tests to evaluate the relevant properties. In order to assist UK clients in implementing the European system of specification, UK industry representatives have developed and published guidance on how to specify materials commonly used in the UK; PD 6691:2010 Guidance on the use of BS EN 13108 Bituminous mixtures - Material specifications.

Consideration of whole life costs

The HA approach to pavement design presented in the DMRB has been developed on principles of whole life costing supported by extensive experience, data and research. One of the principal cost components relates to the road user disruption costs caused by in-service maintenance works. This has driven a design approach which results in the selection of long service lives and pavement construction materials that require minimal maintenance. For example, jointed concrete pavement construction is avoided as the joints require frequent maintenance which would lead to high user delay costs.

For new pavement construction the trunk road authorities use a design life of 40 years which would minimise whole life costs, although marginally increasing the initial costs. The local highway authorities may choose a lower design life for affordability reasons and this may also provide a minimum whole life cost option for a lightly trafficked route with several alternatives for which the disruption costs would be minimal.

Levels of prescription

The pavement design standards have sufficient flexibility built into them. Within each standard, the mandatory requirements are clearly highlighted by enclosing these within a 'box'. The majority of the text within the standards is advisory in nature and is recommended for the consideration of designers.

The standards also allow alternative design approaches to be used (subjected to departures process) where these can result in cost savings, while placing restrictions on the overall design philosophy and material properties to be considered.

There is no significant duplication or overlap between the standards used by the different highway authorities in the UK for the design and construction of road pavements. There is also no overlap with national or European standards. However, how these standards are interpreted by different contracting authorities may drive increased costs.

As an example of this, Midland Quarry Products in Leicestershire produces asphalt for pavements for a number of local authority clients. Simon Willis, the Managing Director of the quarry has advised that despite the relatively simple hierarchy of requirements, differing interpretations by clients has led to the quarry producing 270 different asphalt mixes.

Summary of Bridges & Structures codes

Bridge design and specification has undertaken very significant change over recent years as a result of the transition to Eurocodes (EN 1990 – EN 1999) and companion European Product and Execution Standards. Since March 2010 the use of these Standards has been a requirement for organisations bound by the Public Procurement Directive, which include the Highways Agency, Network Rail and Local Authorities.

The introduction of European Standards has brought greater alignment between client requirements, particularly where they are required to adopt such Standards as a result of European Directives or Regulations (e.g. PPD and CPR).

In the case of bridges, a consultation undertaken with the UK Bridge Owners Forum following the implementation of the Structural Eurocodes (EN 1990 – EN 1999) identified only a very limited number of areas where further rationalisation of design requirements is possible. An independent comparison of client design requirements for bridges had similar findings [Atkins].

Once all legacy schemes designed to former British Standards have been completed, the implementation of the Structural Eurocodes for bridge design will enable the number of client Standards to be reduced. For example, for the Highways Agency, this will lead to a reduction of around fifteen Standards in the Design Manual for Roads and Bridges.

This transition to European standards does however introduce its own direct and indirect costs, including the costs of managing change and the need for active UK participation in Standards development to promote alignment with UK practice and market need.

Performance Based Specifications

A performance based specification states goals and objectives to be achieved and describes methods that can be used to demonstrate whether or not the deliverables meet the specified goals and objectives. Contrast a prescriptive standard; which typically prescribes materials, design and management methods, without stating goals and objectives.

The main advantages of performance based specifications is that they allow users flexibility in choosing materials, design, construction and maintenance controls and options to meet the goals and objectives. The advantages of this approach can include:

- **Innovation**—performance based standards can help to encourage users to find optimum ways to meet performance criteria, which will result in building the knowledge base and developing the entrepreneurial spirit, which in turn supports efficient delivery.
- **New Technology**—performance based standards can allow earlier use of new technology. The users of these standards will be free to implement new technology as soon as it is approved, without waiting for standards owners to modify standards to permit the use of new technology.
- **Barriers to Trade**—performance based standards can permit the use of new or non-traditional parts and methods when their use meets the performance criteria. This widens the marketplace, giving more options from which to choose. Whilst the use of internationally recognised standards ensures interoperability and consistency avoiding the common issue of duplication between Standards industry requirements and regulatory interpretation at a local level
- **Transparency**—performance based standards have clearly stated goals and objectives that answer the question of what is to be achieved. For most prescriptive standards, the goals and objectives are implied at best and unknown at worst. For many rules in prescriptive standards, it is often very difficult to answer with certainty the question of what end function is to be achieved.
- **Efficiency**—the development and maintenance of performance based standards ultimately requires less effort. While initially it is more difficult to establish goals and objectives, the decision for inclusion or not of various requirements is much easier. Maintenance of standards can be simpler as well; for example a standard that describes the properties of acceptable materials of construction is much easier to maintain than one that lists acceptable materials by reference to various material specifications.

The degree to which a standard can be effectively performance based rather than prescriptive depends on the ease of judging whether or not the deliverables meet their goals and objectives before they are put into use. However, when performance based requirements lead to costly and

complicated testing procedures, or where it is not possible to define performance based requirements as a result of the complexity of the goals and objectives, prescriptive requirements are more appropriate. Similarly, it may also be inefficient for clients to have a number of different solutions to similar requirements, which may, for example, lead to increased asset management life cycle costs. There is therefore a trade off to be made between prescriptive requirements for standard assets and performance based standards.

Goal-based regulation

Goal-based regulation does not specify the means of achieving compliance but sets goals that allow alternative ways of achieving compliance. For example, "People shall be prevented from falling over the edge of a cliff" is goal-based. In prescriptive regulation the specific means of achieving compliance is mandated, e.g. "You shall install a 1 metre high rail at the edge the cliff".

There are acknowledged shortcomings of prescriptive regulation. The parties applying such regulations are only required to carry out the mandated actions to discharge their responsibilities. If these actions then prove to be insufficient to prevent a subsequent accident or incident, it is the regulations (or standards) and those that set them that are seen to be deficient, not the parties applying them, whose responsibility, in law, it actually is.

Prescriptive regulations tend to be a distillation of past experience and, as such, may become less and less relevant over time and at worst create unnecessary dangers in industries that need to be technically innovative. It is the innovator that is best placed to ensure the safety of their design, not the regulator. Clearly, prescriptive regulations and standards are unable to cope with a diversity of design solutions.

Prescriptive regulations and standards encode best practice at the time they were written and rapidly become deficient where new methods are developed, e.g. with evolving technologies. In fact, it is quite probable that prescriptive standards are preventing the rail industry from full adoption of current best practice. It follows that there are clear benefits in adopting a goal-based approach as it gives greater freedom in developing technical solutions and accommodating different standards. BSI has been urging a lighter touch regulatory process allowing goal based standards created through a robust consensus process as the best way forward.

As any industry moves towards adoption of the goal-based approach, the relevant standards will need to describe broad, over-arching goals against which the safety, competence, and experience of people can be verified at design and construction stages and during operation and maintenance. At each stage of construction, operation, and maintenance, it should be possible to demonstrate, and more importantly, to verify that the infrastructure is being managed in such a way that complies with the goal-based standard requirements.

Levels of prescription within standards and procurement specifications

A number of company standards are seen to be too prescriptive in nature. Where, the requirements are not appropriate for a particular project, applying the standards in a prescriptive way prevents innovative and cost effective solutions being developed. On the other hand, lack of standards or if the standards are too lax, can lead to bespoke solutions being developed which adds to design costs, discourages competition, and in some cases can introduce errors leading to failure and accidents.

Therefore for each project there is a point of optimum prescription which will minimise whole life costs.

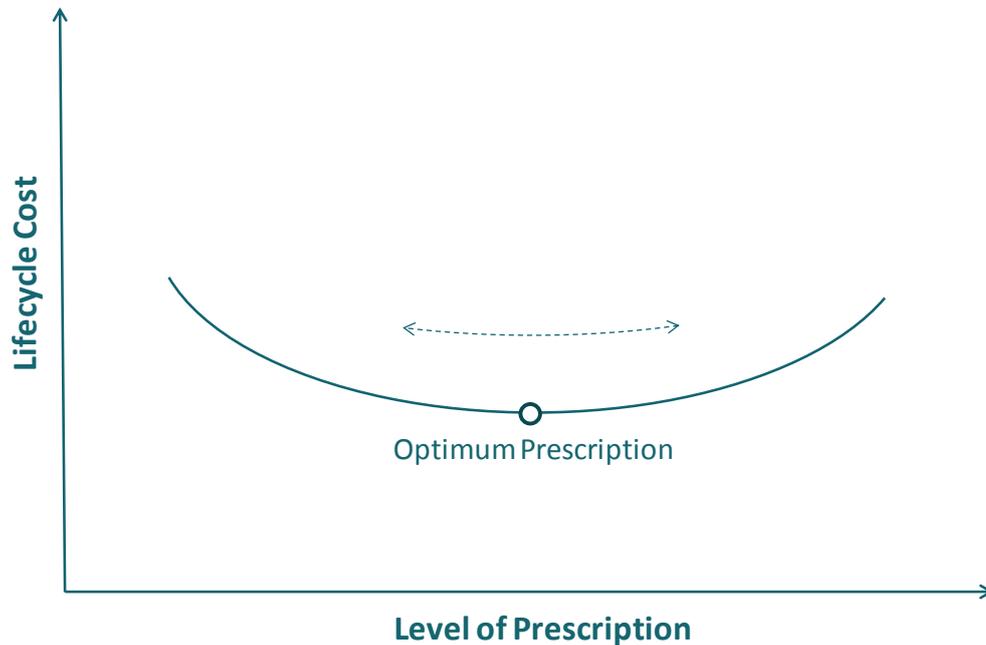


Figure 3: Illustration of the impact of level of prescription on lifecycle cost

The influence of level of prescription on total lifecycle cost is illustrated in Figure 3 above. The shape of the curve and “position” of optimum prescription will vary between different types of project, and will be influenced by both client and supplier capability. For example, a highly complex, safety critical project is likely to require a higher level of prescription to achieve its objectives than a simpler, repeatable project. Clients should therefore ensure that they fully consider the impact on life cycle cost of how they set out their requirements.

