SUNRA

Sustainability – National Road Administrations

Measures to Improve Sustainability – Framework Part 2

Report v1.0

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Executive summary

The project

National Road Authorities (NRAs) across Europe continually strive to improve the performance of their road networks. This improvement has been underpinned by significant research in the optimisation of road planning, design, construction and maintenance, which has enhanced the understanding of the social, environmental and economic aspects of managing a road network. These aspects form the three pillars of sustainability and are addressed at different levels across European countries, through sustainable development plans and strategies. Whilst there is common understanding in some aspects of sustainability there is not a common understanding of sustainability as a whole and thus how to benchmark and improve overall performance.

The 'Sustainability for National Road Authorities' (SUNRA) project is tasked with identifying how NRAs can contribute to sustainable development. This involves three main tasks:

1. Providing a common way of defining sustainable development within the context of European NRAs.

2. Identifying how to measure sustainable development performance at a strategic level and integrate sustainable development decision making into key intervention points.

3. Developing a sustainability rating system framework that will enable NRAs to improve performance within the context of building and managing roads.

The tasks and methodology

The first task of defining an NRAs contribution to sustainable development has been undertaken through work package one (WP1) of the project. This report summarises the work that has been undertaken on task 2 on identifying how to measure sustainable development performance at a strategic level (WP2), with the resulting objective to develop a metrics framework that NRAs with different levels of sustainability knowledge and structures can use to improve sustainability performance. To develop this framework the following three activities have been undertaken:

- Literature review

    1. The websites and corporate reports of NRAs and government departments across Europe and a number of other countries were reviewed to identify sustainable development metrics currently in use.

    2. Research papers and final reports from recent research into NRA metrics and indicators were reviewed to identify recommended metrics.

    3. The EU Sustainable Development Strategy (SDS) and the Transportation Research Board Guidebook for Sustainability Performance Measurement for Transportation Agencies were reviewed to identify European and international priorities for sustainable development.

- Workshop

    4. A workshop with key stakeholders, sustainability professionals and sustainability leads from across Europe was held to prioritise the metrics that are currently used and to identify gaps.

- Identify good practice

    5. The project team consulted key contacts to identify good practice examples from North America and Europe of NRAs successfully implementing sustainable development principles.

The literature review identified 270 metrics that were currently being measured by NRAs, demonstrating the wide range of data that is collected and reported by NRAs. The study then attempted to rationalise the metrics in three stages. Stage one of the rationalisation reviewed the current metrics in use and identified those that were reported by more than one NRA. Stage two saw the metrics integrated with others recommended by wider research that had examined the gaps in what is currently being measured. While, stage three considered the rationalised list of metrics against the EU sustainable development priorities, as set out in the EU SDS.

At the workshop attendees were presented with a range of metrics and measures which had been identified through the literature review. These included the most commonly reported metrics that were currently being measured and those being proposed by wider research. The attendees were asked to identify their key priorities out of the list of metrics and measures provided. Following the workshop, analysis of the prioritisation exercise was undertaken and this produced a set of priority metrics and associated priority topic areas for consideration as the framework was developed. The workshop attendees were also asked to identify any gaps in what is currently being measured and these were also taken forward for consideration in the framework.

The project team consulted contacts in NRAs from Europe, North America and Asia to identify good practice examples of client interventions that have created improved performance in sustainability. The purpose of this exercise was to identify practical examples that have been implemented by NRAs. The examples looked at, including, 'Sustainability as a measure of true value – Highways Agency (England)', 'The power of sustainable procurement – Commissioners of infrastructure projects in the Netherlands' and 'Incorporating sustainability into decision-making – New York State Department of Transportation (US)' represent a mix of initiatives at various levels of implementation which demonstrate that intervention is possible and can have a positive effect on an organisation as a whole.

The findings from the literature review, workshop and case studies were then used to develop the framework and this is illustrated schematically in Figure NTS1.
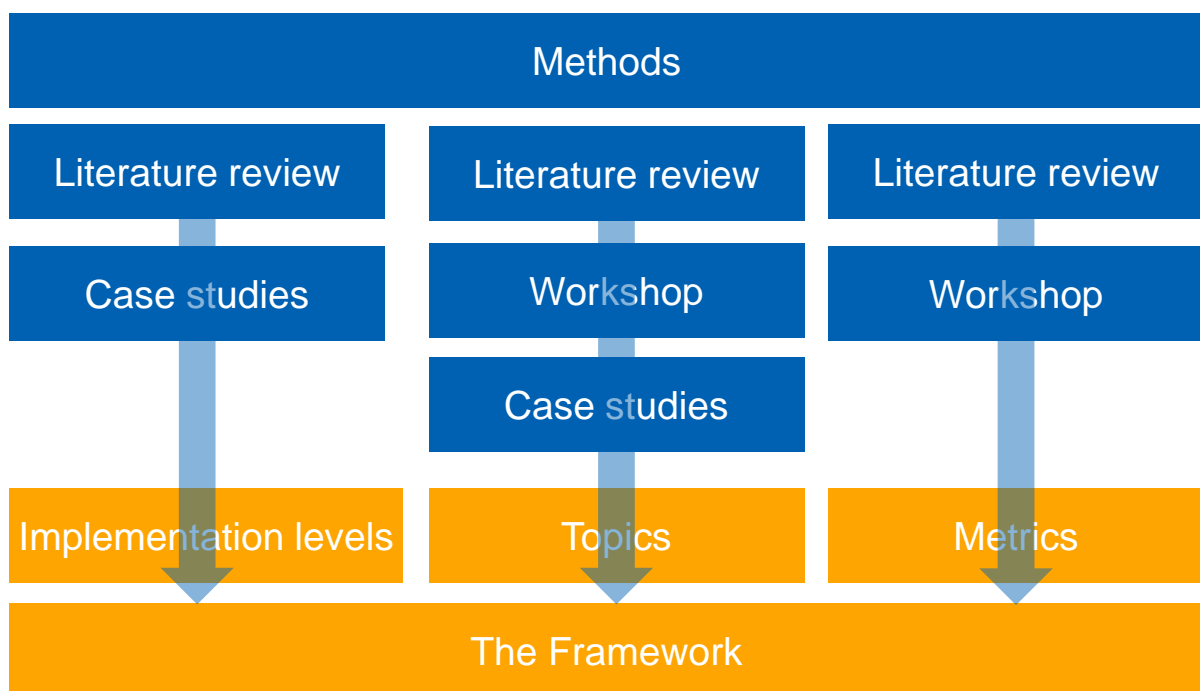
Figure NTS1: Development of the framework

NRAs are set up to deliver on their strategic functions, with their current targets and metrics focused towards achieving this. From the good practice case studies, we can see that this is the major focus for implementing sustainability within the NRAs, however they do also demonstrate that actions are taken at different levels of their organisations (board, programme and project) and this was important when developing the framework.

The literature review followed by the workshop enabled the prioritisation of metrics and the identification of key sustainability topic areas. When these 14 topic areas identified are compared with the 11 sustainability goals recommended by the Transportation Research Board guidebook aimed at helping transportation agencies measure their sustainability performance it is clear that there are very many similarities, with the majority of the issues overlapping, and this provides some indication that the work undertaken in this research is valid. In order to provide for consistency with the work already completed in the US, as this research developed its framework it drew on both the terminology and the recommended sustainability goals in the TRB report. It nevertheless also recognised that there were additional priority topics identified within this research (i.e. in the EU SDS) and ensured that these were also covered in the framework. Along with topic areas that were identified as important through the case studies.

As described previously, the literature review identified a total of 270 (rationalised) metrics that are currently being measured by NRAs, along with a number of additional metrics and measures that are being recommended by wider research. The most commonly reported of the 270 metrics and measures, along with those recommended by the wider research were then put through a prioritisation process at the stakeholder workshop. The results of this process provided the team with list of metrics that were considered to be a priority and also a list of those metrics and measures which were not considered to be a priority. Where possible the metrics that were selected for inclusion in the framework came from the list of priority metrics that had been identified. Where there was a topic identified that did not have a metric on the priority list, a suitable metric from the larger list of metrics was selected or a metric was selected from those recommended as suitable measures by the TRB, as part of their 'Guidebook for Sustainability Performance Measurement for Transportation Agencies'. In some cases where no suitable metric could be found, one was either developed by the team or it has been identified as a gap.

The framework

In order to ensure that NRAs with different levels of commitment and reporting capabilities can benchmark themselves against the framework, it is proposed that a staged approach is used for measuring performance. The framework has four levels, with one being the lowest and four being the highest (Figure NTS2). It is expected that NRAs will begin by achieving level one, before they then start to move up through the framework as they consider it to be appropriate for their organisation. The levels within the framework can be described as follows:

- Level 1 – the NRA is monitoring a number of its own current priorities in terms of sustainability.

- Level 2 – the NRA is monitoring a wide range of priorities in terms of sustainability.

- Level 3 – the NRA is monitoring wider issues that demonstrate its contribution to sustainable transport.

- Level 4 – the NRA is monitoring issues that demonstrate its wider contribution sustainable development.
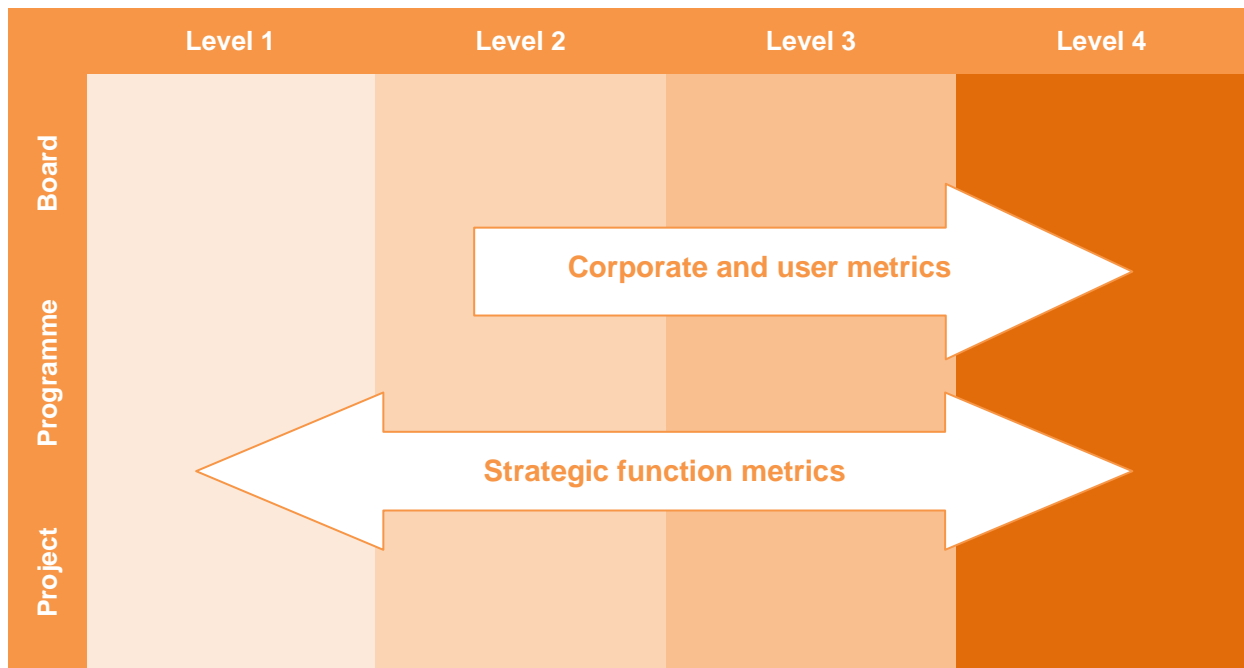
Figure NTS2: Structure of the framework

At the lower levels there is a focus on metrics that monitor the strategic functions of the NRAs, with the corporate and user metrics being introduced at the higher levels. The number of metrics reported at each level of the framework increases with those achieving level four monitoring the greatest number of metrics.

As the analysis has shown that it is important the NRAs integrate and monitor their performance in terms of sustainability at the different levels in their organisation, metrics are included in the framework at the project, programme and board level. The structure of the framework is such that NRAs achieving the lowest level of sustainability will only be expected to monitor performance at the project level, however as NRAs progress through the levels they will be expected to monitor performance at the project, programme and board levels.

The framework covers 24 sustainability topics which were identified either as priorities through the literature review (e.g. in the EU SDS or TRB's Sustainability Goals), workshop, or case studies. Those topics identified as priorities are monitored at all levels of the framework, whereas those topics identified through the EU SDS are only monitored at the higher levels where NRAs will be expected to be considering the wider issues of sustainable transport (level 3) and sustainable development (level 4). Under each of the sustainability topics a set of relevant metrics have been outlined which will need to be monitored by the NRAs.

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1 Introduction

1.1 SUNRA

National Road Authorities (NRAs) across Europe continually strive to improve the performance of their road networks. This improvement has been underpinned by significant research in the optimisation of road planning, design, construction and maintenance, which has enhanced the understanding of the social, environmental and economic aspects of managing a road network. These aspects form the three pillars of sustainability and are addressed at different levels across European countries, through sustainable development plans and strategies. Whilst there is common understanding in some aspects of sustainability there is not a common understanding of sustainability as a whole and thus how to benchmark and improve overall performance.

The Sustainable Development Strategy for the European Union (EU SDS) (European Council, 2006), sets out a framework for the long-term vision of the EU and highlights certain development priorities. The 2009 review of the strategy reinforces the need to have a balanced approach to sustainable development to meet the global financial, social and environmental challenges (EC, 2009). The development plan sets out a vision for Europe in delivering sustainable development but not in the specific context of building and managing a road network. For NRAs to effectively contribute to this long-term vision there must be an understanding, and a clear process identified, of how sustainable development is applicable to all stages of road planning, design, construction and maintenance.

The 'Sustainability for National Road Authorities' (SUNRA) project is tasked with identifying how NRAs can contribute to sustainable development. This involves three main tasks:

4. Providing a common way of defining sustainable development within the context of European NRAs.

5. Identifying how to measure sustainable development performance at a strategic level and integrate sustainable development decision making into key intervention points.

6. Developing a sustainability rating system framework that will enable NRAs to improve performance within the context of building and managing roads.

The first task of defining an NRAs contribution to sustainable development has been undertaken through work package one (WP1) of the project (see section **Fehler! Verweisquelle konnte nicht gefunden werden.** for further details). This report summarises the work that has been undertaken on task 2 on identifying how to measure sustainable development performance at a strategic level (WP2).

1.2 Measures to improve sustainability

The aim of 'Measures to Improve Sustainability' (WP2) is to enable NRAs to use metrics to improve their sustainability performance at a strategic level. The resulting objective is to develop a metrics framework that NRAs with different levels of sustainability knowledge and structures can use to improve sustainability performance. This report details the WP2 background and methodology, including the literature review and stakeholder workshop.

The resulting framework is provided as a separate standalone document, 'Measures to Improve Sustainability, Framework Part 2: Framework'. The following section outlines the structure of this report.

1.3 Structure of the report

The report is structured as follows:

- Section 2 provides background information.
- Section 3 provides an overview of WP2 methodology.
- Section 4 describes the purpose, methodology and findings of the literature review.
- Section 5 describes the purpose, methodology and findings of the stakeholder workshop.
- Section 6 discusses the identified good practice initiatives.
- Section 7 analyses the findings of the earlier stages and introduces the framework.
- Section 8 discusses a number of wider issues, including strategic communication and influence and value for money, life cycle, and monetisation.
- Section 9 provides a conclusion.

2 Background

2.1 Measuring sustainable development

Measuring performance is a key factor in managing performance. International standards for environmental management (ISO 14001) and quality (ISO 9001) include measurement as an integral part of their system so that improvements can be targeted and improved. Taking this one stage further and reporting results has added benefits. Ioannis Ioannou and George Serafeim (2012) from the Harvard Business School identified in their working paper on the Consequences of Mandatory Sustainability Reporting 2012 that:

'Sustainability reporting not only increases transparency but can also change corporate behaviour. Disclosure of environmental, social and governance information forces companies to manage these matters effectively in order to avoid having to disclose bad….performance to their multiple stakeholders.'

NRAs need to be able to understand what to measure to improve sustainability performance and in particular identify how to use that process to influence key intervention points and enable the NRA to contribute to sustainable development.

Figure 1 shows how metrics and measures are used in the concept of sustainable development.
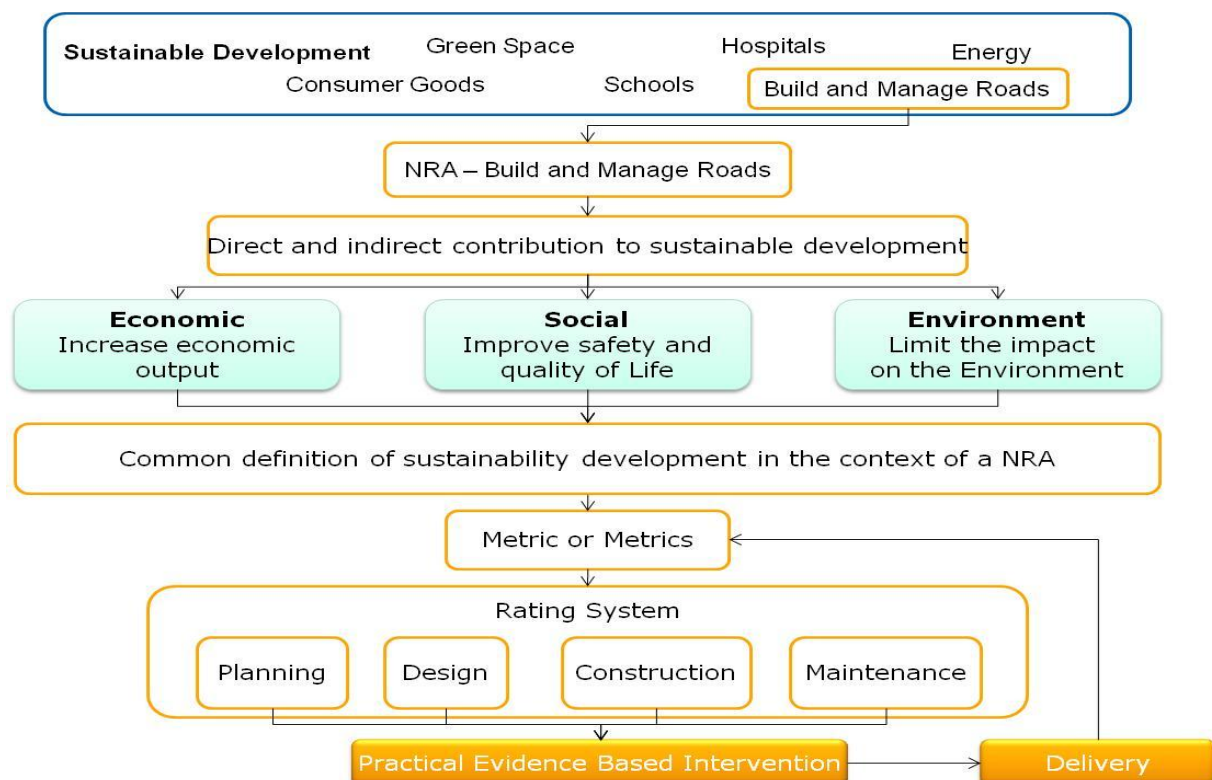
Figure 1: A process by which NRA's can contribute to sustainable development

Sustainable development requires the consideration of social, economic and environmental resources so that they are improved or sustained within the context of future generations. Sustainable development is therefore influenced by all parts of society locally and globally. An NRA is responsible for planning, building and managing roads and as such has a responsibility to implement sustainable development within this context. NRAs may also have

wider responsibilities, such as sector leadership and collaboration with other bodies, in which they will also need to consider sustainability.

An NRAs contribution to sustainability will be both direct and indirect but should result in an increase in economic output, an improvement in safety and quality of life and limit or reverse the impact of roads on the environment.

A common 'definition' or context within which the NRA should consider sustainability is required. Work package 1 has conducted a review of a NRA's influence on sustainable development to provide this definition.

2.2 NRA sustainable development metrics and measures

NRA across Europe use metrics to measure performance on a wide range of topics. The metrics are used to enable strategic, programme and project management of key activities that relate to performance criteria required by their stakeholders. There is a growing requirement globally to improve our understanding of sustainable development. This is highlighted by policies targeted to improve financial sustainability, following the banking and sovereign debt crisis, increase social sustainability, to address inequalities and social exclusion and environmental; to respond to local natural and historical environment protection, global impacts such as climate change and resource scarcity and security. There is also a need to understand how clients in a globalised world affect the sustainable development of supply chains in other regions.

In 2006, the European Commission set out a sustainable development strategy which highlighted key indicators relating to sustainable development (EU SDS). Within the EU SDS, sustainable transport was highlighted as a key theme and various relevant indicators were developed (see Table 1).

Table 1: EU SDS sustainable transport themes and indicators (Eurostat, 2011)

Theme	Headline indicator (Level 1)	Subtheme	Level 2	Level 3
Sustainable transport	Energy consumption of transport relative to GDP	Transport and mobility	Modal split of freight transport	Volume of freight transport relative to GDP
				Volume of passenger transport relative to GDP
			Modal split of passenger transport	Investment in transport infrastructure
				Passenger transport prices
		Transport impacts	Greenhouse gas emissions from transport	Average CO2 emissions per km from new passenger cars
				Emissions of NO_X from transport
			People killed in road accidents	Emissions of particulate matters from transport

Each European country will have developed their own strategy to implement sustainable development within the context of their own countries (e.g. Department for Environment, Farming and Rural Affairs (DEFRA) Sustainable Development Indicators in the UK, the 16 Environmental Quality Objectives which guide environmental action at every level of society in Sweden, and Denmark's National Strategy for Sustainable Development). These strategies are often translated into strategy documents for the NRAs, as with the Highways Agency Sustainable Development Plan in the UK. Each NRA will have a different set of stakeholder drivers towards sustainability and has translated those drivers in different ways.

In this document we review the current metrics that are measured by NRAs across Europe and determine their importance towards sustainable development to provide NRAs with clear direction towards improved performance.

The metrics that are used enable performance to be monitored at different levels of an NRA. The information required at a board level is different than that at the programme and project level. This is illustrated in Figure 2. The board is required to set, monitor and measure corporate sustainability objectives and report these to stakeholders. Programmes (e.g. area maintenance, major projects, etc.) deliver the strategic objectives and prioritise project actions, while reporting to senior levels. At the project level, there is a need to align project practice with corporate priorities and report on project performance.
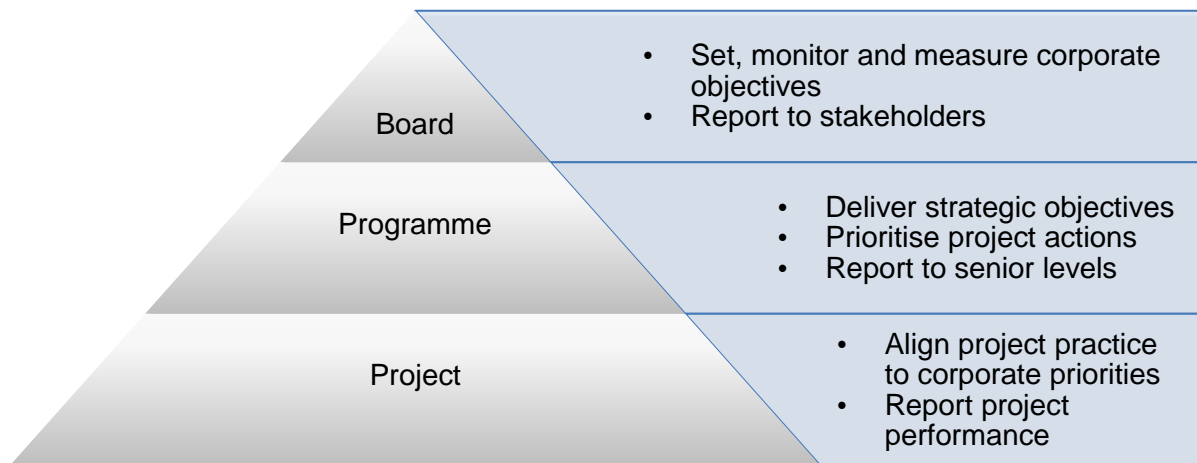
Figure 2: Reporting at each level improves transparency and leads to improved performance

Previous ERA-net projects, **S**trategic **B**enchmarking **a**nd **K**ey **P**erformance **I**ndicators (SBAKPI) and **En**vironmental **I**ndicators for the **T**otal Road Infrastructure **A**ssets (EVITA) identified a requirement to develop metrics that enable performance to be measured in the social and environmental pillars. A holistic approach to sustainability should enable an NRA to understand their true role in society, the full impact of their actions and the full benefits that they can deliver towards sustainability.

There are a number of levels to which sustainability can be considered by an NRA:

1. To fulfil government and legal requirements.

2. To manage operations to achieve the best value for economic, social and environmental impact in the construction, maintenance and operation of roads.

3. To manage the road network so that it maximises the sustainable development opportunities in the wider global context, such that it balances economic, social and environmental benefits and impacts.

This essentially follows the principles of:

1. Meeting the statutory obligations towards sustainable development;

2. Limiting the scope of sustainable development intervention to the delivery parameters of the NRA (e.g. the government tells us what to build and we build it); and

3. Taking a holistic approach to the road network (e.g. providing advice to government on what roads to build and maintain and advice to users on how to use them).

A framework that enables an NRA to understand the contribution at each of these levels and takes a staged approach to metrics would enable an NRA to monitor its performance and plan for future action.

2.3 Key intervention points

Metrics are only useful if they are used to intervene and improve performance. An NRA has a number of strategic, programme and project level intervention points where sustainability can be integrated into the decision-making process. Each intervention point is important in ensuring that sustainability is considered at all levels of the NRA. The most impact can be had at the strategic level and through early interventions on projects. If however, early interventions are not followed up at later stages then actions are often stunted or not delivered.

An NRA will manage their network from a strategic level to maintain and enhance the current network, to deliver major improvement projects and to maintain operations, as shown in Figure 3.
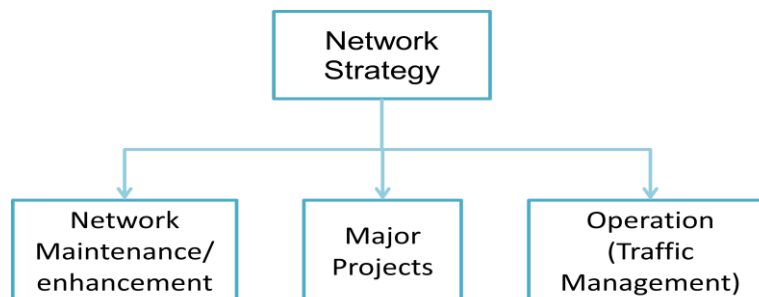
Figure 3: NRA strategic network management

Sustainability should be considered at the network strategy level, as how it is integrated here sets the priorities for maintenance and enhancement, major project and operations.

NRA Intervention: Integrate sustainability into network strategy decision making and set the principles for implementing sustainability through strategy documents.