Equally, the position of the point of optimum prescription may change as markets, technologies and capabilities mature. For example, the HA adopted very prescriptive standards and specifications for roadside technology and systems when they were first introduced on roads from the late 1980s and created a bespoke provision for the strategic road network. However, as the market matured, suppliers were able to provide a more integrated approach that was available to highways authorities which could also take account of the fast pace of development in the technology field. This was recognised by HA who has adopted a less prescriptive approach to allow newer and innovative products and systems to be adopted.

4. EVIDENCE BASE

How application of Standards influences whole life cost

Escalators

The group focused their investigation on escalators building on the anecdotal evidence indicating that there were significant potential savings from simplification of standards and client requirements. The team was told that an escalator for LU costs in the region of £1 million while a similar escalator for the Berlin underground costs £200K.

Through the investigation, there were a number of reasons offered as why LU escalators need to be “different” from other metro systems worldwide:

- London has a higher volume of passengers than any other underground system (last year LU recorded 1.171 billion passenger journeys)
- The underground stations in London are generally deeper, for example the escalator at Angel station on the Northern line is 60m long. In many other European countries they are shallow and can be constructed using “cut and cover” techniques. This allows new escalators to be wheeled in; this is not the case with LU.
- All parts are of a higher specification, heavier and harder wearing
- Machine rooms are used instead of motors being an intrinsic part of the escalator
- Maintenance differences. For example:
 - Most of the maintenance work can only be carried out from after the last train and until 30 minutes before the first train, a 4 hour window – so increasing worker costs
 - Maintenance is done by specialist workers.
 - The demand for LU services is such that stations cannot be closed for refurbishment of escalators, unlike the Paris Metro.

Whilst there are a number of operational and legacy reasons why existing LU escalators and lifts are bespoke and hence more expensive than for other nominally similar operators, this does not mean there are not opportunities for simplification and reduced whole life costing for new escalators and lifts.

These factors drove LU to undertake a fundamental review of their in house requirements that were driving higher costs. By challenging its own specifications, it enabled LU to develop a new modern specification for their escalators.

This process led to a significant simplification of their requirements. For example, using the “old” LU specification, an escalator was installed at Oxford Circus at a cost of £1.7m. Under their new requirements which allow greater use of standard rather than bespoke products, a similar sized escalator was installed at Charing Cross for around £0.8m – saving of around 50%.

The Crossrail project offered LU the opportunity to increase savings compared with the original bespoke proprietary LU escalator design. The Crossrail procurement team included key personnel from the Olympics where common purchasing arrangements to clear standards had radically reduced costs, increased innovation and delivered successfully. As with the Olympics, getting early and sustained interest from the supply chain was seen as crucial in cutting costs and risks. With 57

escalators needed – approximately the equivalent to seven years of normal LU purchases – there was sufficient size to get a wide range of suppliers interested, particularly as the design was 90% standard (based on EN11) with bespoke additions e.g. EMC protection.

The benefits to Crossrail were not just on purchase costs but included reduced civils cost as the escalators were smaller in cross section so needed smaller diameter tunnels, reduced risks on handover through early commissioning, 30 years of maintenance from the supplier and performance level in terms of availability and mean time between failures that exceeded existing LU escalator performance. The target cost for the Crossrail team was 25% less than the lowest equivalent UL escalator and the team actually achieved better than 30% savings.

The team believe that the close cooperation between LU and Crossrail, combined with LU's own internal cultural changes, were the keys to being able to move from proprietary bespoke to formal standards-based escalator design and procurement.

Overall this led to savings to LU on escalator costs in the region of £87 million and a 25% saving to Crossrail on overall escalator provision.

Similarly for BAA at Terminal 5, these escalators are 95% standard, are high volume, in near constant use, and have similar maintenance timing problems i.e. cannot be easily taken out of use. However, in most cases the terminal design allows for passengers to use both lifts and escalators and the access issues are far less onerous due to the terminal design. This allows more standard designs to be used. Therefore designing for access and alternative passenger routes is fundamental.

Across the industry, there is room for improvement in accessibility to the various proprietary standards for LU, DLR, Network Rail and Crossrail. Better accessibility will allow comparison of methodologies, metrics and definitions across the standards, thus leading to opportunities to harmonise in relevant areas.

Bridge Assessment

In considering areas offering potential for cost savings for bridges, the focus of the group has been on those areas under UK control. As such, areas where there is potential for improvement at a European level have not been specifically explored. However, it is widely recognised that cost savings may be achieved through improving the ease of use of some European Standards, and it will be important that the UK continues to play an influential role in ensuring that Standards development at an international level aligns with UK needs.

Bridges are extremely long life assets. In the UK, they have a design life of 120 years. Furthermore, a very significant proportion of the current UK bridge stock has been in service even longer, particularly in the rail sector. As a result, the option to try to transition to performance based requirements brings with it very considerable challenges, and would require significant changes in procurement practice to be cost effective.

Although cost savings can be achieved from improving the ease of use and reducing unnecessary or over-constraining requirements in Standards and Specifications, in the case of bridges one of the greatest opportunities for achieving cost savings concerns enhancing the quality of application of Standards for bridge assessment. The load assessment of existing structures is essential to ensure the ongoing safety of bridges, and over the past 25 years there has been a major programme of bridge assessments in UK. In contracts to design, where the cost of a modest degree of conservatism is typically very small, in assessment, conservatism can lead to adequate structures

being condemned as unsafe leading to unnecessary strengthening or replacement, with significant cost, environmental and social impacts.

A comprehensive audit undertaken in 2003 by Parsons Brinckerhoff highlighted 'conservative or inappropriate analysis' as the most common reason for reported assessment failures of primary structural elements. The application of rigorous and appropriate assessment methods, including targeted testing, has been demonstrated to save many millions of pounds.

In connection with bridges, the following opportunities for whole life cost savings have been identified:

- **Achieving improved alignment between client design Standards for bridges**

Very considerable effort has been invested successfully by major client organisations to support the transition to the Structural Eurocodes (EN 1990 – EN 1999) for bridge design, and in associated areas of technical governance. As a result the degree of alignment between client design Standards for bridges is already high, and the differences that exist are largely thought to be justifiable. However, some differences and some gaps do remain. There would be value in reviewing the implementation requirements of the principal client organisations (HA, NR, LA, LU) and identifying those areas where some greater alignment could be achieved.

- **Achieving improved alignment between client Specifications for bridges**

Although the introduction of the Structural Eurocodes has also brought some greater alignment between construction specifications for bridges through the need to adopt European Execution Standards such as EN 1090 and EN 13670, there remain significant differences between clients' requirements. Whilst it is understood that there are efforts underway to improve alignment, bringing enhanced focus to this effort has the potential to remove some duplication and deliver cost savings.

- **Enhancing quality of application of bridge assessment Standards**

Significant cost savings can be achieved if assessment standards are applied using the full array of analysis tools that are available and with a high level of expertise.

- **Improving the basis of Standards and specification for bridge management**

A very significant proportion of the UK's spend on bridges is concerned with the maintenance and management of existing structures. Standards exist for the management of structures, including inspection and maintenance, and over recent years considerable investment has been made in developing related guidance such as the Code of Practice on Bridge Management and the Bridge Inspection Manual. In parallel, major client organisation are working to implement integrated asset management regimes through which funding decisions can be prioritised rationally across asset types.

Given the significance of the spend in this area and therefore the potential for cost savings through better targeting of resources reflecting short and longer terms needs, it is vital that the basis for decision making is robust, and there is confidence in the integrity of data and in understanding the real durability performance of structures. Further work in this area is needed.

- **Streamlining Standards for the rehabilitation and modification of existing structures**

Bridge assessments are undertaken to assessment standards, but the design of any result modification is typically undertaken to Eurocodes, albeit that the Eurocode requirements often need to be adapted. The difference between the requirements of assessment and design standards lead

to challenges and inefficiencies in developing and agreeing the design approach for structural modification and strengthening.

Drawing the requirements of assessment standards and the Eurocodes more closely together will reduce some of these difficulties, and their associated cost implications. In particular, there is scope to align the limit state philosophy and loading models between assessment and design standards without making assessment requirements any more conservative.

Furthermore, there are provisions included within the Eurocodes that are extremely powerful in achieving realistic assessment ratings, with the potential to deliver major cost savings. The direct incorporation of such methods into UK bridge assessment Standards will foster their more widespread use, streamline the agreement of their basis for application, and reduce the risk of mixing provisions from different standards.

It is essential that the provisions of bridge assessment standards reflect the stock of bridges to which they are applied, and therefore, given the different predominant types of structures on the road, rail and London Underground networks, different clients have different needs in relation to the scope of their assessment standards. At present, the Highways Agency, Network Rail and LU have different assessment standards. Considerable investment has been made in the development of these standards and it is considered that working to consolidate this knowledge base would be worthwhile.

Examples of benefits resulting from rationalising standards

Network Rail

By the middle of 2004, Network Rail had completed the transfer of nearly 16,000 new employees into the business. Bringing the maintenance of the rail infrastructure in-house more or less doubled the size of the organisation but also increased the standards portfolio by more than 500%. In addition, the disaggregation of Railway Group Standards during the last 5 years has also added significant numbers of 'infrastructure management' standards to the Network Rail portfolio.