The next section of this report outlines the key intervention points considered in network maintenance/enhancement and for major projects. It has not considered intervention points during operation as this is outside the scope of current work. Figure 4 describes the typical intervention points in a major project.
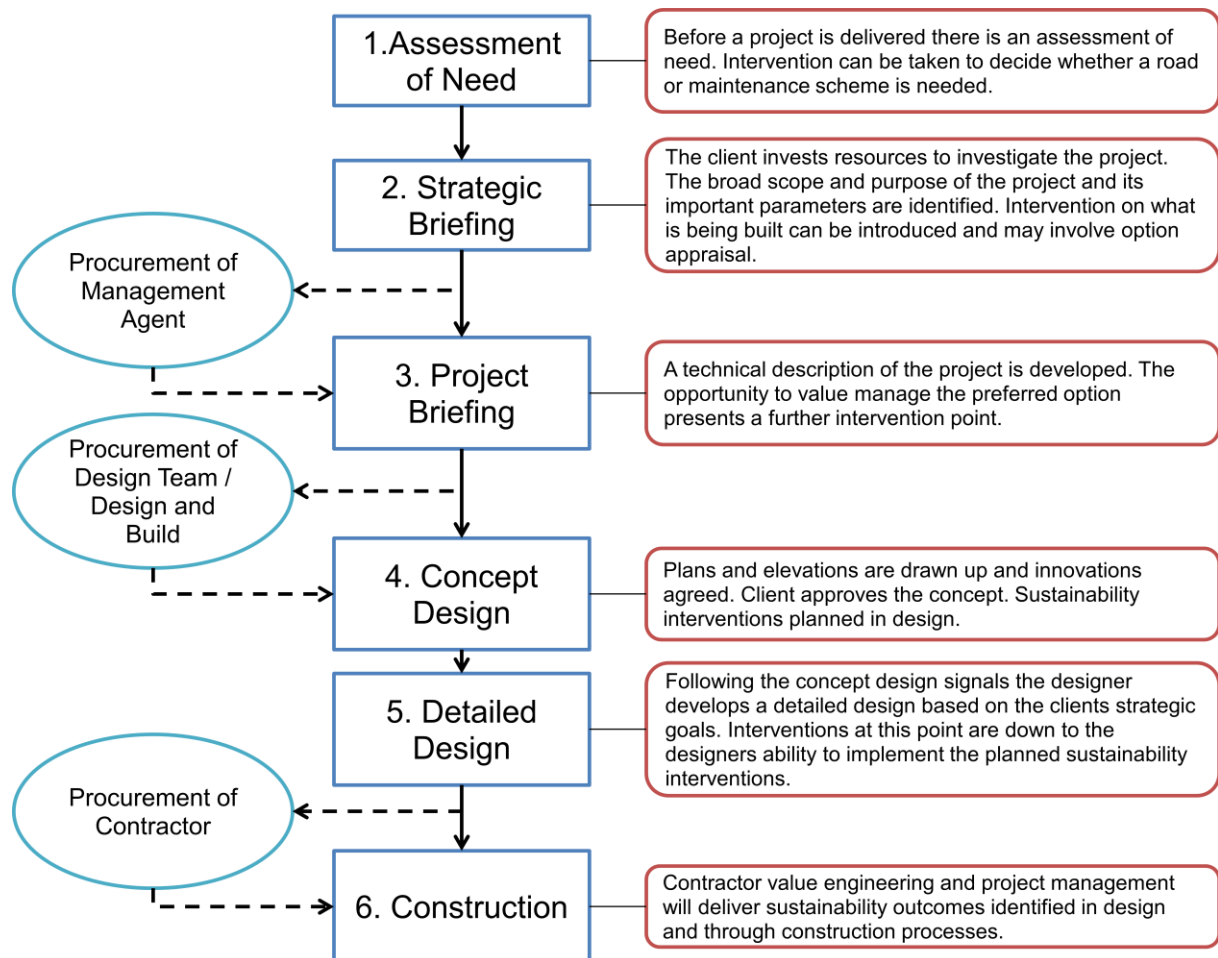
Figure 4: Typical major project intervention points (RICS, 2011)

Through these intervention points the client shapes the delivery of the project from conception and the assessment of need through to construction. These intervention points are the same points at which sustainability can be considered by the client and decisions made to improve performance. Sustainable development should be integrated into these intervention points so that it is considered as part of the process and not as a separate action. It is important to note that early inclusion of sustainability requirements is vital to ensuring that sustainability considerations are fully integrated into the project and to limit additional costs. In addition, to ensure delivery of sustainability requirements there needs to be close monitoring and management throughout the project life cycle. NRAs will need to develop a robust assurance process so that they can manage and assess the performance of their contractors to ensure compliance.

For major projects the typical intervention points and NRA intervention actions are:

1. Assessment of need: Initially the NRA will assess the need for the project. This will likely be at a strategic level, in some NRAs and particularly for significant projects these decisions may be taken at a ministerial level. Integrating sustainability into the assessment of need enables questions to be asked about the broader impact of the scheme. This starts at the point of whether a new road or major upgrade is required at all, whether it is the most appropriate solution and how it should integrate with other transport modes. The assessment of need can also identify the parameters within which it is appropriate to build a new road e.g. its size, lifespan and potential future improvements.

   NRA Intervention: Preparation of the briefing to the key decision maker(s) which includes an assessment of sustainable development.

2. Strategic Briefing: At the strategic briefing the client invests resources to investigate the project. They will likely require the development of options which will meet the required need. To enable sustainable development decision making to be considered at this point, the options must include an appraisal of the sustainability benefits and impacts of the scheme. The scheme options can then be considered based on their contribution to sustainable development.

   NRA Intervention: The NRA will either employ a consultant or pass the project to the technical in-house lead to conduct this task. The intervention will therefore be in their tender or project brief and the technical response.

3. Project Briefing: A preferred option is developed and a briefing prepared for the design team. At this point there is an opportunity to 'value engineer' the preferred option during design. The client can set the parameters for this process and incorporate the principles of sustainable development.

   NRA Intervention: The NRA will instruct the designer to consider the sustainable development principles in design. This may be through a further procurement process to a design team, a design and build team, as a technical brief to in-house staff or as part of a contract management process with a management agent / consultant.

4. Concept Design: Client ensures that the sustainable development innovations are incorporated in the design concept and appropriate planning has taken place to ensure sustainable development concepts are considered during detailed design.

   NRA Intervention: NRA ensures that the brief is followed and a process for incorporating sustainable development in the detailed design is identified.

5. Detailed design: It is important that the sustainable development principles are considered during detailed design. The designer refines the concept and develops the components of the project. Choices will be made on the materials, composition and techniques used. The client will have determined what needs to be considered in this process at the project brief stage and the concept design stage.

   NRA Intervention: NRA reflects the sustainable development priorities in project / contract management.

6. Construction: After the design is finalised the contractor is appointed. This may be an in house appointment or contracted through a tender process. The tender process may have been initiated prior to design or at the end of design to appoint a contractor. This appointment provides a further intervention. At construction the decisions about the project have been made. At this stage the performance needs to be managed to ensure it is delivered in a sustainable way.

   NRA Intervention: The NRA includes a requirement for sustainable performance in the brief prior to construction.

The interventions for maintenance and enhancements are different to that of major projects, with the work in this area often identified in programmes for particular areas or regions. The intervention points are therefore fewer although the same staged approach can be taken.

Figure 5 shows the typical intervention points for network maintenance / enhancements.
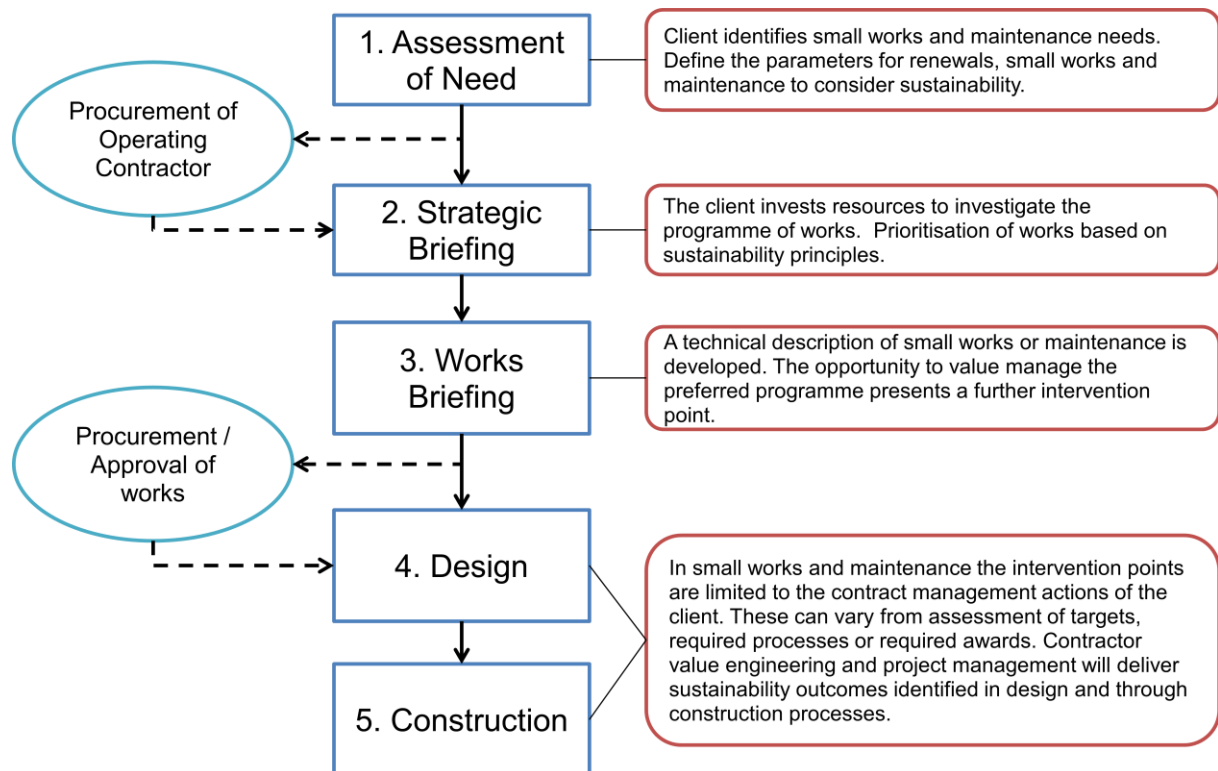
Figure 5: Typical NRA intervention points for network maintenance / enhancement (RICS, 2011)

Similarly to major projects the integration of sustainable development decision making aligns with the intervention points that an NRA typically has in a maintenance / enhancement programme.

1. Assessment of need: The NRA identifies the need for maintenance and enhancement for the network. This assessment of need is often based on the condition of the network and the available finance to maintain and enhance the network. Including a holistic sustainable approach to the assessment of need should ensure that the NRA gets the true value out of the applied funds.

   NRA Intervention: NRA sets the principles for the assessment of need and identifies maintenance and enhancement programmes based on sustainability principles. This intervention may be through the procurement of an operating contractor.

2. Strategic Briefing: Within the programme of work will be small works and maintenance projects that will need to be prioritised. The NRA should work with the maintenance teams (whether internal or external) to prioritise the works based on the principles of sustainable development.

   NRA Intervention: NRA should set criteria for prioritising programme of works based on sustainable development principles.

3. Project Brief: A project will be developed and should be worked up based on recommendations from the strategic briefing. Any options to improve performance should be taken.

   NRA Intervention: Approval or procurement of works based on performance actions.

4. Design and Construction: The delivery of the programme is monitored by the NRA to ensure performance targets are met.

NRA Intervention: NRA sets targets and reporting criteria to ensure performance is delivered.

2.4 Summary

The framework of metrics should therefore enable NRAs to identify the metrics that are appropriate for them and within the context of the intervention points at a board, programme and project level. The framework should also enable NRAs to identify what metrics are appropriate based on their current performance and their aspiration to either: comply with legal requirements, focus on the sustainability principles of NRAs or influence the broader sustainable development potential of the road network.

3 Methodology

Work package 2 is tasked with identifying the metrics that can be used to monitor performance towards sustainable development at a strategic level and enable NRAs to utilise the intervention points identified in section 2.3.

The methodology involved:

1. Identify the metrics that are currently used by NRAs to measure sustainable development performance.

2. Review research into recommended metrics that relate to sustainable development performance.

3. Compare metrics against European and international sustainable development priorities.

4. Consult NRA stakeholders to prioritise metrics.

5. Identify good practice implementation of sustainable development principles.

These tasks were separated into three activities:

- Literature review

    a. The websites and corporate reports of NRAs and government departments across Europe and a number of other countries were reviewed to identify sustainable development metrics currently in use.

    b. Research papers and final reports from recent research into NRA metrics and indicators were reviewed to identify recommended metrics.

    c. The EU SDS and the Transportation Research Board Guidebook for Sustainability Performance Measurement for Transportation Agencies were reviewed to identify European and international priorities for sustainable development.

- Workshop

    d. A workshop with key stakeholders, sustainability professionals and sustainability leads from across Europe was held to prioritise the metrics that are currently used and to identify gaps.

- Identify good practice

    e. The project team consulted key contacts to identify good practice examples from North America and Europe of NRAs successfully implementing sustainable development principles.

More detail on the methodologies used is provided in sections 4 and 5.

4 Literature review

A literature review of metrics and measures for sustainable development was conducted between December 2011 and April 2012. The purpose, methodology and results of that review are described in this section of the report.

4.1 Purpose of the literature review

The purpose of the literature review was to:

- Identify the current metrics and measures which are reported by NRA that demonstrate performance towards sustainable development.

- Identify good practice metrics and measures proposed by wider research.

- Review EU and global sustainable development strategies and reporting mechanisms to identify the role of NRAs in global reporting and identify any gaps.

4.2 Methodology

This literature review examined metrics and measures relating to sustainable development currently being reported by EU NRAs and a selection of other countries. The websites and published annual reports for all European countries were reviewed to identify the metrics and measures that relate to sustainable development. In addition to EU countries a selection of NRAs from other regions, namely Australia, Japan, China and New Zealand were also reviewed to take into account global practice.

The sustainable development indicators were then categorised based on whether they measured user impacts, network construction and maintenance (NRA strategic functions) or NRA corporate activities (operational buildings and facilities run by the NRA such as offices, vehicles, etc). Figure 6 illustrates the wide range of influence that an NRA has in terms of its environmental and social impacts. NRAs are only directly responsible for their own corporate activities, which contribute very little in terms of social and environmental impact. The greatest environmental and social impacts are made by the user of the road network that is managed by the NRA. However, the NRA has very little responsibility for this group of people and can only influence their activities by changes in NRA policy or procurement procedures. In between these two sits the NRA strategic functions such as construction and maintenance, over which the NRA has more limited responsibility, influencing via its procurement, policy and procedure decisions.
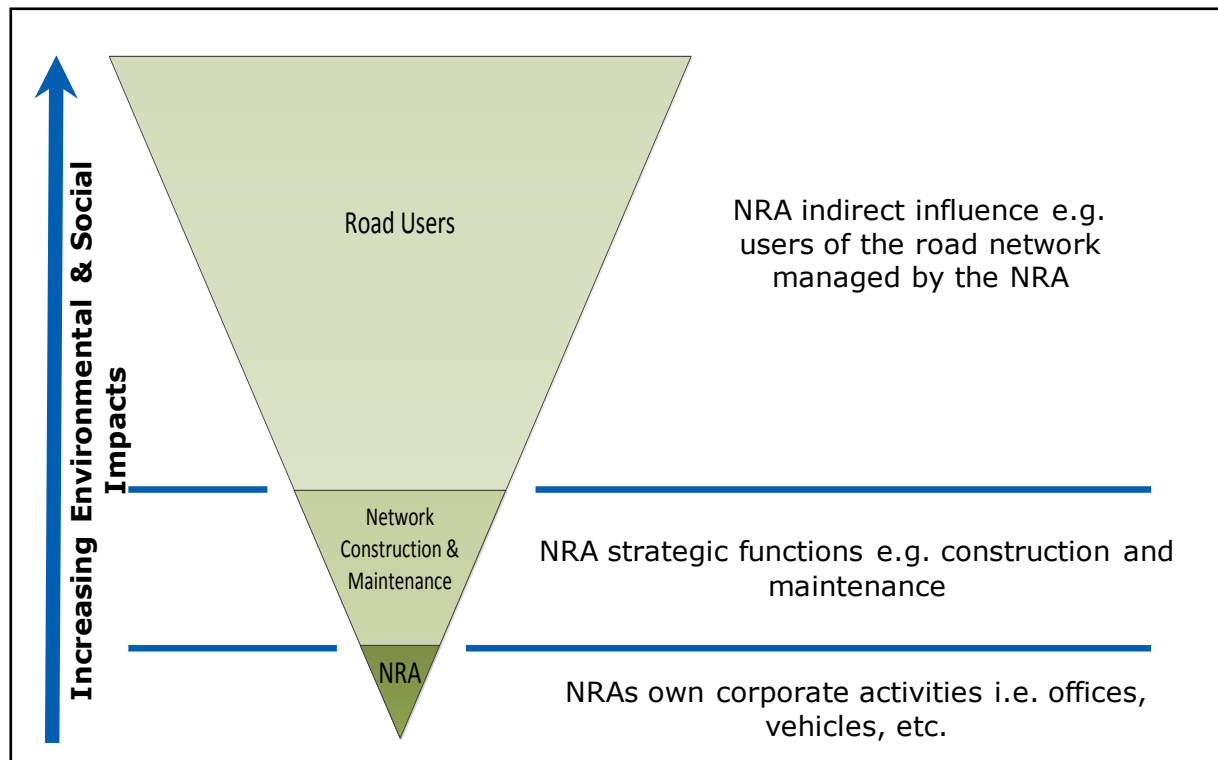
Figure 6: NRA levels of influence

It is useful to break down the NRA function into these three levels because it demonstrates the different levels of influence and the different levels of impact that an NRA has.

At the NRA (corporate activities) level the NRA has the most influence. They directly procure energy, equipment, manage staff behaviour, run vehicle fleets, and purchase office supplies and equipment. They are able to directly influence the sustainability of these activities through changes to work practices. Change is not always straight forward but it is strongly within the control of the NRA. However the impact on sustainable development is limited to the localised footprint of the NRA corporate activities. Changes will have an indirect impact on the functions or the NRA because it helps to enforce a culture that supports sustainability. Activities, such as recycling, energy saving, car-pooling and use of public transport, internally create a culture that encourages decisions about sustainable development to become common practice.

The NRA strategic function to manage the construction, maintenance and operation of the network has a much larger impact on sustainable development. What roads are built and maintained and how they are built and maintained will significantly contribute to the sustainable development contribution of the NRA. The NRA has a direct influence on the strategy and policy but the delivery of these actions are often carried out by their supply chain. The NRA still has control over the outputs at this level but is often reliant on the market to respond to the requirements set by the NRA. The impact is therefore higher but the relationship is less direct.

The road users will have some of the largest impacts on sustainable development. How the roads are used, the distances that are travelled, the vehicles that are used, and the activities that benefit from their use are dependent on the road user. The NRA has an indirect influence on this level. Which roads are built, how they are managed, what publicity and engagement surrounds the road infrastructure and what information is provided will affect the user element. The NRA can therefore contribute to the user impact indirectly.

These three levels are often addressed by different parts of an organisation. The NRA corporate activities may be managed by quality, health and safety and environment

management systems. Strategic functions will be managed by directors, programme managers and project managers often using procurement and contract management to deliver functions. The user element is then influenced by different teams across an NRA, some with a remit to provide information to influence behaviour, others with a remit that has an indirect effect on the user.

As well as the different levels of influence there are also the three pillars of sustainability to consider; economic, social and environmental.

The metrics and measures were tabulated and marked whether they were user, strategic function or NRA corporate activity and whether they were economic, social or environmental.

In order to manage all the information that this literature review produced, a spread sheet was developed which consisted of:

- A summary sheet of the EU indicators of sustainable development for reference.

- An index page listing all 37 of the countries to be researched together with who was responsible for each country.

- One sheet per country where all the metrics and measures were listed according to their sustainability pillar (economic, environmental and social) together with the relevant website reference.

The literature review was internet based. The starting point for the review for each country was the national government website, and from here links to the relevant government department (if it existed) or NRA could usually be found. For example, in England, it would be the Department for Transport and Highways Agency websites that were visited primarily, along with the Department for Environment Food and Rural Affairs (DEFRA) website. If, for a particular country, it was not possible to track down the NRA details, then the national statistics department website for that country, where the metrics and measures that are collected nationally are collated and compared, was used to gain information on the metrics and measures collected by that country that related to NRA activity and sustainable development.

Box 1 summarises the literature review process.

> Web-based information from **37 countries reviewed** (33 from Europe, plus Australia, China, Japan, and New Zealand).
>
> Useful **information was obtained from 30 countries.** A review was not feasible for 7 countries (Belgium, China, Cyprus, Finland, Luxembourg, Netherlands, Slovakia) due to language constraints.
>
> Typical data sources: **NRAs, government departments, national statistics**.

Box 1: Summary of literature review

Once all the countries on the index page had been researched, the metrics and measures that had been found were reviewed and cross referenced across all the countries to see where there were examples of several countries reporting on the same metric or measure. The metrics and measures were then re-tabulated according to the three pillars of sustainability – economic, environment and social and each metric was ranked according to how many countries had been found to report on it. The metrics could then be reviewed according to their popularity.

Following the review of metrics and measures currently in use the metrics and measures that were proposed by wider research, such as the SBAKPI and EVITA projects, were also reviewed. These were used to complement the other metrics and further tabulated in the spread sheet.

The final part of the literature review was to review the sustainable development priorities of the EU.

4.3 Metrics and measures currently in use

4.3.1 Step 1: Identified metrics and measures from NRA

The number of metrics identified by the literature review, broken down by both sustainability pillar and responsibility, are summarised in Box 2 below.

270 rationalised metrics identified

By sustainability pillar:

- **121 economic**
- **57 social**
- **92 environmental**

By responsibility:

- **188 user**
- **67 strategic function**
- **15 corporate**

52 metrics were being reported by more than one country

Box 2: Summary of findings

The number of metrics demonstrates the wide range of data that is collected and reported by NRAs. The pie charts in Figure 7 show how the metrics are split when allocated by pillar or responsibility.
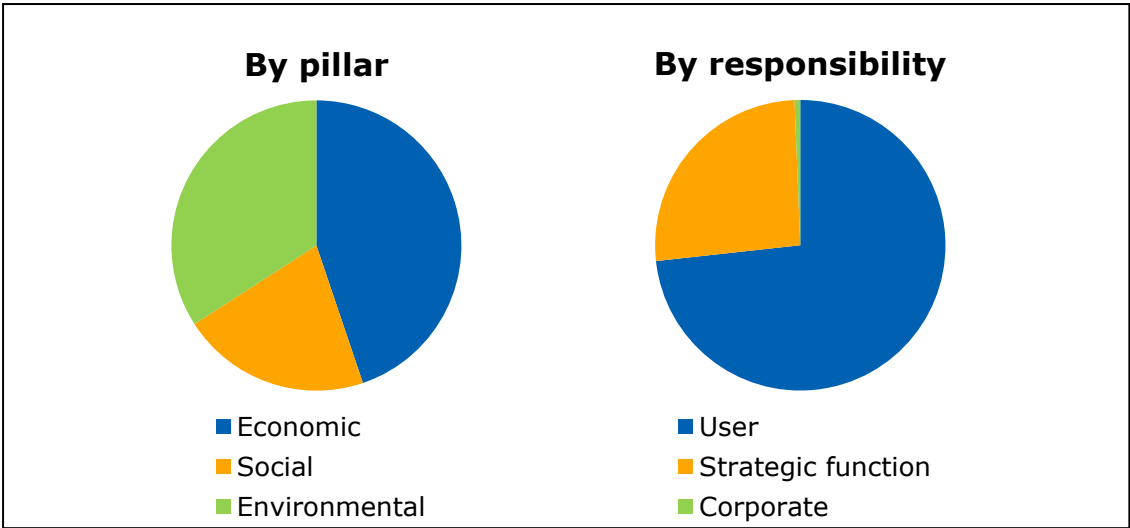
Figure 7: Summary of findings by pillar and responsibility

Almost half of the metrics identified are economic, over one third are environmental and less than a quarter are social indicators. This may indicate a ranking in priority for metrics recorded by NRA. The percentage of the 32 NRAs that record one or more metrics for the three pillars is shown in Figure 8.
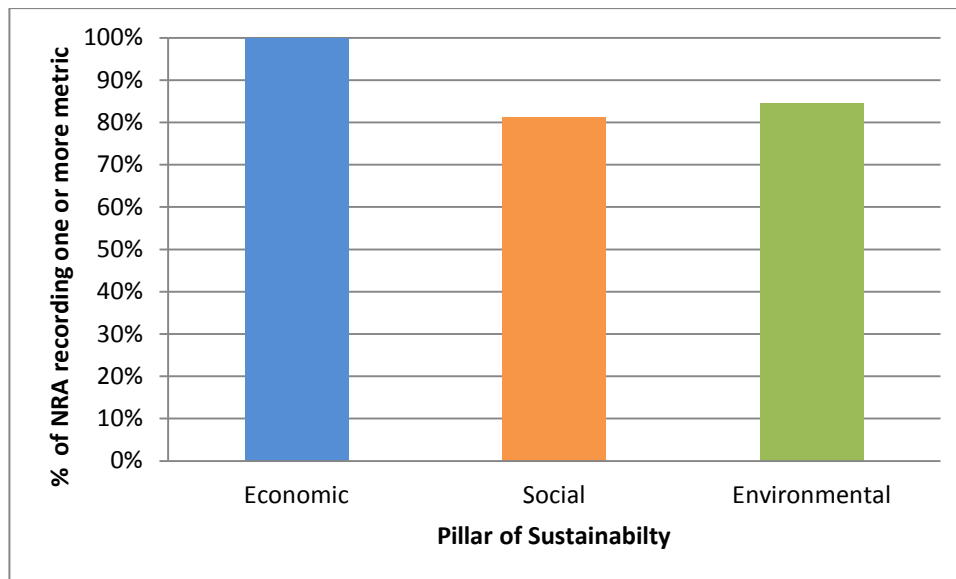
Figure 8: Percentage of NRAs recording one or more metrics per pillar

An economic indicator was recorded in all NRAs, 84% of NRAs recorded at least one environmental indicator and 81% recorded a social indicator. An average of 14 indicators was recorded by each NRA: seven economic, three social and four environmental. This shows how varied the metrics that are used across countries are with 270 unique indicators found across the 32 countries and identifies the need to rationalise the metrics used and to encourage a broader implementation of social and environmental indicators.

Figure 7 also shows the indicators "by level". The pie chart highlights the fact that NRAs are recording very few metrics that relate to their corporate activities; just over a quarter of metrics recorded relate to the strategic function and just under three quarters are related to user activity. Whilst this is the largest impact, it is the level at which the NRA has least influence. There is a need to understand what NRAs can influence with regards to the user level and to identify the priorities in the strategic levels and the NRA corporate activity.

4.3.2 Step 2: Rationalisation of the metrics and measures

This study is attempting to rationalise the metrics used by NRAs so that they can be used to benchmark performance. The rationalising will comprise of three stages:

1. Prioritise current metrics based on use across Europe.
2. Integrate metrics identified by research into gaps in sustainability performance.
3. Assess rationalised list against sustainable development priorities.

The highest number of metrics recorded by an NRA was 27. It should be expected that an NRA is unlikely to record more than 30 metrics relating to sustainable development. At the lower end of the scale, some NRAs were recording four metrics. A framework therefore needs to take into account this range of reporting capability and priority.

The stage 1 rationalisation reviewed the current metrics in use and identified those that were reported by more than one NRA. Boxes 3, 4 and 5 below summarise the metrics that are being reported, according to this literature review, for the economic, social and environmental pillars of sustainability.

- Average age of vehicles
- Cars per 1,000 inhabitants
- Change in ownership of registered vehicles
- Congestion
- Consumption of fuels
- Expenditure on road construction
- Expenditure on road maintenance
- Expenditure on roads
- External costs of transport
- Kilometres travelled by road
- Length of freight haul
- Length of new road completed
- Length of road network
- Modal split of freight transport
- Modal split of passenger transport
- Number of bridges
- Numbers of HGVs used
- Number of new motor vehicles registered
- Number of private cars
- Number of registered motor vehicles
- Operating cost
- Passengers kilometres
- Road condition
- Road fuel prices
- Road network density
- Total motor vehicles
- Traffic volume
- Travel time variability
- Vehicle ownership per capita
- Volume of freight transport
- Volume of passenger transport

Box 3: Economic metrics being reported by more than one country

- Children Killed and Seriously Injured (KSI)
- KSI
- Mobility
- Number of accidents
- Number of accidents involving personal injury
- Number of casualties
- Number of fatalities
- Number of persons slightly injured
- Road user satisfaction
- Social cost of accidents

Box 4: Social metrics being reported by more than one country

- Consumption of biofuels
- CO_2 emissions from transport
- Emissions of NO_x
- Emissions of PM_{10}
- Percentage of energy consumption of transport over GDP
- Emissions of greenhouse gases by type of transport
- Energy consumption by transport mode
- Greenhouse gas emission by sector – transport
- Energy use in transport
- Energy consumption of transport in state energy consumption
- Emissions and transportation of passengers and goods

Box 5: Environment metrics being reported by more than one country

4.4 Metrics and measures proposed by wider research

It is widely recognised that there are gaps in what is currently being measured by NRAs, particularly in terms of the environmental and social pillars. As a result, over recent years, various research projects have been undertaken which have tried to fill this gap by making recommendations about new metrics and measures that could be used. The literature review examined the outputs of these various projects and compiled a list of recommended metrics and measures. The research projects looked at included:

- **S**trategic **B**enchmarking **a**nd **K**ey **P**erformance **I**ndicators (SBAKPI)
- **E**n**v**ironmental **I**ndicators for the **T**otal Road Infrastructure **A**ssets (EVITA)
- Cost 354: Performance indicators for road pavements
- Cost 356: Towards the definition of a measurable environmentally sustainable transport.