The introduction of 'one company – one way' principles in Network Rail was designed partly to aid integration of maintenance routines and practices, and it also presented an opportunity to reduce the inherited portfolio of standards. A new approach to standards management with a specific focus on removing duplication and redundant practices has helped to reduce the standards portfolio by *more than 80%*. The figure below charts the progress made by Network Rail in reducing and simplifying their portfolio of standards.

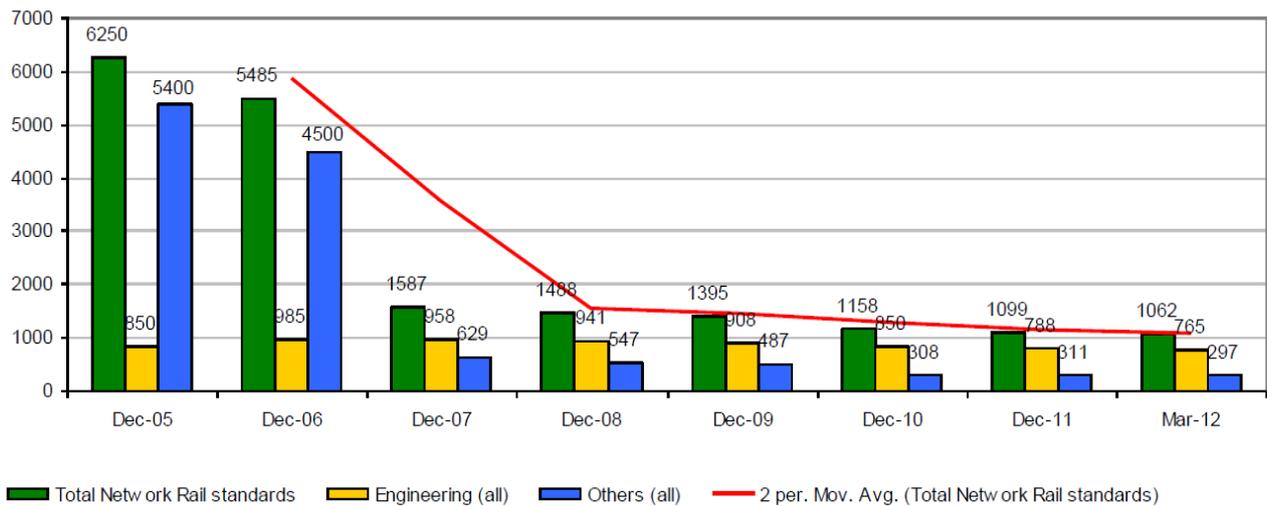


Figure 4 – Network Rail Standards Portfolio

Historically, Network Rail standards had evolved over time without a coherent, logical structure. As part of the move to performance standards, a new framework based on established risk management and asset management principles (PAS 55) has now been implemented.

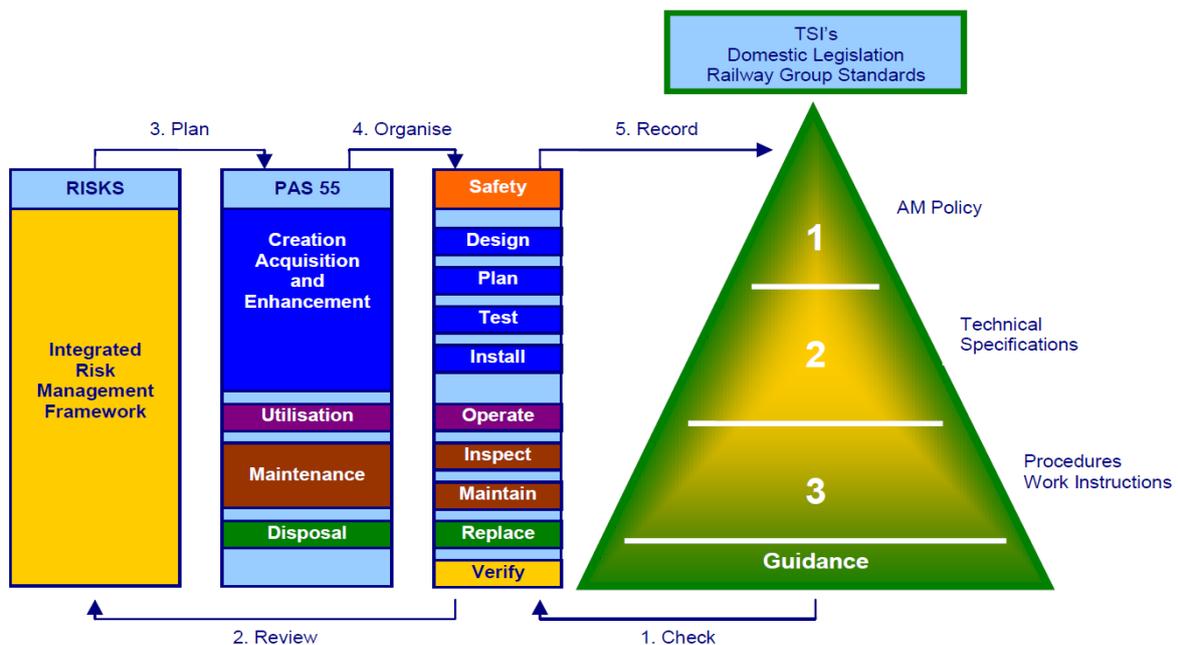


Figure 5 – Risk Based / Asset Management Standards Framework

This new framework was designed to help the organisation to develop requirements that are designed to control and/or mitigate against identified risks. These requirements (risk controls) are then incorporated into the asset management lifecycle stages, which in turn are described within the corresponding Network Rail standards.

Network Rail's re-write campaign is a programme of activity is currently being developed to enable its standards requirements to be re-written within the guidelines of the new framework. Where appropriate, industry agreed standards (EN, ISO, etc.) will be adopted. Where necessary, Network Rail standards will be re-written as performance requirements with the flexibility needed for efficient implementation appropriate to local environments and conditions. All new and revised Network Rail standards will include the RAG classification. Two recent examples of the new approach are:

1. **Inspection and Maintenance of Track:** this new standard enables local risk-based decision making and provides opportunities to reduce costs e.g. inspection of assets determined by level of known risk saving up to £5mpa, direct savings from reduced train delays up to £3mpa. It creates opportunities to reduce costs by up to £50m during CP5.
2. **Modular Signalling:** this new standard incorporates lessons learned from pilot installations and provides opportunities for replacement signalling schemes to be delivered at costs of up to 50% less than traditional schemes.

Rationalisation of Standards by London Underground

London Underground (LU) has been on a 10 year journey of rationalising its internal standards, and although this work is still ongoing it has resulted in a suite of company standards that reflect many of the recommendations set out in this report.

LU commenced a review of their business processes and standards in preparation for the PPP contracts with Metronet Rail and Tube Lines. This review found that many of the standards at that time were:

- Outdated
- Written in different styles
- Specified different requirement levels
- Were sometime conflicting, or
- Had notable gaps, especially in relation to operational requirements.

Many of these deficiencies could be traced to the development of these standards as they had grown over the years, sometimes in response to discrete safety incidents rather than in response to strategic objectives. This in itself is not surprising as evidence gathered through this IUK review has found this to be a typical reason for burgeoning company standards.

The plan for LU's programme of standards improvement (2001-2004) was written such that it could be incorporated in Consultant's commissions (where used) as well as LU in-house standard creators to provide all the necessary information on methodology and ensure collaborative working across the whole Company. The main thrust of this programme was to create a coherent, output-based, set of standards, which became LU's Category 1 and Category 5 Standards as outlined in the table below:

Category	Scope / Intention
1	These are mandatory standards on LU, all suppliers and anyone else working on or accessing the LU network. These reflect the LU environment and are additional to legislation, Euro Norms, British Standards or any other International Standard that LU may select. They are mostly output based and set LU's minimum safety, technical and performance constraints.
2	These standards either offer solutions to the output based Category 1 Standards or determine LU's minimum requirements in the absence of an overarching Category 1 Standard. They are prescriptive rather than output based.
3	Guidance purposes only – not a Standard

4	Redundant – no longer required
5	These are mandatory standards and apply to LU only. They mostly determine LU's Business requirements.

Table 1: London Underground categorisation of internal company standards

This categorisation of standards is aligned with the hierarchy of project specifications as set out in Figure 6, which provides a sound basis to achieve the optimum Level of Prescription illustrated in Figure 3.

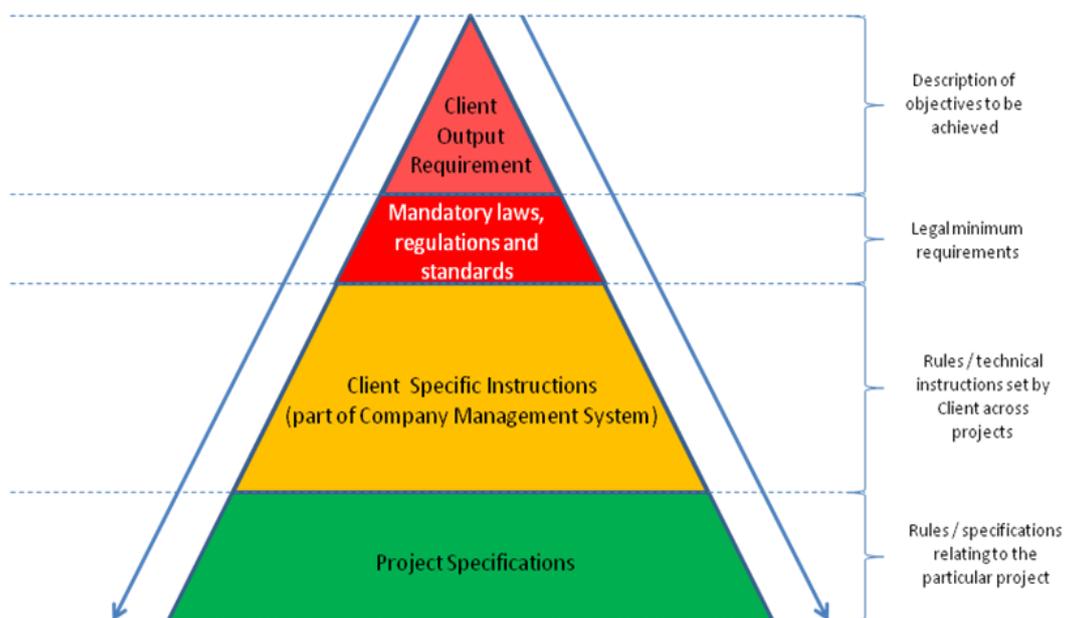


Figure 6: Hierarchy of project specifications

In developing the Category 1 standards the initial focus was to create high level (1 page) policies from which the standards could then be linked. This enabled the subsequent standards to be focused on output based requirements, with a default position being the adoption of national and/or international standards where appropriate.