Boxes 6 and 7 (below) summarise the metrics and measures that have been recommended by the research projects listed above. It is interesting to note that the projects do not propose any further economic metrics. It is likely that this is because the list in Box 3 (above) is already comprehensive in the range of economic topics that it covers.

• Noise complaints	• Proportion of road with managed drainage
• Number of dwellings exposed to excessive noise	• Number of managed drainage outfalls
• Number of AQZAs in road network	• Outfalls with water quality treatment
• Length of road network within AQZA	• Material resource efficiency
• Carbon dioxide (CO_2) emitted by NRA and contractors	• Number of wildlife crossings on the network
• Cultural heritage	• Habitat fragmentation

Box 6: Recommended environment metrics and measures / topics

- Number of complaints from stakeholders
- Number of responses to complaints from NRAs
- Population/km new roads/lanes constructed
- Population/km ITC/ICT constructed
- Length of road affected by schemes to reduce to congestion and improve journey time reliability

Box 7: Recommended social metrics and measures

These indicators have been developed by researchers to fill in gaps in the monitoring processes of NRAs and to enable a more holistic approach to sustainable development to be considered. These metrics will be combined with those identified in 4.3.2 to provide a list of priority metrics that will be considered further as this process continues.

4.5 Sustainable development strategies and reporting mechanisms

The starting point for sustainable development in the European Union is the Sustainable Development Strategy (SDS) developed by the European Commission. It sets the priorities for sustainable development across the EU and includes priorities for sustainable transport. An NRAs primary function in relation to the SDS is to address the transport issues that are identified, although it should also consider sustainability in the wider context. Figure 9 demonstrates the requirements of an NRA as set out in the context of the SDS.
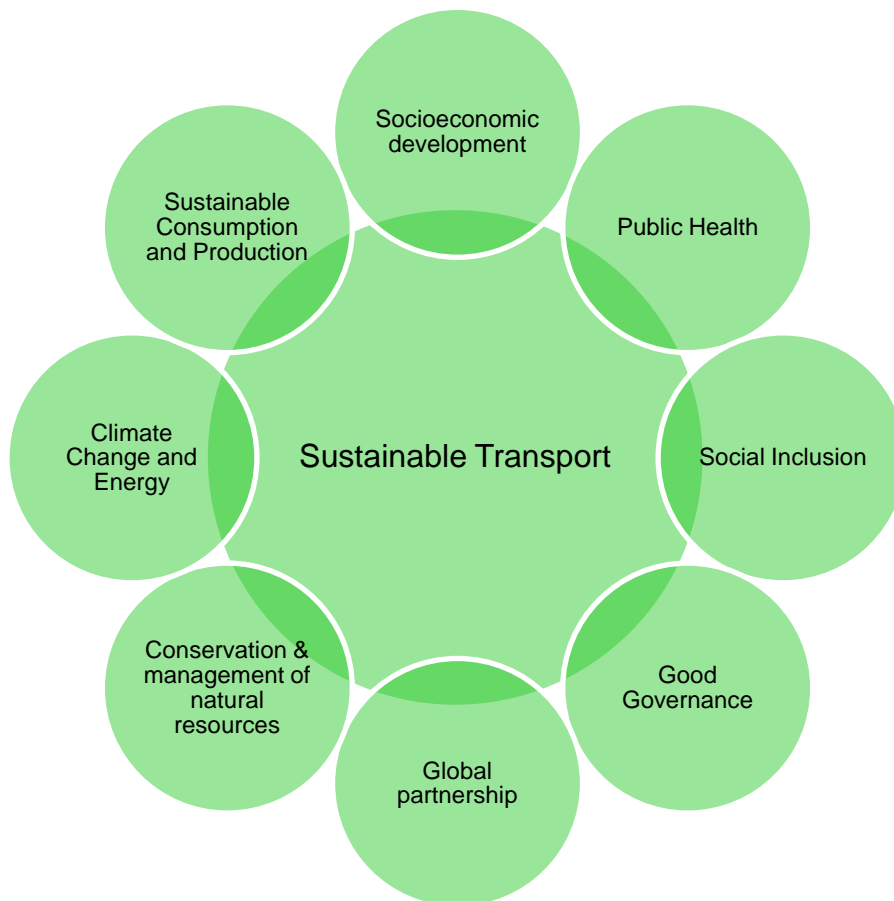
Figure 9: European Union Sustainable Development Strategy in the context of an NRA

A NRA is focused on delivering transport solutions and as such is mainly focused on delivering sustainable transport within sustainable development. Sustainable transport in itself will have a broader sustainable development impact and as such will contribute to the other areas identified, however the NRA as an organisation will have an impact within each of the themes identified in the SDS.

Metrics and measures therefore need to enable NRAs to monitor performance in the context of sustainable transport at the cross over and for the NRA as a whole. The biggest impact an NRA will have is in the sustainable development of transport and this is where it should focus. We can therefore determine a series of levels based on an NRAs contribution to sustainable development. This is expressed in Figure 10.
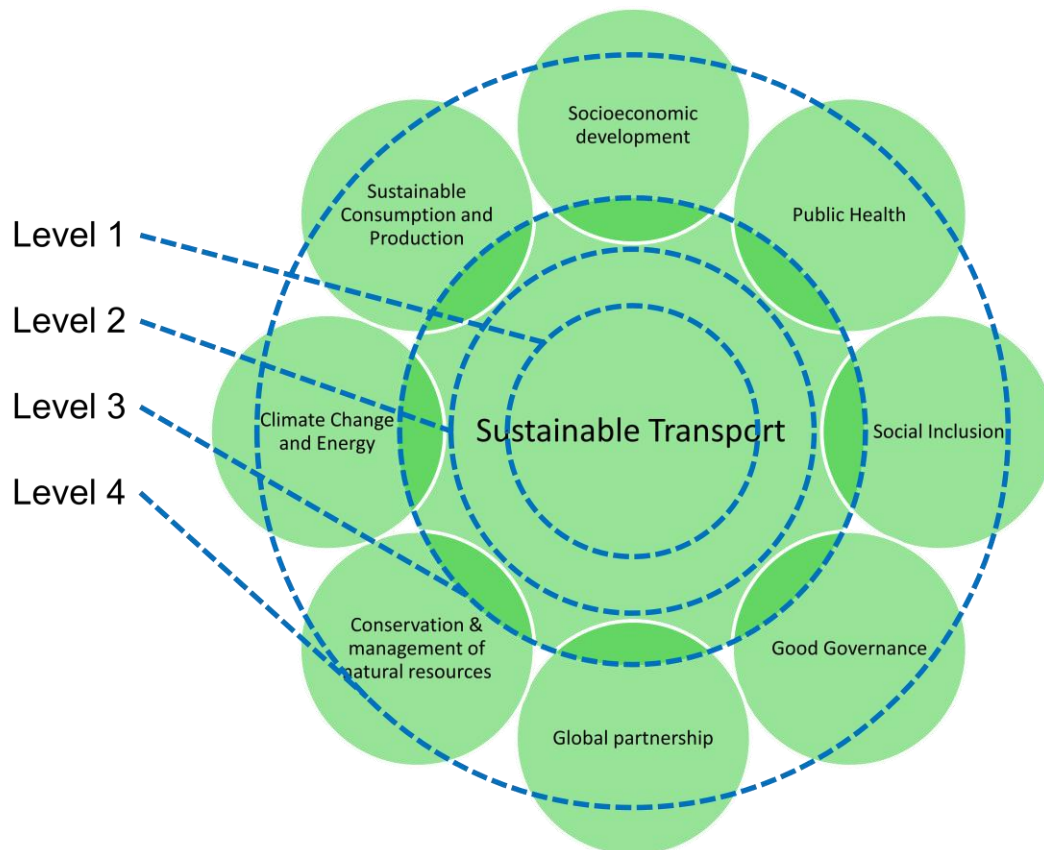
Figure 10: Levels of sustainable development performance for an NRA

Within the context of an NRA the levels can be described as follows:

- Level 1 – the NRA is monitoring a number of its own current priorities in terms of sustainability.

- Level 2 – the NRA is monitoring a wide range of priorities in terms of sustainability.

- Level 3 – the NRA is monitoring wider issues that demonstrate its contribution to sustainable transport.

- Level 4 – the NRA is monitoring issues that demonstrate its wider contribution to sustainable development.

Level 1 would constitute the key priorities for an NRA towards sustainable transport, while level 2 would broaden this out to cover a large range of priorities. The SDS sets the headline indicator for sustainable transport as energy consumption of transport relative to GDP. At the next level the SDS includes the two sub themes, transport and mobility, and transport impacts (Table 2). These sub themes and the headline indicators represent key topics and metrics that could be used by NRAs to measure their performance in relation to sustainability.

Table 2: Sustainable transport sub themes in the SDS (Eurostat, 2011)

Subtheme	Level 2	Level 3
Transport and mobility	Modal split of freight transport	Volume of freight transport relative to GDP
		Volume of passenger transport relative to GDP
	Modal split of passenger transport	Investment in transport infrastructure
		Passenger transport prices
Transport impacts	Greenhouse gas emissions from transport	Average CO_2 emissions per km from new passenger cars
		Emissions of NO_X from transport
	People killed in road accidents	Emissions of particulate matters from transport

The wider SDS themes, such as socio-economic development, climate change and energy, sustainable consumption and production etc. and their sub themes and indicators (Table 3), would then be explored as the NRA expands into levels 3 and 4 and considers their contribution to sustainable development more widely.

Table 3: SDS themes, sub themes and indicators (Eurostat, 2011)

Theme	Headline indicator (Level 1)	Subtheme	Level 2	Level 3
Socioeconomic development	Real GDP per capita	Economic development	Investment	Regional disparities in GDP
				Household saving
		Competiveness, innovation and eco-efficiency	Labour productivity	Research and development expenditure
				Energy intensity
		Employment	Employment	Female employment
				Regional disparities in employment
				Unemployment
Climate change and energy	Greenhouse gas emissions	Climate change	Greenhouse gas emissions by sector	Greenhouse gas intensity of energy consumption
				Global surface average temperature
	Consumption of renewables	Energy	Energy dependency	Gross inland energy consumption
				Electricity generation from renewables
				Consumption of renewable energy in transport
				Combined heat and power
				Implicit tax rate on energy
Sustainable consumption and production	Resource productivity	Resource use and waste	Non-mineral waste	Domestic material consumption
				Hazardous waste
				Recycled and

Theme	Headline indicator (Level 1)	Subtheme	Level 2	Level 3
				composted municipal waste
				Atmospheric emissions
		Consumption patterns	Electricity consumption of households	Number of people in households
				Household expenditure
				Final energy consumption
				Car ownership
		Production patterns	Environmental management systems	Eco-labels
				Area under agri-environmental commitment
				Organic farming
				Livestock density index
Conservation and management of natural resources	Abundance of common birds	Biodiversity	Protected areas	-
		Freshwater resources	Water abstraction	Water quality in rivers
	Conservation of fish stocks	Marine ecosystems	-	Fishing capacity
		Land use	Increase in built up land	Forest increment and fellings
Public health	Life expectancy and healthy life years	Health and health inequalities	Deaths due to chronic diseases	Suicides
				Unmet needs for healthcare
		Determinants of health	Production of toxic chemicals	Exposure to air pollution by particulate matter
				Exposure to air pollution by ozone
				Annoyance by noise
				Serious accidents at work
Social inclusion	Risk of poverty or social exclusion	Monetary poverty and living conditions	Risk of poverty after social transfers	Intensity of poverty
			Severe material deprivation	Income inequalities
		Access to labour markets	Households with very low work intensity	Working poor
				Long term unemployment
				Gender pay gap
		Education	Early school leavers	Adults with low educational attainment
				Lifelong learning
				Low reading literacy performance of pupils
Demographic changes	Employment rate of older workers	Demography	Life expectancy at age 65 (men's)	Fertility rate
			Life expectancy at age 65 (women's)	Migration
				Elderly population compared to working-age population
		Old-age income adequacy	Income level of over 65s compared to before	Risk of poverty for over 65s
		Public finance	Public debt	Retirement age

Theme	Headline indicator (Level 1)	Subtheme	Level 2	Level 3
		sustainability		Expenditure on care for the elderly
				The impact of ageing on public expenditure
Global partnership	Official development assistance	Globalisation of trade	Imports from developing countries	Share of imports from least developed countries
				Subsidies for EU agriculture
		Financing for sustainable development	Financing for developing countries	Share of foreign direct investment in low-income countries
				Share of official development assistance for low-income countries
				Share of untied assistance
				Assistance for social infrastructure and services
				Assistance for debt relief
		Global resource management	CO_2 emissions per inhabitant	Assistance for water supply and sanitation
Good governance	-	Policy coherence and effectiveness	Infringement cases	Citizens confidence in EU institutions
				Transposition of Community law
		Openness and participation	Voter turnout	E-government availability
				E-government usage
		Economic instruments	Environmental taxes compared to labour taxes	-

This section has described the current metrics being measured by NRAs in terms of sustainability and has then discussed the context within which sustainable development in Europe should be considered and measured, i.e. the EU SDS. As indicated, NRAs can contribute both to sustainable transport and more widely to sustainable development and this will need to be considered as the framework is developed.

The following section provides detail on the stakeholder workshop.

5 Stakeholder workshop

5.1 Introduction

A stakeholder workshop was held on 14th May 2012 in London and was attended by sustainability leads from within NRAs, consultants, academics and industry leads from across Europe. The list of attendees can be found in Appendix A.

The workshop was held jointly with WP1[1], with half the session given to each work package.

5.2 Purpose of the workshop

The purpose of the workshop was to identify:

- How NRA would like to demonstrate sustainable development performance.
- What metrics and measures are important to NRAs.
- Any gaps in what is currently being reported and gaps in the research.

The agenda can be found in Appendix B.

5.3 Methodology

The workshop was split into three parts:

1. Presentation - A presentation was given to demonstrate the benefits of metrics and measures, demonstrate how they can be used within NRAs and present the results of the literature reviews.