Following the return of the former Metronet Rail organisation and work into LU, this programme has moved on to reviewing and streamlining Category 2 standards that Metronet brought with them. The drivers for this is to ensure that they are up to date and do not unnecessarily constrain suppliers. For example, maintenance regimes under this new approach are now far more risk based than the previous time interval regimes, and as a result are providing resource savings through greater efficiency.

Although the initial need to rationalise standards arose through the external stimulus of the formation of the PPP contracts, the subsequent maintenance and indeed expansion of the LU standards rationalisation programme has been driven by a clear view that there are process and indeed financial benefits. It is widely agreed a streamlined, coherent suite of standards provides the best platform for improvement. In addition to the examples in other sections of this report in the last year alone LU has authorised 250 individual changes to standards. Three examples are set out below.

- **Civil Engineering earth structures.** Implementation of a new design approach to encourage designers to consider all types of failure mechanism and promotes the use of directly derived material parameters in a worst credible failure mechanism, which will lead to more economic remedial works design or remove the need for works all together. A major benefit of the new approach is that it allows site specific observations to be integrated in a coherent framework for selection of appropriate geotechnical parameters. The new approach may also lead to significant benefits in prioritisation of earth structure assets for remediation in the future by considering which are most susceptible to progressive failure over time.
- **Track:** A progressive and carefully controlled move to risk based inspection requirements, offering opportunity costs to target resources where they are most effective thereby increasing efficiency and reducing the number of derogations by a third.
- **Key processes mandated on suppliers.** Re-organising the way the Company manages compliance to LU specific fire legislation to offer the quickest possible route for our suppliers to design and manage their work to ensure these legal requirements are met.

Regardless of whether a precise financial return can be determined it is clear that LU has achieved a notable reduction in total number of standards, and rationalisation to reduce overlaps and cover gaps. In doing so, LU has gained some insights that others undertaking such standard rationalisation programmes can learn from:

- Recognise that not everyone will be bought into output based standards, as some will feel that there will be a loss of control
- Be ready to enable collaboration between different corporate groups where conflict could occur due to conflicting / overlapping standards
- Split down to reflect areas of responsibility. Technical Leads were responsible for identifying /procuring technical support and writing technical brief which went with generic brief
- Allow different technical areas to take different approaches based on the condition of their current standards. But place all within the same overall framework:
 - Identify what the standard set should look like
 - Identify what is required to support a risk based approach
 - Undertake a comparison with what exists
 - Force identification of overlaps and where allocation of responsibility should lie.

Finally, it is critical to ensure there is recognition of, and focus on, the behavioural aspects of getting people to let go of their control of standards. It is therefore an important leadership function in organisations to ensure these behaviours are enabled and supported at the highest levels.

5. REALISING OPPORTUNITIES FOR COST SAVINGS

Framework for Rationalising and Harmonising Standards

The industry recognises that there must be clear reasons for having standards, and that each standard must deliver against those reasons.

The rail industry – including Network Rail, the freight and passenger operators, and their supply chains – define the cross-industry standards to which they all work. The standards (RGSs) are mandated by the ORR via licence conditions, but the content of each standard is decided by the industry itself. Railway Group Standards are the documents in which the industry collectively defines how the different parts of the industry cooperate across interfaces. They exist to provide for the most cost effective, efficient and compatible means of rail system delivery, whilst providing for a safe railway.

All RGSs are reviewed by Standards Committees on a regular basis and changed if necessary, taking into account experience of using the standard including derogations granted. A current example relates to the standard which governs platform width at stations. The large number of station enhancement projects being carried out in the industry during the current Control Period has resulted in the Infrastructure Standards Committee granting around 50 derogations. The existence of a large number of derogations does not automatically mean that the standard should be changed, since the variety of topographical constraints at individual sites means that no single standard could be universally applicable. However, the Standards Committee is now reviewing the data to consider whether any changes to the standard would indeed be appropriate.

By applying these principles, the number of RGSs has now been reduced from 227 to 133 – over 45% - and the number of individual requirements contained within RGSs has been reduced by a larger proportion.

The review of company standards across different asset types and client bodies has highlighted that standards are often not properly structured. Diverse sets of requirements are included within a single document and it is often not clear what within a standard is mandatory or is purely guidance. The term “standard” is also used loosely to apply to a whole range of company processes and procedures. All standards are given the same weight regardless of the level of risk they manage.

In order to allow an appropriate balance between flexibility and prescription that is appropriate to the level of risk, the following six point framework is recommended for rationalising in-house company standards.

1. Alignment between national and company standards and specifications

It should be recognised that the main purpose of standards is to ensure safety, consistency and compatibility; and promote competition, efficiency and value for money. The project procurement specifications have the same objective on a specific project. Often the standards and specifications are not aligned with the overall business objectives of the organisation and its asset management policy and strategy.

Each organisation is required to comply with the national infrastructure policies, national and international laws, regulations and standards. The in-house company standards should enable the organisation to achieve compliance with such mandatory requirements.

It is therefore strongly recommended that each client body should review its existing standards, specifications and other business process documents and ensure their alignment as illustrated below in figure 7.

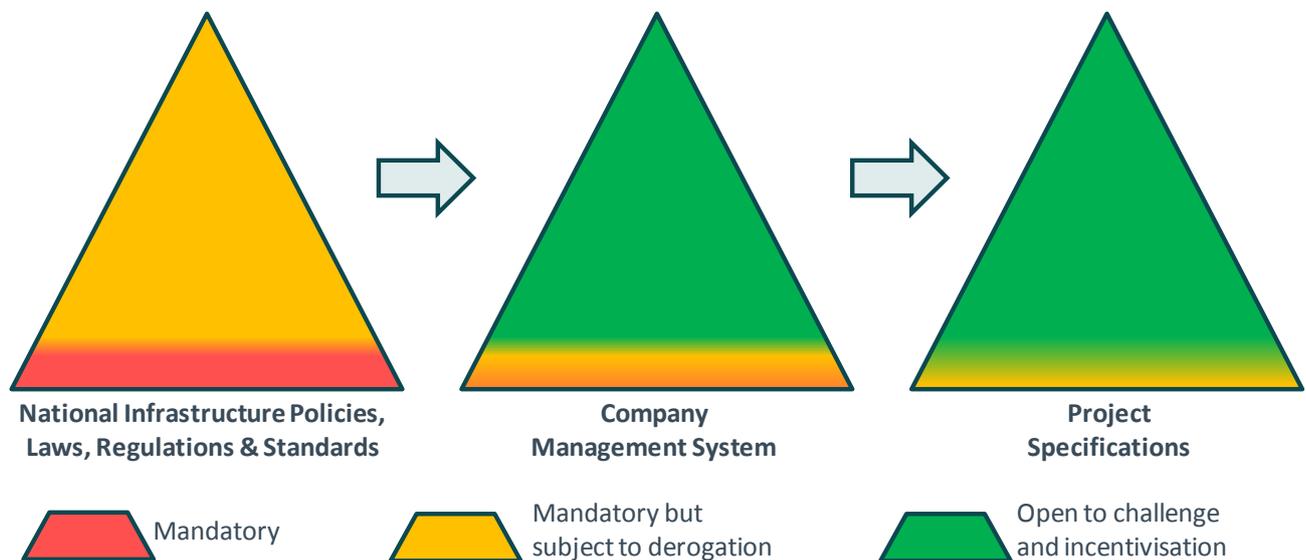


Figure 7: Alignment between national and company standards and project specifications

2. RAG grading of documents

It is important to grade standards documents (and the sections within these documents) so that the users are clear which of these are mandatory and which are advisory or open to challenge. It is recommended that the following RAG coding is used for this purpose:

- **Red** – those that are mandatory and not subject to derogation
- **Amber** – those that, while mandatory, could be subject to derogations and amendment
- **Green** – those that represented best practice but are not mandatory, open to challenge and risk/reward sharing incentivisation

The client bodies should grade their policies, engineering standards and other process documents according to the above scheme.

3. National infrastructure policies, laws, regulations and standards

The UK Government is introducing a number of new policies or making changes to existing policies across different infrastructure sectors to support national economic development and competitiveness. As part of this, changes are also being made to the regulations and regulatory mechanisms. It is very important that all the applicable policies, laws, regulations and standards for the national infrastructure are aligned and support the delivery of the national infrastructure goals and objectives as set out in the National Infrastructure Plan, 2011.

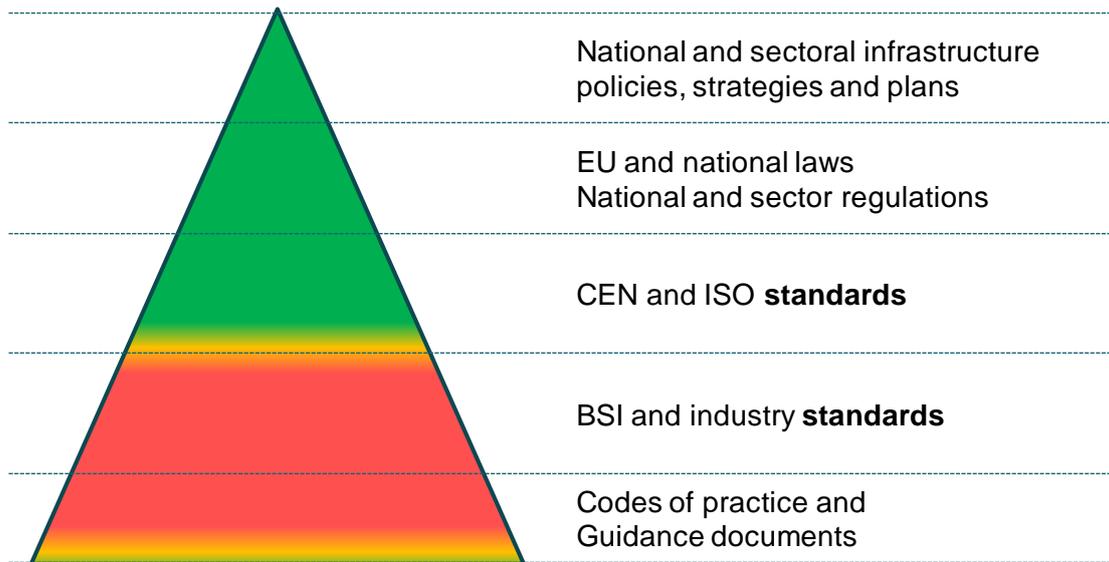


Figure 8: Alignment of national infrastructure policies, laws, regulations and standards

4. Company Integrated Management System documentation

Every organisation needs and uses a suite of documents to control its activities in delivering its business objectives. Major infrastructure organisations have typically developed Integrated Management Systems for asset management, quality management, health & safety management and environmental management. Standards such as BS PAS 55 and the emerging ISO 55000 suite of standards provide the specifications for an Asset Management System that supports the achievement of organisational objectives through the effective and efficient management of infrastructure assets.

As illustrated in the figure below, Integrated Management Systems typically adopt a hierarchical structure for organising the various policies, strategies, plans, standards, business processes, procedures and records used by an organisation.

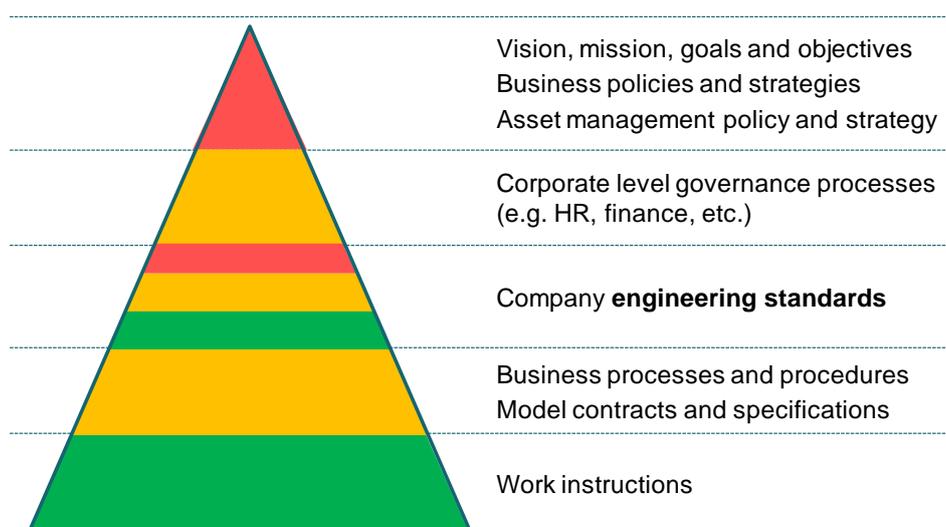


Figure 9: Alignment of Integrated Management System documents used by an organisation

Engineering standards, model contracts and specifications should be aligned with and enable the delivery of the company’s asset management policy and strategy.

5. Structure of engineering standards for particular asset class(es)

Some engineering standards are not appropriately structured to provide clear linkages between different standards that apply to a particular asset class or a group of similar asset classes. Often different types of requirements (e.g. performance, loading, materials, etc.) are included within a single document. This makes them inflexible when applying to a wide range of projects.

It is recommended that as standards are created, revised or re-written, they should be grouped to set out the basis of design, performance standards, loading standards, design standards, material specifications and construction specifications to ensure clarity in use or for challenge in line with the structure set out in Figure 10 below.

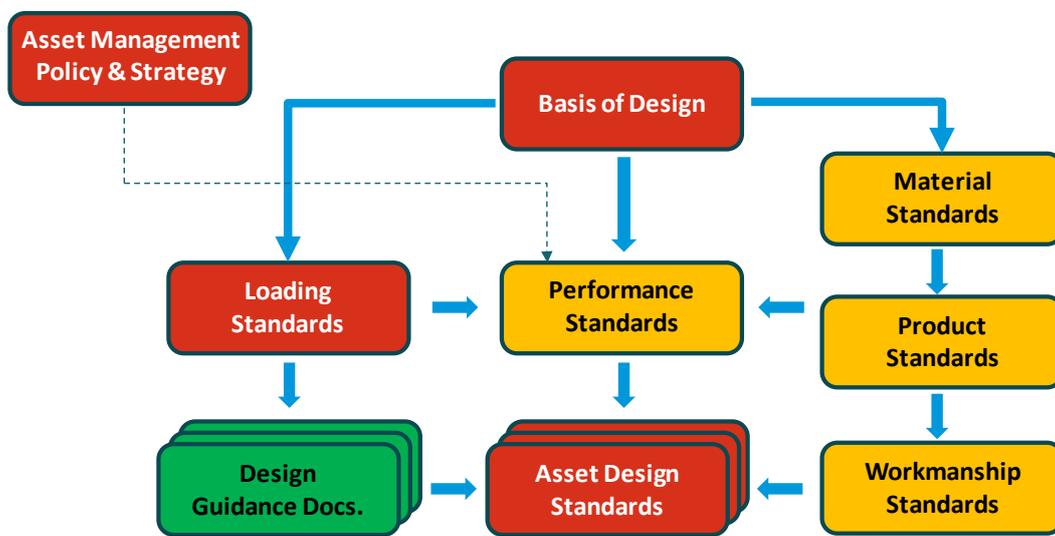


Figure 10: Structure of engineering standards for a particular asset class

The ‘Basis of Design’ standard provides the overall framework and specifies the fundamental principles for design; for example the limit states to be considered, loading types and their combination, safety factors to be considered, etc. This document forms the basis for the development of other standards for the asset class.

The above categorisation would allow client bodies to decide which of these standards they should retain ownership for and which ones would be best left to the trade bodies and supply chain to develop; possibly under the auspices of BSI.

The client bodies should preferably retain ownership for only the ‘performance standards’ which define the performance parameters relevant for the asset class. The performance standards should provide flexibility to adjust the ‘performance parameters’ for individual assets/projects depending on the functional needs and potential risks; and not impose the same requirement in every case.

6. Risk and performance based approach to standards

Transport infrastructure assets are typically long life assets and they function as part of a networked system which may be managed by different organisations (e.g. Network Rail, rolling stock owners and train operating companies). It is important that the assets are designed, constructed, operated and maintained to maximise the overall performance of the system as a whole.

The engineering standards should be goal-oriented and less prescriptive, which is the approach taken by modern standards developed by BSI, CEN and the ISO. The standards should seek to optimise performance, cost and risks on a whole life, whole-system and whole industry basis; and ensure compatibility at the interfaces.

Standards Derogation Process

Even allowing for the changes proposed in regards to the relationship of standards documentation, levels of prescription and clarification between mandatory and guidance requirements, there should remain scope for standards to be challenged in order to stimulate innovation. This process is referred to by a number of names; derogations, deviations, departures, concessions. However, regardless of the name, this is a key process that supports challenge, innovation and continuous improvement in delivery.

However, a common complaint from designers, builders and suppliers is that under current practice it is challenging to obtain a Standards change by way of Departure or Derogation as a result of a first submission. Indeed, it appears that it is easy to default to a rejection of such requests especially where there are differing viewpoints available. Also, quite often numerous submissions are required to achieve the objective. This is costly from both a time perspective and from an economic perspective. Key areas to address in this regard are:

Process:

- Speed of response. Opportunities are often not even attempted as a result of the length of time that the process takes (sometimes perception, sometimes real).
- Level of resources required for reviewing submissions. These are often underestimated and as a result when subsequently realised delays in sourcing lead to the requested Departure failing due to time constraints.
- Location of resources. As a result of the expertise associated with considering departures from Standards, the individual(s) tend to be widespread in terms of location. It is believed that a central forum and/or direction for these resources would be a benefit.
- Quality of the Submission Document is key to the efficient running of the process. Unfortunately poor quality submissions are quite common.
- Administrative errors in following the proper departures process sometimes become an easy excuse for refusing to consider a submission.
- An inability to re-apply a departure in repeated circumstances.

Personal interpretation:

- The receiver of the Departure does not understand the context of the project and cannot therefore take a fully informed judgement.
- The Reviewer may incur a personal responsibility for his/her approval of a departure and that this can drive individual behaviours leading to rejection of the submission, particularly for perceived safety issues.
- It is a function of individual interpretation, and therefore open to subjective assessment.

- Often difficult for the reviewer to take life-cycle considerations into account and as a result perceived short-term issues outweigh potential long-term benefits.