2. Prioritisation of metrics - The attendees were given a list of the rationalised metrics and asked to prioritise these metrics based on whether they should be measured, shouldn't be measured or maybe should be measured.

3. Understanding the gaps - A group discussion was held after the prioritisation exercise to identify any gaps in the metrics and measures presented.

5.3.1 Prioritisation of metrics

The attendees were presented with a range of metrics and measures which had been identified through the literature review. These included the most commonly reported metrics that were currently being measured and those being proposed by wider research. The attendees were asked to identify their key priorities out of the list of metrics and measures provided, within the context of the definition of sustainability discussed in the WP1 presentation.

Each of the attendees was given 10 red, yellow and green sticky dots. They were asked to place these against the metrics and measures they felt were not a priority (red), could be a priority (yellow) or were a priority (green). The metrics and measures considered are listed in Appendix C.

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[1] Details of the workshop in relation to WP1 can be found in deliverable D3: Measures to Improve Sustainability – Framework Part 1 (August 2012).

5.3.2 Understanding the gaps

A group discussion was held where attendees were asked to discuss the feasibility of reporting these metrics and how they would be applied at senior leadership, programme and project level. The attendees were also asked to comment on any gaps that they had identified within the list of metrics given, as well as to make any comments they had in general about the metrics and measures that they had been presented with.

Following the workshop, the results of the prioritisation exercise and the group discussion were analysed to determine the priority metrics and identify the gaps. The results of this analysis are provided in section 5.4.

5.4 Results

5.4.1 Prioritisation of metrics

The metrics that were identified in the literature review were prioritised by the workshop attendees. In total 397 scores were given (151 green, 120 yellow and 121 red) to the 83 metrics, with an average of 20 of the 30 (10 green, 10 yellow, 10 red) scores being allocated by each of the attendees. Using these scores it was possible to prioritise the metrics identified in the workshop, as shown in Table 4.

The metric given the most priority by the attendees was 'CO$_2$ emissions from transport', which received a weighted score of 20. This was closely followed by 'operating cost' and 'reduction in carbon dioxide emissions as a result of NRA efforts which scored 19 and 18 respectively. In fourth and fifth place were 'material resource efficiency' (scoring 17) and 'KSI' (scoring 16).

In terms of metrics which were given least priority, 'number of bridges' scored -20, 'type of road' scored -14, and 'number of responses to complaints from NRA' scored -12. Notably, many more of the economic and social metrics received minus scores when compared to the environmental metrics. In fact, only four of the 21 environmental metrics received a weighted score of less than zero, these being: 'number of AQZAs in road network' (scoring -1), 'number of wildlife crossings on the network' (scoring -1), 'noise complaints' (scoring -2) and 'consumption of biofuels' (scoring -4). This equates to 19% of the environmental metrics, compared to 39% of the economic metrics and 50% of the social metrics.

Table 4: Priority metrics and measures

See Figure 6: NRA levels of influence for a description of the levels.

* To calculate the weighted score a green is given 2 points, a yellow 1 point and a red -2 points. Therefore a red and a green will score 0, two yellows and a red will score 0, a green, yellow and red will score 1 and a yellow and a red will score -1.

Level[#]	Pillar	Metric	Green	Yellow	Red	Weighted score[*]
User	Environment	CO$_2$ emissions from transport	9	2	0	20
Strategic function	Economic	Operating cost	8	3	0	19
Corporate	Environment	Reduction in carbon dioxide emissions as a result of NRA efforts	9	2	1	18
Strategic function	Environment	Material resource efficiency	7	3	0	17
User	Social	KSI	8	0	0	16
Strategic function	Economic	Residual life of pavements	6	3	0	15
User	Economic	Congestion	6	2	0	14
Strategic function	Environment	Habitat fragmentation	6	2	0	14

Level[#]	Pillar	Metric	Green	Yellow	Red	Weighted score[*]
User	Environment	Emissions of PM_{10}	7	1	1	13
User	Social	Number of accidents involving personal injury	6	0	0	12
User	Environment	Number of dwellings exposed to excessive noise	6	0	0	12
Strategic function	Economic	Traffic flow	5	4	1	12
Strategic function	Economic	Road condition	6	0	0	12
Strategic function	Environment	Proportion of road with managed drainage	3	5	0	11
Corporate	Environment	Carbon dioxide (CO_2) emitted by NRA	3	5	0	11
User	Social	Road user satisfaction	2	6	0	10
Strategic function	Environment	Carbon dioxide (CO_2) emitted by contractors	5	0	0	10
User	Economic	Travel time variability	5	1	1	9
Strategic function	Economic	Expenditure on road maintenance	4	1	0	9
Strategic function	Economic	Length of road constructed/re-surfaced	3	3	0	9
Corporate	Social	Accidents involving personal injury at roadwork sites on motorways and expressways	4	1	0	9
User	Environment	Greenhouse gas emission by Sector - transport	4	0	0	8
User	Economic	Modal split of freight transport	2	4	0	8
Strategic function	Economic	Expenditure on roads	3	1	0	7
Corporate	Social	NRA contribution to reduction in killed or seriously injured	2	3	0	7
User	Social	Number of complaints from stakeholders	1	3	0	5
Strategic function	Economic	Expenditure on road construction	2	1	0	5
Corporate	Environment	Travel carbon footprint for staff: commute and business travel	2	1	0	5
User	Economic	Volume of freight transport	2	0	0	4
User	Economic	Traffic volume	0	4	0	4
Strategic function	Environment	Cultural heritage	1	4	1	4
User	Environment	Length of road network within AQZA	3	1	2	3
User	Environment	Energy consumption by transport mode	1	1	0	3
User	Economic	Km travelled by road	1	1	0	3
User	Economic	Modal split of passenger transport	0	3	0	3
Strategic function	Environment	Number of managed drainage outfalls	0	3	0	3
Strategic function	Social	Length of road affected by schemes to reduce congestion and improve journey time reliability	0	3	0	3
Strategic function	Economic	Return on construction expenditure	1	2	1	2
Strategic function	Economic	Reduced travel time by car between regions and surrounding areas	1	0	0	2
Strategic function	Economic	Transport infrastructure investment	0	2	0	2
Strategic function	Economic	Contractor delivery of maintenance service according to contracts	0	2	0	2

Level[#]	Pillar	Metric	Green	Yellow	Red	Weighted score[*]
User	Environment	Percentage of energy consumption of transport over GDP	1	1	1	1
User	Social	Number of casualties	0	1	0	1
User	Economic	Total motor vehicles	0	1	0	1
Strategic function	Environment	Outfalls with water quality treatment	0	1	0	1
User	Economic	Vehicle ownership per capita	0	2	1	0
User	Social	Number of fatalities	0	0	0	0
User	Economic	Volume of passenger transport	0	0	0	0
User	Economic	Number of registered motor vehicles	0	0	0	0
Corporate	Social	Gender balance - female executives	0	4	2	0
Corporate	Social	Reduce the average annual level of absenteeism due to sickness	0	4	2	0
Corporate	Social	Develop a plan to address issues identified in the NICS staff attitude survey	0	2	1	0
User	Environment	Number of AQZAs in road network	0	1	1	-1
Strategic function	Economic	Length of road network	1	1	2	-1
Strategic function	Environment	Number of wildlife crossings on the network	0	3	2	-1
Strategic function	Economic	Reduced travel time by car between rural areas and main towns	0	1	1	-1
User	Environment	Noise complaints	2	2	4	-2
User	Economic	Cars per 1,000 inhabitants	0	2	2	-2
Strategic function	Economic	Funds allocated for construction schemes to eliminate bottlenecks	0	1	2	-3
Strategic function	Economic	Total stoppages on the state road network	0	1	2	-3
Corporate	Social	Gender balance - female employees with higher education	1	1	3	-3
User	Environment	Consumption of biofuels	1	0	3	-4
User	Social	Number of accidents	0	0	2	-4
User	Economic	Number of new motor vehicles registered	0	0	2	-4
Strategic function	Economic	Road network density	0	2	3	-4
Strategic function	Economic	Reduction in travel speeds because of new road project openings	0	0	2	-4
Strategic function	Economic	Deployment of asphalt compared to expenditure	0	0	2	-4
Corporate	Social	Employee satisfaction	0	2	3	-4
Strategic function	Economic	Length of new road completed	0	0	3	-6
Strategic function	Social	Population/ km ITS/ICT constructed	0	0	3	-6
Corporate	Social	Implement Information Security Strategic Action Plan	0	2	4	-6
Corporate	Social	Ethnic diversity - immigrant employees with higher education	0	0	3	-6
Strategic function	Social	Population/ km new road/lanes constructed	0	0	4	-8
Corporate	Social	Complete the transfer of powers to the local councils in support of the Review of Public Administration	1	0	5	-8

Level[#]	Pillar	Metric	Green	Yellow	Red	Weighted score[*]
Corporate	Social	Inform applicants for Blue Badges of our decision within 15 working days of receipt of their valid applications	0	0	4	-8
Strategic function	Economic	Width and type of pavement	0	1	5	-9
Corporate	Social	Respond to written enquiries from customers within 15 working days	0	1	5	-9
Strategic function	Economic	Number of truck parking spaces on the motorway/expressway network	0	0	5	-10
Strategic function	Economic	Development for the length of road with reduced bearing capacity caused by spring thaw	0	0	5	-10
Corporate	Social	By July 2010 to have developed new organisational structures for the Roads Service	0	0	6	-12
Corporate	Social	Number of responses to complaints from NRA	0	0	6	-12
Strategic function	Economic	Type of road	0	0	7	-14
Strategic function	Economic	Number of bridges	0	0	10	-20

As a result of the prioritisation, we can therefore look to discount a number of metrics and also prioritise metrics based on user, strategic function and corporate activities.

Table 5 shows the 20 metrics and measures in the user category that received a weighted score of +1 or more. In this category, CO_2 emissions of transport scored the highest, followed by KSI and then congestion.

Table 5: Prioritisation of user metrics and measures

Pillar	Metric	Weighted score[*]
Environment	CO_2 emissions from transport	20
Social	KSI	16
Economic	Congestion	14
Environment	Emissions of PM_{10}	13
Social	Number of accidents involving personal injury	12
Environment	Number of dwellings exposed to excessive noise	12
Social	Road user satisfaction	10
Economic	Travel time variability	9
Environment	Greenhouse gas emission by Sector – transport	8
Economic	Modal split of freight transport	8
Social	Number of complaints from stakeholders	5
Economic	Volume of freight transport	4
Economic	Traffic volume	4
Environment	Length of road network within AQZA	3
Environment	Energy consumption by transport mode	3
Economic	Km travelled by road	3
Economic	Modal split of passenger transport	3
Environment	Percentage of energy consumption of transport over GDP	1
Social	Number of casualties	1
Economic	Total motor vehicles	1

Table 6 shows the metrics and measures in the strategic function category that received a weighted score of +1 or more. Similar to the user category, 20 metrics scored one or more. In this category, operating cost scored the highest, followed by material resource efficiency and then the residual life of pavements.

Table 6: Prioritisation of strategic function metrics and measures

Pillar	Metric	Weighted score[*]
Economic	Operating cost	19
Environment	Material resource efficiency	17
Economic	Residual life of pavements	15
Environment	Habitat fragmentation	14
Economic	Traffic flow	12
Economic	Road condition	12
Environment	Proportion of road with managed drainage	11
Environment	Carbon dioxide (CO_2) emitted by contractors	10
Economic	Expenditure on road maintenance	9
Economic	Length of road constructed/re-surfaced	9
Economic	Expenditure on roads	7
Economic	Expenditure on road construction	5
Environment	Cultural heritage	4
Environment	Number of managed drainage outfalls	3
Social	Length of road affected by schemes to reduce congestion and improve journey time reliability	3
Economic	Return on construction expenditure	2
Economic	Reduced travel time by car between regions and surrounding areas	2
Economic	Transport infrastructure investment	2
Economic	Contractor delivery of maintenance service according to contracts	2
Environment	Outfalls with water quality treatment	1

Table 7 shows the five metrics and measures in the corporate category that received a weighted score of +1 or more. In this category, reduction in carbon dioxide emissions as a result of NRA efforts scored the highest, followed by carbon dioxide (CO_2) emitted by NRA and then accidents involving personal injury at roadwork sites on motorways and expressways.

Table 7: Prioritisation of corporate metrics and measures

Pillar	Metric	Weighted score[*]
Environment	Reduction in carbon dioxide emissions as a result of NRA efforts	18
Environment	Carbon dioxide (CO_2) emitted by NRA	11
Social	Accidents involving personal injury at roadwork sites on motorways and expressways	9
Social	NRA contribution to reduction in killed or seriously injured	7
Environment	Travel carbon footprint for staff: commute and business travel	5

Overall it seems that the attendees prioritise CO_2 as a key metric for all three activities. They also highlighted cost and safety as other key areas requiring measurement.

As well as looking at the metrics within the three functions of an NRA, we can also assign these prioritised metrics (i.e. those scoring +1 or more) to common (sustainability) topic areas. Consequently, as shown in Table 8, the priority metrics have been categorised into 14 topics. These being:

- Carbon
- Cost
- Materials resource efficiency
- Safety
- Congestion/travel time
- Ecology
- Air quality

- Noise
- Road condition
- Water quality
- User satisfaction
- Modal split
- Cultural heritage
- Contract management

Our review of the metrics in Section 4 determined that an NRA could be expected to measure up to a maximum of 30 metrics. There is therefore also scope to fill a number of gaps, should one metric be identified for each topic.