It is recognised that addressing these areas will not be easy and will require effort on behalf of both those who control standards and those seeking Departures. However, the potential benefits to be gained from improved derogation processes should outweigh the associated efforts through encouraging:

- Continuous improvement of standards which in turn achieves the optimum level of prescription within standards
- Innovation, leading to reductions in both capital and whole life costs
- Reductions in direct costs associated with Derogations, through reduced effort required in both the preparation of submissions and their subsequent assessment.

With relation to continuous improvement of standards the Industry Standards Group commends the structured approach taken by London Underground in ensuring that its standards are reviewed:

- At least every five years
- Whenever there is a change to a BS or CEN upon which the standard relies
- There are more than three written notices i.e. the central process upon which clarifications are sought)
- There are ten derogations
- As a result of an Incident Review.

From a review of existing practice regarding Derogations there are notable areas of good practice. For example, in the case of London Underground where the derogations (concessions) are centrally managed, features include:

- Clear accountability for creating and approving concessions and managing mitigations
- Clear criteria for approving concessions
- A largely automated and centrally managed process, including defined timescales for review and approvals, and
- Performance management against these metrics.

Similarly in the rail sector, whilst RGSs are mandatory, they are supported by a process for obtaining deviations as defined under the RGS Code. Deviations can be permanent 'derogations' or 'temporary non compliances'. Deviations are handled by the Standards Committees in an open and flexible way. If the people managing an infrastructure project determine that applying an RGS would not be appropriate in the circumstances of their project, they can set out the alternative measures that they intend to implement and seek a derogation. Standards Committees seek early engagement with infrastructure projects and encourage projects to consider whether derogations may be necessary. The Industry Standards Coordination Committee (ISCC) and the RSSB Board have recognised that where there are perceived to be problems with RGSs, in practice the problems are more likely to be with how the standards are applied. ISCC has initiated a programme of improved engagement with the front-line users of standards, including infrastructure projects, to make sure

that projects make full use of the derogation process where needed, and that projects know how to obtain advice on standards from Standards Committee members and RSSB.

Of those derogations not withdrawn by the applicant, 98.5% are granted.

However, although relatively easy to criticise standard custodians for issues related to Derogations, consultants, contractors and suppliers must also bear their share of the negative impact of failed submissions and delays. Indeed, all too often the Derogation submission is made far too late for its consideration under the stated review timescale. To address this is relatively simple and relies on effective project planning and project management by consultants, contractors and suppliers. Specifically, it is recommended that in order to stimulate innovation the review of standards and timescale for potential derogations are embedded within projects plans.

Incentivisation

It is not sufficient just to state that the Standards applied to UK infrastructure can and should be improved to create the efficiency savings required. Consideration also needs to be given to how such improvement will be achieved and what will be the catalyst for change.

Bearing in mind the difficulties encountered when trying to secure change in Standards, the question may be one of “How and where do you start?” However, in the knowledge of the ensuing challenge, perhaps the question should actually be “Why would you try?” This leads to consideration for what the incentives are that will actually bring such change about?

Incentives need to exist to motivate organisations to make the effort to improve the Standards themselves, the processes by which change to Standards is enabled and the practicalities and quality of their application. It is not the intention of this report to set out the specifics of any particular types of incentive mechanisms that can be instigated. That is a requirement calling for the skill of management. However, it is clear that organisations and teams can react very positively to incentives associated with risk mitigation, financial betterment or increased workload. When combined with a framework that fosters collaboration, the right incentives do generate the necessary behaviours for change to occur.

The objective must be to allow consideration of alternative solutions when they may lead to a project benefit. Such benefit may manifest itself as a pure cost saving, a programme saving, a life-cycle enhancement or a risk reduction. Such consideration of alternative solutions will generate maximum competition in the supply chain, encourage innovation and motivate efficiency in time and cost. Therefore, a mechanism needs to be put in place to facilitate and enable challenge either of the Standard itself or the application of the Standard. When applied to a project, the mechanism should apply to both the pre-construction and construction phases.

For larger projects, where there may be a significant volume of challenge to Standards or the application of Standards, consideration should be given as to how to prioritise those challenges with the most beneficial outcome. The case study for the M25 DBFO describes the creation of a working group of senior sponsors from the various project stakeholders that were able to ensure that each of the high impact challenges were given timely and proportional consideration.

Case Study: M25 DBFO Derogations

Success in obtaining departures from standards has led to some significant benefits to the UK infrastructure on the recent M25 DBFO widening contract carried out by a Skanska Balfour Beatty Joint Venture on behalf of Connect Plus for the Highways Agency. A substantial proportion of efficiencies developed were achieved by reconfiguring existing infrastructure to make it serviceable and fit for purpose. This meant challenging a number of the Standards applicable to the works.

Applying current standards would have resulted in full replacement of the central reserve. However, the project team also decided to consider retaining as much of the existing infrastructure as was practical. In particular this required:

- Checking that the existing drainage network would satisfy the design requirements of the widened carriageway to avoid removal and replacement of the existing assets at surface level
- Checking and adapting the existing system for surface water collection to accommodate the widened carriageway
- Using the more expensive “superspan” gantries to avoid the need to construct gantry bases in the Central Reserve
- Introducing alternative approaches to the design of the works under the over-bridges to avoid time consuming and costly bridge pier strengthening in the central reserve.

An important factor in the success of the M25 DBFO project achieving their necessary Departures was the establishment of a cross-project Strategic Works Group (SWG). The SWG ensured that the key value engineering opportunities requiring departures were dealt with quickly and efficiently by a group that fully understood and acknowledged the strategic nature of the proposed departures. Appropriate incentives were instrumental in driving the right behaviours to enable the challenge.

- **The need for risk mitigation.** Being a DBFO form of contract, the consequences of programme over-run were very extensive to the Contractor. Similarly, the need to complete in accordance with the programme was critical to the Highways Agency.
- **Financial betterment.** The Contractor was able to share in the financial gains from innovation and efficiency with the Highways Agency who achieved a lower project cost.

In all some 400 Departures submitted and accepted on the M25 DBFO with numerous and extensive benefits arising. However, it should be acknowledged that this achievement did require considerable effort from all parties bearing in mind the extensive and robust procedures involved.

The adaption and re-use of the existing central reserve was only fully achievable in specific areas but this was sufficient to create a significant advantage to the project and was a particular influence in being able to re-open the motorway (now with 4 lanes) between J16 to J19 six months ahead of programme and with a major early benefit of congestion reduction.

Since the completion of the design on this project the HA have produced the Existing Motorway Minimum Requirements that has updated key standards to remove the need for many of the departures required when existing motorways are widened which recognises the performance of the route compared to designing a new motorway.

Developing the role of Standards in successful project delivery

Through one of the other work streams being undertaken as part of the Infrastructure Cost Review, Infrastructure UK are developing a procurement route map which aims to ensure that the process of procurement best supports efficient delivery. Figure 11 below illustrates the approach of the route map. It supports this group’s conclusions that the client and supply chain maturity, combined with project complexity will influence the optimum level of prescription. This group therefore recommends that the definition of Client Requirements should form part of the “best practice” toolkit within the route map.

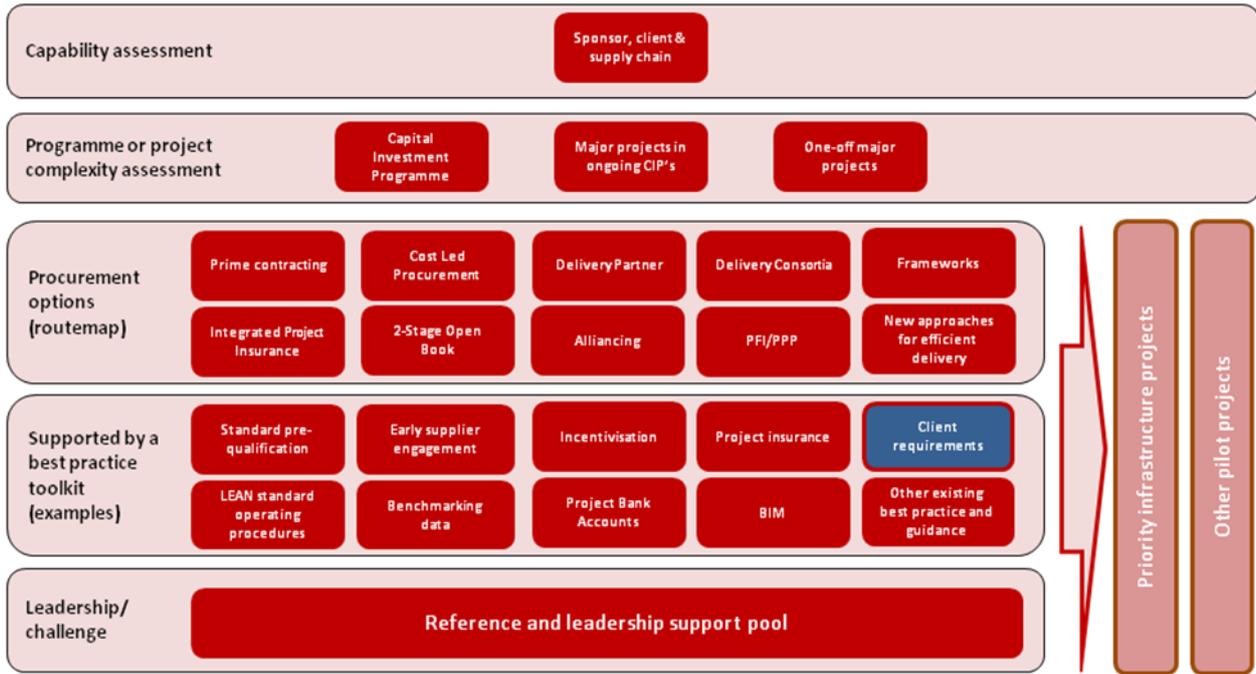


Figure 11 - Procurement Routemap

Client Requirements should therefore, in line with the approach described in the procurement routemap, consider both the project complexity and the client / supplier maturity. For example, the table below illustrates how these factors could influence the requirements.

Project Complexity	High	Reference Design	Client selects between: a) Output / Performance Specification b) Prescription where client has greater knowledge of asset management life cycle costs / risk
	Low	Follow RAG standards and industry best practice	Commodities
		Low	High
Client / Supplier Maturity			

The recommendation to inform the client requirements as part of the best practice tool kit with in route map should ensure the following factors are included.

Figure 12 illustrates the importance of applying the right level of specification prescription to a project in order to achieve the optimum cost result.

A level of prescription will occur on every project due to some mandatory requirements. These are the basic client output requirements, necessary to describe what the project must achieve in order for it to function as required and those requirements that are required by law, regulation etc.

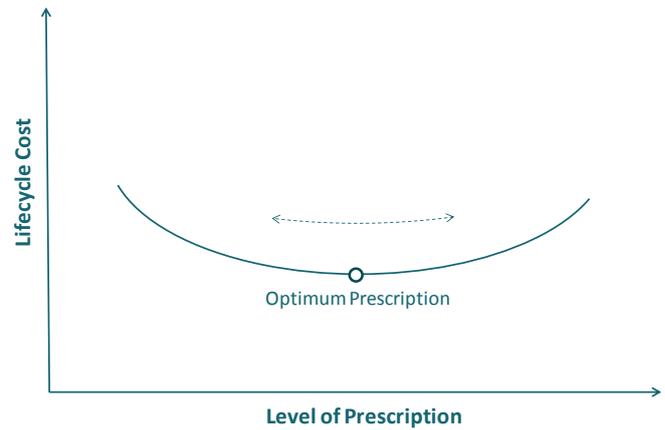


Figure 12

These two types of mandatory specification are both depicted in red in Figure 13 since they are not open to challenge. However, clients often need to dictate further specification for a project which although not necessarily affecting the functionality of the final product and not required by law, will impact upon the acceptability of any proposal subsequently received. An example is a requirement to submit operating and maintenance information. This is depicted in amber in Figure 13. Further, there may be a need to dictate all or part of the project specific specification, for example the finishes on a platform in order for them to match existing finishes elsewhere on the same line. This is depicted in green in Figure 13.

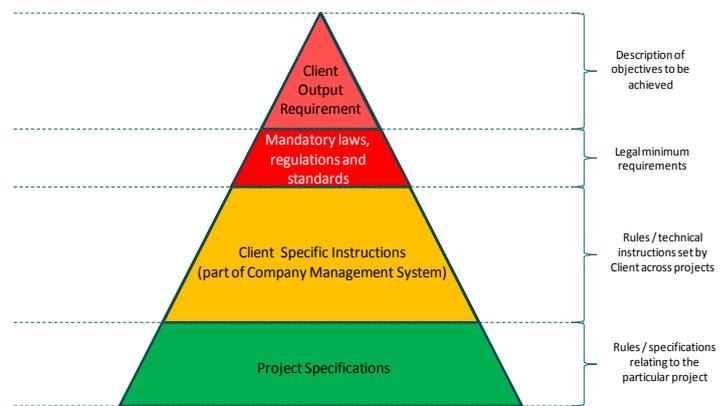


Figure 13

The amber and green areas of Figure 13 are intended to demonstrate those elements of specification that are not an absolute must, either in terms of functionality or in terms of law and regulation. They represent the choices that a client can apply when preparing an enquiry to the supply chain. There is no right answer as to how much prescription of specification should be applied. There can however be a wrong answer.

Maximum prescription in the green and amber segments will result in maximum constraint on the supply chain, whilst minimum or no prescription will allow the supply chain the opportunity to consider the full range of alternative solutions and innovations (Figure 14).

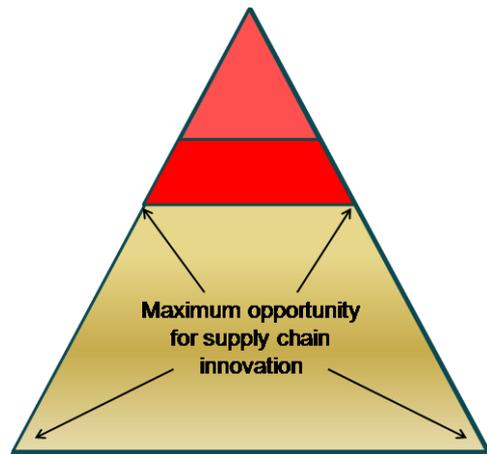


Figure 14

Each public organisation should be capable of identifying to its supply chain the difference between those parts of the specification which are mandatory (i.e. red) and those parts which are not (i.e. amber or green). Similarly the organisation should be capable of recognising the proportion of amber and green sections which are turned red by the specification (i.e. they are made mandatory). Furthermore, the organisation should be capable of explaining *why* part of the amber and/or green sections have been made red.

Figure 15 depicts a project where the client has applied maximum prescription on the supply chain, severely constraining the options open to the supply chain, whereas Figure 16 depicts the minimum level of prescription, allowing maximum opportunity for the supply chain to be innovative.

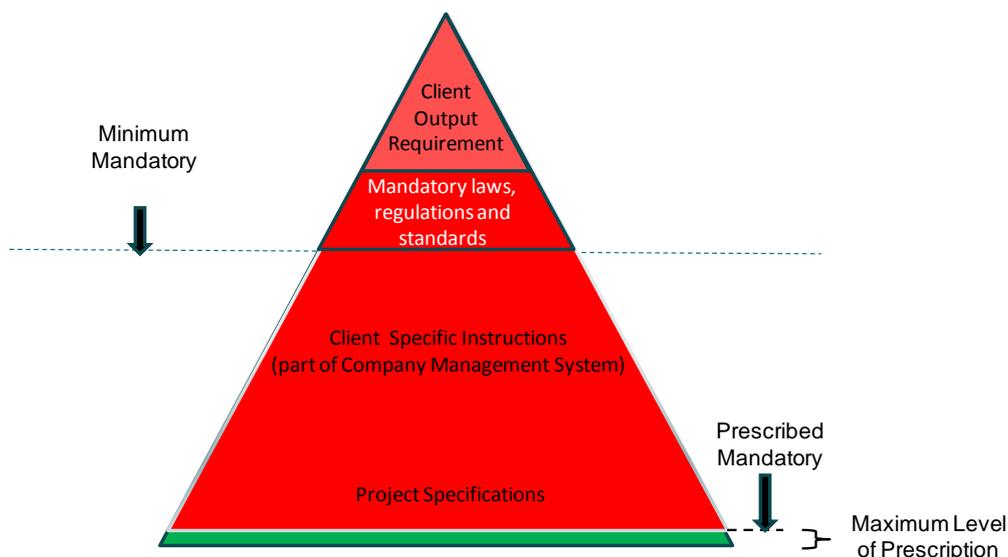


Figure 15

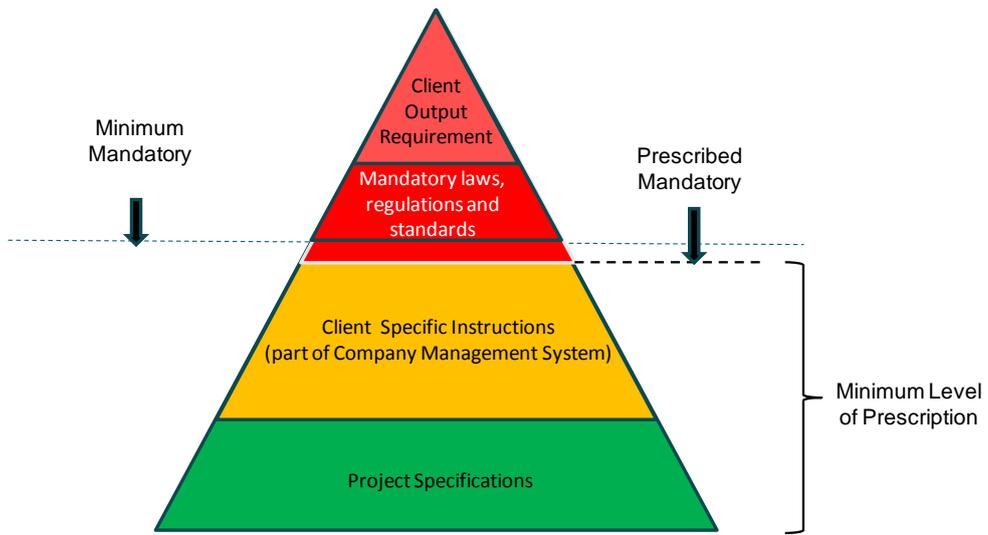


Figure 16

6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

There is a widespread perception that in-house company standards in the UK for infrastructure construction are complex, confusing and contradictory. There are too many standards, they overlap, are in conflict; and this leads to excessive cost and delay on projects.

A number of company standards are seen to be too prescriptive in nature. Where, the requirements are not appropriate for a particular project, applying the standards in a prescriptive way prevents innovative and cost effective solutions being developed. It is therefore important that an appropriate balance is achieved between prescription and flexibility within standards and procurement specifications.

The principal issue with standards is to determine how to make them simpler to understand, ensure that the number of standards is minimised, provide the right balance between prescription and flexibility and ensure there is an efficient system to manage derogations and change.

This report presents a flexible framework for rationalising and harmonising standards, project procurement specifications and other company management system documents.

Standards and specifications are simply a means to an end. The objective of standards is to ensure safety, consistency and compatibility; and promote competition, efficiency and value for money. If the standards do not currently achieve this objective, it is a symptom of a wider problem. Standards have developed over several decades and have not always kept pace with the rapidly changing market place, organisational priorities and Government's policy objectives. It is important that company engineering standards are seen as part of its overall asset management system and should align with the organisation's asset management policy and strategy.