Table 8: Metrics and measures by topic area

Level	Topic area	Metric	Weighted score[*]
User	Carbon	CO_2 emissions from transport	20
Corporate	Carbon	Reduction in carbon dioxide emissions as a result of NRA efforts	18
Corporate	Carbon	Carbon dioxide (CO_2) emitted by NRA	11
Strategic function	Carbon	Carbon dioxide (CO_2) emitted by contractors	10
User	Carbon	Greenhouse gas emission by Sector - transport	8
Corporate	Carbon	Travel carbon footprint for staff: Commute and Business travel	5
User	Carbon	Energy consumption by transport mode	3
User	Carbon	Percentage of energy consumption of transport over GDP	1
Strategic function	Cost	Operating cost	19
Strategic function	Cost	Expenditure on road maintenance	9
Strategic function	Cost	Expenditure on roads	7
Strategic function	Cost	Expenditure on road construction	5
Strategic function	Cost	Return on construction expenditure	2
Strategic function	Cost	Transport infrastructure investment	2
Strategic function	MRE	Material resource efficiency	17
User	Safety	KSI	16
User	Safety	Number of accidents involving personal injury	12
Corporate	Safety	Accidents involving personal injury at roadwork sites on motorways and expressways	9
Corporate	Safety	NRA contribution to reduction in killed or seriously injured	7
User	Safety	Number of casualties	1

Level	Topic area	Metric	Weighted score[*]
User	Congestion/ travel time	Congestion	14
Strategic function	Congestion/ travel time	Traffic flow	12
User	Congestion/ travel time	Travel time variability	9
User	Congestion/ travel time	Traffic volume	4
User	Congestion/ travel time	Km travelled by road	3
User	Congestion/ travel time	Modal split of passenger transport	3
Strategic function	Congestion/ travel time	Length of road affected by schemes to reduce congestion and improve journey time reliability	3
Strategic function	Congestion/ travel time	Reduced travel time by car between regions and surrounding areas	2
User	Congestion/ travel time	Total motor vehicles	1
Strategic function	Ecology	Habitat fragmentation	14
User	Air Quality	Emissions of PM10	13
User	Air Quality	Length of road network within AQZA	3
User	Noise	Number of dwellings exposed to excessive noise	12
Strategic function	Road condition	Residual life of pavements	15
Strategic function	Road condition	Road condition	12
Strategic function	Road condition	Length of road constructed/re-surfaced	9
Strategic function	Water Quality	Proportion of road with managed drainage	11
Strategic function	Water Quality	Number of managed drainage outfalls	3
Strategic function	Water Quality	Outfalls with water quality treatment	1
User	User Satisfaction	Road user satisfaction	10
User	User Satisfaction	Number of complaints from stakeholders	5
User	Modal Split	Modal split of freight transport	8
User	Modal Split	Volume of freight transport	4
Strategic function	Cultural Heritage	Cultural heritage	4
Strategic function	Contract Management	Contractor delivery of maintenance service according to contracts	2

5.4.2   Understanding the gaps

After completing the exercise in which they prioritised the metrics, the attendees were asked to comment on two issues as part of a group discussion. Firstly, whether they had identified any gaps in the metrics that had been presented to them and secondly, whether they had any thoughts on how best to measure NRA performance in terms of sustainability.

The attendees identified a number of gaps in relation to what is currently being measured and suggested by wider research. These are shown below in Box 8. As shown, gaps were identified in relation to a variety of environmental, social and economic topics.

- Climate change adaptation/resilience of the network
- Cultural heritage
- Cycling, for NRAs that have a remit in this area
- Job creation and training for the local community
- Noise in relation to dwellings
- Procurement, such as sustainable or environmentally friendly tenders
- Renewable energy production
- Road user charging

Box 8: Gaps in metrics and measures identified by workshop attendees

In terms of measuring performance the attendees made numerous interesting points, including that:

- Little is mentioned in relation to how provincial and regional NRAs feedback into the process. It was suggested that these levels of NRAs could be asked whether they consider their higher level (i.e. national) NRA to be sustainable.

- Environmental bodies could be asked whether projects and their impacts turned out as they expected.

- It is likely to be an issue getting contractors to report on new KPIs when they are already part way through a long-term contract. It was commented that contractors will not report on anything that is not a requirement of their contract.

- All of the impacts being assessed could be turned into positives.

- Consideration should be given to using DPSRI (Drivers, Pressures, Stresses, Response and Impacts).

- Consideration should be given to different socio-economic groups and measuring the different impacts on these groups.

- There is a need to consider how to get the supply chain involved in the process.

- It may not be worthwhile including measures that are legal requirements as you would expect NRAs to be doing these anyway. Also there is an issue in relation to what is required in one country not necessarily being applicable elsewhere, i.e. as a result of different interpretations of EU directives.

5.5 Summary

As shown in the previous section the workshop has allowed for the metrics and measures identified in the literature review to be prioritised within their category (i.e. user, strategic function or corporate). Some of the metrics identified can now be discounted as they were not considered to be a priority, whereas other such as CO_2 emissions, operating cost and KSI will need to be considered further as the framework develops. The workshop has also highlighted that there are a number of key topic areas within sustainability that are considered to be important for NRAs.

The next section describes a number of good practice studies that will also help to inform the development of the framework.

6 Good practice case studies

NRAs across Europe, North America and Asia have implemented strategic measures that improve sustainability and performance. In this section we discuss a number of good practice examples that have been identified which inform the development of the Framework Part 2 – Metrics and Measures.

6.1 Introduction

The project team consulted contacts in NRAs from Europe, North America and Asia to identify good practice examples of client interventions that have created improved performance in sustainability. The purpose of this exercise was to identify practical examples that have been implemented by NRAs. The examples represent a mix of completed and on-going initiatives which demonstrate that intervention is possible and can have a positive effect on an organisation as a whole.

The examples described are:

- Sustainability as a measure of true value – Highways Agency (England).

- The power of sustainable procurement – Commissioners of infrastructure projects in the Netherlands.

- Incorporating sustainability into decision-making – New York State Department of Transportation (US).

6.2 Sustainability as a measure of true value – Highways Agency (England)

6.2.1 Background

The UK Highways Agency manages the maintenance of the highways and trunk road network in England. They do this through a series of asset support contracts let to consortia of consultants and contractors (Operating Contractors (OCs)) that manage and deliver the maintenance of the network, which is divided into 13 areas.

The OC surveys the network and monitors its condition. They produce an outline programme of work that meets the HA priorities set out in their policy documents. Potential schemes are scored using the value management scoring system. High score schemes are put forward into year 1 and lower score schemes are put back to be re-evaluated for later years. This is shown in Figure 11.
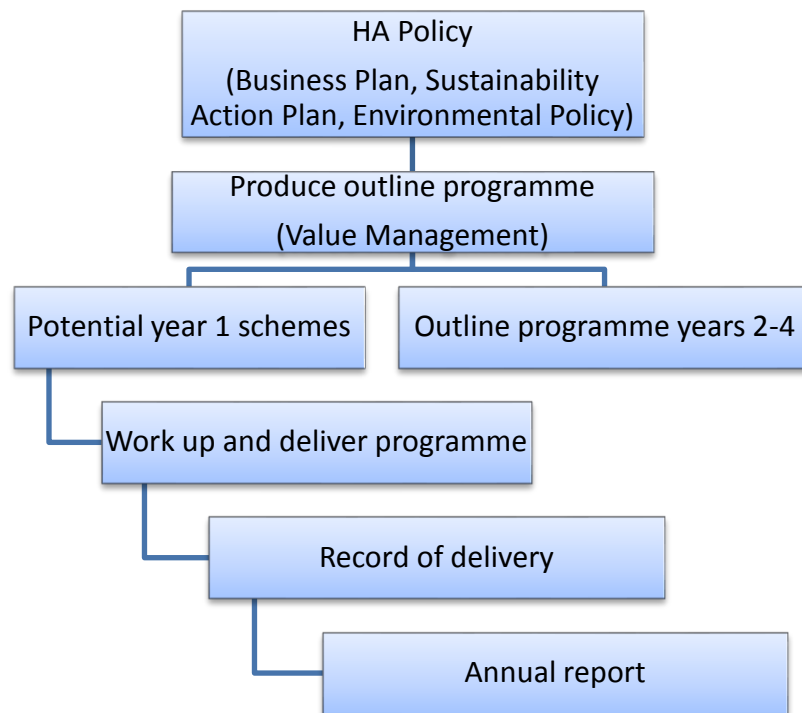
Figure 11: HA maintenance programme delivery process

The Value Management (VM) process is used to evaluate the programme of maintenance presented by the OC. A score is developed for safety, value for money and environment. The principle is that the projects that; demonstrate the most value to the HA; are safe; and limit the impact on the environment, will go forward.

The assessment is completed at the scheme identification stage and then repeated at design and at construction. This ensures that proposals identified at the start of the project are implemented later in the project.

6.2.2   Integrating sustainability into contract management

This system effectively integrates sustainability into contract management by implementing a structure that ensures projects are assessed based on sustainability criteria before they go ahead. The HA hold a value management meeting to discuss projects and only allocate funds when they are happy that the proposed projects fulfil the required criteria.

6.2.3   Reasons for adopting the value management system

The HA developed the system to ensure that the projects that were delivered presented the most value to the agency. The value management system started as a process looking at just value for money; however it has been developed to also include safety and environmental factors. In 2011, the system was expanded so that it now assesses:

- Safety (30% of marks)
- Value for money (50% of marks)
- Environment (20% of marks) including:
    - Air quality
    - Noise and vibrations
    - Material resources

- o Construction waste

- o Soil and geology

- o Nature conservation

- o Water quality

- o Flooding

- o Landscape / Townscape

- o Cultural heritage

- o Accessibility

- o Society and community

- o Energy use

The value management system ensures that these factors are considered when the contractor is developing a project. The weighting enables the HA to assign priority to value for money, then safety, and finally environment.

The effect is that projects only go forward if the project demonstrates the benefits required by the HA. This has enabled the HA to take advantage of new techniques during the course of a contract and save money as a result.

6.2.4   Lessons learnt

The primary function of the value management process is to achieve value for money and as such the process is set up in this way. Introducing safety has had a large impact as it represents a significant percentage of the score. However, the environmental elements only have a marginal effect on the overall assessment as the 13 elements only share 20% of the score. This has resulted in significant work being carried out in terms of looking at environmental factors for a relatively small consideration in terms of the overall project.

6.3 The power of sustainable procurement - Commissioners of infrastructure projects in the Netherlands

6.3.1   Background

The Dutch government, provinces, water boards and municipalities together annually spend almost 60 billion euros[2]. The various levels of Dutch government have agreed objectives for sustainable procurement, in order to stimulate the public market for sustainable products and services and to set an example for other organisations. In 2010 the government objective was to achieve 100% sustainable procurement, for municipalities and water boards this was 75% and for provinces this was 50%. By 2015, all levels of government and the water boards have committed themselves to achieve 100% sustainable procurement.

To specify what qualified as sustainable procurement, criteria were developed for each product group (for example office supplies, transport, buildings) under the supervision of the Ministry of Infrastructure and Environment, among others for the product group infrastructure. The criterion however was considered to be unsatisfactory by both the commissioners of infrastructure projects (including the NRA and rail companies) and contractors, as they provided little differentiation from normal 'non-sustainable' practices. As a result, a number of large commissioners and companies took the initiative to further develop sustainable

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[2] http://www.pianoo.nl/dossiers/duurzaam-inkopen-1 (in Dutch)

procurement in the civil engineering sector[3]. This initiative, called 'Sustainable Civil Engineering' (in Dutch: '*Duurzaam GWW'*), has led to a shared approach being developed by the commissioners and contractors.

The approach to 'Sustainable Civil Engineering' is comprised of a phased development plan which provides guidance at all phases of procurement, from early initiatives to the realisation and use phase[4]. As part of this approach several tools have been developed, including 'the CO_2 performance ladder' and 'DuboCalc'. These two tools can be utilised during the tender process to stimulate sustainability by creating a tangible benefit in the form of a - fictional - discount on the bid.

6.3.2   Sustainable procurement by the Dutch NRA

The Dutch NRA has successfully applied the procurement approach 'most economically advantageous tender' (in Dutch: *EMVI, Economisch Meest Voordelige Inschrijving),* with contracts normally granted to the lowest bid. However, using this sustainable procurement approach other criteria beside price can also be taken into account, such as environmental sustainability, reduction of traffic delays, etc., by virtually lowering the bid if other criteria are met. For example:

- During the construction works on the A1 Highway near Amsterdam there was a focus on the reduction of traffic delay. Project proposals with the least (zero) vehicle hours lost during the period of construction could gain a fictional discount of up to 30% of the tender bid. The vehicle hours lost were calculated using a dynamic traffic model.

- During the reconstruction of the National Road N61 (Hoek- Schoonedijke) there was a focus on the reduction of the environmental impact of the materials used. Here both the DuboCalc and the CO_2 performance ladder tools were used in the tender process (see next paragraph for an explanation of these instruments). Here again project proposals with a low environmental impact gained a fictional discount.

6.3.3   Instruments used to measure performance in sustainable procurement

The next paragraphs provide detail of two instruments currently being used in the Netherlands to improve sustainable procurement.

CO_2 performance ladder

The CO_2 performance ladder is a tool to help stimulate companies to consider CO_2 when tendering for work. The premise of the ladder is that efforts made by companies to improve sustainability (by reducing emissions) are rewarded. Thus, a higher score on the ladder is rewarded with a tangible benefit in the tender process in the form of a - fictional - discount on the bid.

The CO_2 ladder has 5 steps or levels, rising from 1 to 5, based on the extent of action taken by the company. The aim of the ladder is (1) to encourage companies to *know* their own CO_2 emissions - and the emissions of their suppliers and (2) to permanently *look for new emission reduction opportunities* in their own operations and in their projects. The ladder is encouraging companies then to (3) *actually reduce emissions*, (4) *share* the gained *knowledge* in a transparent manner and (5) *actively seek other emission reduction options together with colleagues, knowledge institutions, social organizations and governments.*

Each company inventories its own CO_2 performance on the basis of a certification scheme and audit checklists. A Certifying Institution (CI) then authenticates the statements made by the company based on information presented in technical reports, policy reports, company

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[3] http://www.duurzaamgww.nl/index.php/waarom/ (in Dutch)
[4] http://www.duurzaamgww.nl/index.php/publicaties/ Factsheet de Aanpak Duurzaam GWW (in Dutch)

records, annual reports etc. The CI sets the CO_2 performance ladder level reached by the company, and awards the corresponding CO_2 Awareness Certificate. The higher the level of certification, the larger the fictional discount the company is awarded in the tender process[5], with level 5 now being awarded a 10% fictional discount.

A company's performance in terms of the ladder says something about the way a company looks at its direct CO_2 emissions; however it does not specifically focus on indirect emissions such material usage during projects. Combining its use with more project focussed instruments could be beneficial.

Since the first use of the CO_2 performance ladder in 2009, by the Dutch railway organisation, many Dutch contractors have certified their company, with all large contractors now achieving (the highest) level of certification (5).