The objective of specifications is to set out both the client requirements and the relevant standards that apply to each project.

The Value for Money study led by Sir Roy McNulty found that one of the main reasons why the GB rail sector does not deliver value for money is that there is a lack of common objectives and aligned incentives. The problem is magnified considerably when considering the overall national infrastructure. The Government should provide leadership in establishing an overall policy framework for the national infrastructure and ensure that investment and effort across sectors are aligned with and enable the achievement of the national infrastructure goals and objectives. This framework is illustrated below in Figure 17.

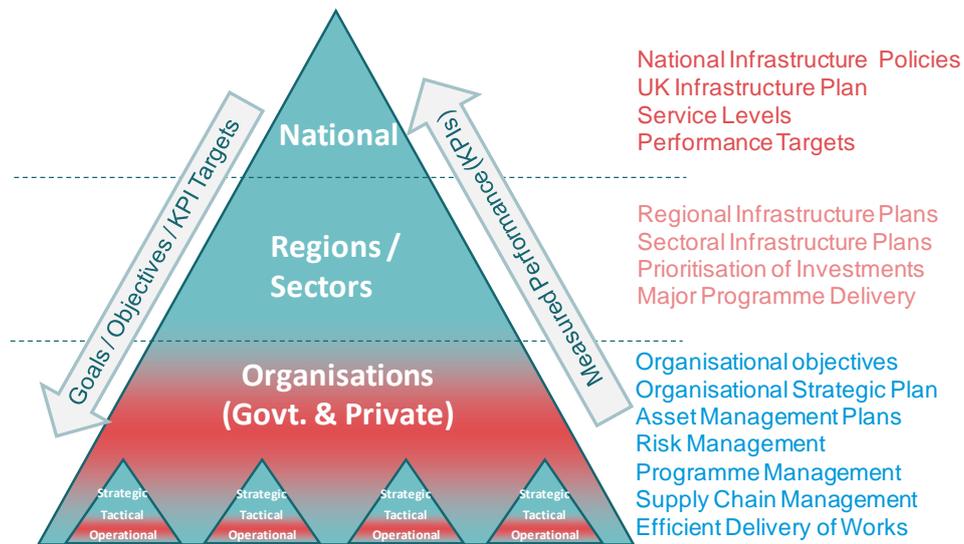


Figure 17: Framework for alignment of objectives across sectors

To support this approach to provide simplicity, reduce bureaucracy and improve whole life value, the group concluded that:

- Improved project outcomes will be enabled when clients are able to assess and define the optimum level of prescription that applies to their project, consistent with their own maturity and supply chain capabilities, and ensure their requirements reflect this.
- The client bodies should continue to refine their standards and, where appropriate, make them more goal-oriented and less prescriptive. The standards should seek to optimise performance, cost and risks on a whole life, whole-system and whole industry basis; and ensure compatibility at interfaces.
- For the non-mandatory elements of standards there should be flexibility to adjust the 'performance parameters' within standards for individual assets/projects depending on the functional needs and potential risks; and not impose the same requirement in every case.
- The background data, empirical evidence and rationale for each standard should be clearly documented and publicly available. This will help the users of the standard to assess if the requirements are applicable to novel situations.
- This flexible framework set out for standards should be extended to apply to specifications.
- A process should be established for better benchmarking of performance and sharing of best practice – from both clients and industry – to drive continuous improvement of standards and specifications through periodic review, ongoing challenge, derogations and incentivisation.

Recommendations

Based on the findings of this review, the following recommendations are made for further harmonisation and rationalisation of standards and specifications in the road and rail sectors in the UK:

1. Define Outcomes, not Inputs

Clients should clearly define their performance and output requirements and structure their specifications and standards to support this objective. For each standard or specification, the mandatory requirements should be clearly distinguished from text that is advisory or informative. Recognising that influence of safety, licensing, regulatory and levels of complexity will vary between sectors and projects, clients should assess, set and justify the level of optimum prescription that will deliver the lowest cost for each project consistent with whole life asset management best practice.

Actions:

- i. **Government.** To include Client Requirements for Standards and Specifications as part of the Best Practice Toolkit within the Procurement Routemap. Government should establish a joint working group with industry and clients, to prepare and publish this element of the toolkit by the end of the 2012.
- ii. **All Clients** should implement a process for measuring and justifying the **level of prescription** within project procurement specifications and assess the impact on whole life costs as part of the Business Case for each project.
- iii. **Mission for Clarity.** The **RSSB** should be empowered by the Department for Transport, to take leadership on behalf of the GB rail industry to propose rationalised and harmonised railway interface standards that will apply across the sector, including High Speed 1 and 2 and Crossrail, by spring 2013.
- iv. **Under the leadership of BSI or the appropriate standards body,** it is recommended that as standards are created, revised or re-written, they should be grouped to clearly set out the basis of design, performance standards, loading standards, design standards, material specifications and construction specifications to ensure clarity in use or for challenge.

2. Enable Standard Assets, not Asset Standards

Different standards and specifications, or different interpretations of the same standard, that apply to the same asset class is uneconomic and can act as a barrier to standardisation. Clients should work together to enable standardisation of assets to deliver improved whole life cost and ensure that any interfaces between their assets/networks are made compatible and safe.

Actions

- v. **The Department of Transport** should bring together Network Rail, Transport for London and the Highways Agency to agree by autumn 2012 a programme for the development of a common technical specification for bridges to eliminate all unnecessary duplication and conflict from the individual client requirements and to examine the potential for convergence

between assessment and design requirements insofar as this will generate efficiencies and simplify decision making in respect of strengthening and rehabilitation schemes.

- vi. **The Highways Maintenance and Efficiency Programme** should publish guidance on their website by summer 2012 for all local authority highways bodies to ensure that a more harmonised approach is taken to specification of pavements, including asphalt mixes

3. Empower Industry to Challenge and Innovate

Clients should seize the opportunity empower their supply chains in the early stages of projects, especially the procurement phase, by ensuring their requirements are clear, accessible and promote innovation. The client bodies should simplify their standards derogation process, work with industry to encourage challenge and make the resolution process faster.

Actions

- vii. **Transport sector clients** should ensure that all procurement requirements clearly list all the relevant standards that apply to the project. Providing industry with clarity and access to these standards will allow industry better to understand and respond to the requirements. This action should be instigated immediately to enable all procurement to comply by the start of the 2013/14 financial year. Statements such as “all relevant standards apply” should not be permitted.
- viii. **Transport sector clients** should ensure that all their in house standards and related on-line standards called for in their specifications are **made freely available to SMEs** during the procurement phase to improve access and reduce the costs of procurement.
- ix. **Compliant Procurement.** Clients should ensure that appropriate use of performance requirements allows industry to develop alternative solutions in the procurement phase. Where the stated performance requirements are met, then they are deemed and assessed in tender evaluations as compliant. This will support early involvement of specialist suppliers that can deliver innovation.
- x. **Introduce a “Derogations Trigger”.** Transport sector clients should ensure that every derogation application is clearly logged, and set an appropriate trigger level for their organisation. If the number of derogations against a standard or requirement exceed this level it should automatically trigger a review of the standard. For example, in LU this level has already been set at 10 derogations triggering an automatic review of the requirement.
- xi. **Industry** must rise to this challenge to improve the quality and timeliness of their derogations submissions. It is recommended that the Industry Group through the Infrastructure Steering Committee produce a best practice toolkit by autumn 2012.

4. Measure Benefits to drive Continuous Improvement

Client bodies should introduce a requirement in their in-house standards development

process to demonstrate clear value for money in introducing new standards and requirements within standards. The value for money should be assessed considering safety, performance benefits, business risks and costs over the whole life of assets and track the benefits.

Actions

- xii. The **Highways Agency** should pilot recommendations vii to xi on a sample of projects in their “pinch point” schemes to enable a measurement of cost savings and performance benefits against other pinch point schemes.
- xiii. The **Highways Agency** should seek to use their developing Reference Road model to measure the impact of changes in standards/specifications and share this with their supply chain.
- xiv. **Bridge Assessment.** It is recommended that the full bridge assessment toolkit is piloted rigorously to measure the cost and performance benefits. The London Bridges Engineering Group (LoBEG) has indicated to the group their willingness to undertake such a pilot with their members. Transport for London should engage with LoBEG to agree funding and an implementation programme for the pilots to enable a report outlining benefits to be completed by March 2013.
- xv. **The Major Projects Leadership Academy** programme should include a module on establishing effective client requirements consistent with the recommendations of this report to embed best practice throughout all areas of public procurement.

Through the implementation of these 15 recommendations, the Industry Standards Group believes that there will be measurable benefits to industry, clients and asset owners through optimising technical requirements that will improve the cost effective performance of UK infrastructure assets in the transport sector. Many of these recommendations are also applicable to other UK infrastructure sectors. The ISG therefore recommends that the Infrastructure Steering Committee develop sector specific actions for all other areas of economic infrastructure to ensure that consistent and sustainable improvements can be delivered across all the UK’s infrastructure assets.

7. ANNEX A

Industry Standards Group membership

Terry Hill – Arup - Chair

Andrea Beddard – British Standards Society and Arup

Greg Craig – Skanska

Steve Denton – Parsons Brinckerhoff

Bill Hewlett – Costain

Mike Low – BSI

Bill McElroy – Turner & Townsend

Campbell Middleton – University of Cambridge

Navil Shetty – Atkins

John Tebbit – Construction Products Association

Observers:

David Clarke – Department for Transport

Ginny Clarke – Highways Agency

Jon Jones – London Underground

Mick McManus – Network Rail

Len Porter – RSSB

Keith Waller – Infrastructure UK