DuboCalc

DuboCalc is a computer program, especially developed for the civil engineering sector, used to evaluate the environmental performance of materials and energy used. It was developed by the Dutch NRA, in dialogue with other authorities and businesses/contractors. DuboCalc is based on the standardized methodology of life cycle assessments (LCA). It can be used to calculate the environmental performance of (different) infrastructure designs, thereby enabling optimization of design. The environmental performance achieved is expressed as Environmental Costs (in Dutch: *Milieu Kosten Indicator, MKI*).

The use of DuboCalc in procurement is relatively new. However, one example of its use was for the construction works on the N61. For this project, the Dutch NRA developed a reference design that had an environmental performance of 8 million MKI. This value was then set as the maximum allowed environmental costs for the project. The maximum fictional reduction on the bid was 2 million Euros and could be earned by designs with an environmental performance of 6 million MKI or less. All of the designs that scored in between the maximum of 8 million MKI and 6 million MKI were given a reduction proportional to the achieved environmental cost reduction. The contractor that acquired the project has to prove that the project is executed within the environmental performance stated in the bid. If the environmental impact is larger the contractor has to pay a fee of 1.5 times the amount of the given reduction[6].

The Dutch NRA is committed to applying DuboCalc in the procurement process of other projects in the future.

6.3.4 Benefits of implementation

The Dutch NRA considers that they have benefited from the introduction of sustainable procurement processes as overall it has resulted in quicker innovation and implementation of more environmentally friendly practices and materials by contractors. Incorporating sustainability into procurement processes provides the business case for contractors to, for example, develop new more environmentally materials, which will help them win work.

6.3.5 Lessons learnt

Sustainable procurement has had a beneficial impact over the last few years in the Netherlands with most contractors working in civil engineering now acting on reducing CO_2 emissions according to the requirements for certification on the CO_2 performance ladder. The incentive to do so was given in the procurement process in the form of a fictional discount on the registration fee.

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[5] http://www.co2-prestatieladder.nl/index.php?ID=18 (in Dutch)

[6] Powerpoint presentation: Reconstructie N61 Hoek – Schoondijke. Duurzaam inkopen met CO2-prestatieladder en DuboCalc. John Duijsens, Rijkswaterstaat (in Dutch)

The same approach was taken for other desired sustainability goals, such as the reduction of environmental impact or traffic nuisance. It has been shown that by using instruments that can measure the performance of a service or a product, the market can be given maximum freedom to find the most (cost) effective solution.

6.4 Incorporating sustainability into decision-making – New York State Department of Transportation (the US)

6.4.1   Background

New York is a state in the Northeastern region of the United States. It has a population of over 19 million, including 8 million who live within New York City, and an area of 121,000 km^2 (United States Census Bureau, 2010). The New York State Department of Transportation (NYSDOT) is responsible for "coordinating and developing comprehensive transportation policy for the State; coordinating and assisting in the development and operation of transportation facilities and services for highways, railroads, mass transit systems, ports, waterways and aviation facilities; and, formulating and keeping current a long-range, comprehensive statewide master plan for the balanced development of public and private commuter and general transportation facilities" [7].

The New York State Transportation network includes:

- A state and local highway system that annually handles over 130 billion vehicle miles. This total system encompasses more than 113,000 highway miles and more than 17,400 bridges.

- An extensive 3,500-mile rail network over which 68 million tons of equipment, raw materials, manufactured goods are produce and shipped each year.

- 485 public and private aviation facilities through which more than 80 million people travel each year.

- Over 130 public transit operators, serving more than 80 million passengers each day.

- 12 major public and private ports[8].

The NYSDOT is committed to improving the quality of their transportation infrastructure in ways that minimise impacts to the environment and as a result the organisation is taking action at several levels to ensure that sustainability is considered in its decision-making processes. NYSDOT is now incorporating "Triple Bottom Line" thinking (economic, social, and environmental) beyond the operational level (the "how") and the more tactical level (the "what") into the strategic level (the "why"). Box 9 outlines the sustainability policy in place at the Department.

Sustainability Vision

Exemplify how transportation supports a sustainable society.

Sustainability Mission

To fully integrate sustainability into the Department's decisions and practices in planning, designing, constructing, maintaining and operating New York State's transportation system. NYSDOT will also model and advance sustainability in managing its internal resources.

Sustainability Definition

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[7] https://www.dot.ny.gov/about-nysdot/responsibilities-and-functions
[8] https://www.dot.ny.gov/about-nysdot/history/past-present

A sustainable society manages resources in a way that fulfils the social (community), economic and environmental needs of the present without compromising the needs and opportunities of future generations.

A transportation system which supports a sustainable society is one that:

1. Allows individual and societal transportation needs to be met in a manner consistent with human and ecosystem health with equity within and between generations.

2. Is safe, affordable, accessible, operates efficiently, offers choice of transport mode, and supports a vibrant economy.

3. Protects and preserves the environment by limiting transportation emissions and wastes, minimizes the consumption of resources and enhances the existing environment as practicable.

Overarching Sustainability Strategies

NYSDOT will advance sustainability by following these strategies:

- Develop, advocate and advance Department sustainability goals, objectives and strategies through interaction with Main Office and Regional employees, program areas, workgroups and external stakeholders.

- Incorporate sustainability concepts into the Department's procedures, investments, policies, manuals, specifications, programs, projects and practices.

- Use the Sustainability Steering Committee as a feedback loop so that constructive participation is vetted through Executive Management.

- Develop and use sustainability measures and indicators to better manage NYSDOTs internal resources and programs.

- Facilitate partnerships through sharing of ideas and best practices.

- Evaluate the costs and benefits (societal, environmental and economic) of transportation investments over life-cycles as well as fiscal cycles.

Box 9: NYSDOT Sustainability Policy[9]

This case study will examine the reasons for implementing the system and how the system developed through its GreenLITES (Green Leadership in Transportation Environmental Sustainability) program. It will also consider measuring performance, the benefits of the system (to NYSDOT and more widely) and the lessons learnt for SUNRA.

6.4.2 "Preservation First"

To ensure that the Department is making good decisions and meeting the needs of their customers, four guiding principles have been identified. The "Forward Four" principles are: Preservation First, System not Projects, Maximize Return on Investment, and Make it Sustainable (Box 10). Individually these principles emphasise a sustainable approach to consider economic competitiveness, environmental stewardship and social equity, while collectively they ensure the integration of sustainability into all of NYSDOTs decisions and investments.

By following these principles, the Department is aiming to maximise the life of existing infrastructure and improve safety, while working to improve livability and promote economic development, within the context of limited financial resources. The following Box provides more detail of the "Forward Four" which are being followed by NYSDOT.

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[9] https://www.dot.ny.gov/programs/greenlites/sustainability

1. Preservation First

The primary focus is on system perseveration and safety, a strategy which is cost-effective (in fiscally constrained times), provides a solid foundation for a sustainable future, and supports the triple bottom line of sustainability.

In terms of economy, preserving linkages to communities and businesses, and slowing or reversing the rate of infrastructure deterioration, supports economically viable communities and makes economically sound, cost effective and affordable decisions for now and for the future.

For society, this strategy focuses the Departments funds on the right treatment, at the right time, and in the right place. For example, the right place considers public benefits such as safety, access/proximity to emergency services, businesses, schools, and modal choices, as well as corridor services such as freight movement and transit.

For the environment, preservation maximise the use of existing materials and infrastructure, reduces waste and minimises footprint.

2. System not Projects

This more holistic approach to transportation decisions considers projects in the context of the larger transportation system, community network and landscape. When making decisions the Department considers and prioritises projects in a manner that treats them as key components or critical links with the larger state transportation system.

3. Maximize Return on Investment

The structure of sustainable programs should be one that maximises all forms of return on investment, with an emphasis on proper management of assets with appropriate treatments, at appropriate times, and at appropriate locations. It is also important that alongside the measurement of economic benefits, the non-economic benefits of transportation projects are also captured. These include the effects on user costs, the environment, CO^2 emissions, and other social and environmental aspects.

4. Make is Sustainable

A sustainable approach to programming should consider the relative and cumulative value of transportation assets as they benefit the public, economy and environment. NYSDOTs decision making process therefore looks broadly at the wider benefits of the programs undertaken by the Department. In terms of economic competiveness, the Department looks to improve efficiencies in work/business travel and freight travel, improve access for tourism and inter-modal connectivity and develop investments which complement or enhance the strategic investments proposed by Regional Economic Development Councils. For social equity and community they aim to improve accessibility for transit, recreation, education, and healthcare, support smart growth, complete streets and livablity, increase safety and consider risks of climate change to transportation infrastructure. Finally, in terms of environmental stewardship the Department will look at increasing energy efficiency, reducing greenhouse gas emissions, reducing resource consumption, limiting impacts that encroach on the environmental footprint, and improving air quality.

Box 10: Summary of the Forward Four Principles (adapted from Nelson et al, 2011)

Although it is recognised that preserving specific transportation assets is important, it is the combination of all of the assets that creates the system and supports the future quality of life and economy of the state. NYSDOT is therefore developing its program within the context of the system as a whole and recognising current fiscal constraints, is considering its investment strategies in a manner that both maximises public benefits and is affordable over the long term. NYSDOT considers sustainability concepts, such as those highlighted above, to be overarching and as a result they are now used throughout the program and project development processes. The following section highlights how the Department is now incorporating sustainability throughout its decision-making processes.

6.4.3 Incorporating sustainability at a strategic level

The incorporation of sustainability into NYSDOT decisions initially started with the implementation of the GreenLITES program. This is a project level self-certification rating system, which begins at the project scoping stage and is finalized at plans, specification and estimate stage, which looks at how a project can be made as green as possible. Primarily, the program is an internal management program that enables the Department to measure their performance, recognise good practices and identify where they need to improve. It was realised however that although this was proving useful there was a need to consider sustainability earlier in the decision-making process, i.e. before getting to project level.

The requirement to consider sustainability at all levels of decision-making and not just at the project level was encouraged by the Department's Commissioner, who set a principle to ensure that the Department was helping to deal with issues being felt in the local community despite current fiscal constraints. The Commissioner put together a team whose remit was to consider how decision-making processes could be improved at the strategic level and how they could incorporate consideration of the triple bottom line.

As a result it was decided to incorporate the consideration of sustainability into its programming and investment decisions. Each of the 11 regions is required to consider how the projects in their five year capital program contribute to the "Triple Bottom Line" and as each program is reviewed at the strategic level (by the asset management framework) the proposals will be reviewed (by the asset management sustainability team) to check they meet a set of sustainability criteria.

Incorporating sustainability issues into decision-making is considered by the Department to be the right way of making decisions and not something that should result in the introduction of a whole new decision-making system – it is about looking at decisions holistically.

Figure 12 summarises the processes in place for considering sustainability throughout the decision-making processes.

Sustainability Policies	• The Department has a vision for sustainability, along with a sustainability mission and overarching sustainability strategies. • The Commissioner is encouraging the consideration of sustainability to improve decision making within the fiscally constrained period.
Forward Four Principles	• The four principles have been developed to ensure that NYSDOT is making good decisions. • They include: Preservation First, System not Projects, Maximize Return on Investment, and Make it Sustainable. Collectively these ensure integration of sustainability into the Departments decisions and investments.
Triple Bottom Line	• Each of the 11 regions must consider how their five year capital program contributes to the economy, society and the environment. • Their contributions to the "Triple Bottom Line" are assessed by the Asset Management Sustainability Team before the program is approved.
Greenlites	• Each project within the regions five year program is assessed through the Greenlites program at the scoping stage to ensure that is is as "green" as possible. • Best practice is feedback up to improve future performance.
Procurement	• NYSDOT work with their supply chain to ensure that the Greenlites assessment is implemented on projects and innovations that improve sustainability performance are encouraged.

Figure 12: Incorporating sustainability into decision-making at NYSDOT

6.4.4 Measuring performance

NYSDOT are currently in the process of developing measures to monitor the performance of their capital programs in relation to sustainability. They are looking to develop a suite of measures, hopefully making use of existing metrics, however they recognise that finding the right mix of measures is a challenge.

In terms of the Greenlites program there is however already some monitoring processes in place. For example, when projects that are under construction are around 75-80% complete a Project Quality Assurance Report (PQAR) is completed which includes some feedback in relation to Greenlites (and sustainability). PQAR findings are fed back into the system so that lessons can be learnt on what has and hasn't been achievable in terms of greening projects. At a project level the Department is also to track some of the benefits achieved – however this is not yet done as a matter of course.

6.4.5   Benefits of the system

The system of considering sustainability at a strategic level, in addition to at the project level, is thought to be beginning to change the way that teams are thinking about their projects, with sustainability being seen as a key part of the decision-making system. This is beneficial to NYSDOT as it ensures that the "Triple Bottom Line" is being considered at all stages of projects and by all project teams with consequent improvements to their schemes. For the wider society, consideration of sustainability at all levels by the Department should help to ensure that all transportation schemes delivered are as a result of environmentally, socially and economically responsible decisions. Thereby ensuring benefits to the local community, protection and enhancement of the environment, and value for money.

Change takes time and commitment, and requires support and engagement from all levels. By linking their vision to their actions, taking a systems approach as they empower their leaders and coalitions, NYSDOT is interweaving its sustainability vision into its culture. NYSDOT's statewide and regional Sustainability Asset Management Teams are promoting sustainability best practices in asset management across the state and across disciplines and program areas. The immediate engagement of the teams has helped to strengthen the importance of the effort and to engage the team leaders in shaping the emerging sustainability tools and guidelines. These evolving efforts and sustainability asset management structure have great potential for pushing sustainability further into NYSDOT's culture – from the regional program area level to the Commissioner level and to its external partners and stakeholders.

6.4.6   Lessons learnt

- The NYSDOT recognises that sustainability is an overarching principle and that part of the success of the program has been its ability to be flexible and adaptable as a result of not being constrained by prescriptive legislation.

- An asset management framework which includes sustainability as an over-arching principle is helping NYSDOT look strategically and critically at investment choices and better inform those involved in the decision-making process. NYSDOT made a conscience decision to create a separate sustainability team within its new asset management framework to ensure sustainability is considered in all asset teams and during the capital program update process.

- Experience in the Department of implementing sustainability practices has shown that there is a need to partner with contractors to allow flexibility rather than put in place mandates requiring improvements to project sustainability. Where the Department has tried in the past to mandate sustainability improvements they have seen the costs of work provided by contractors increase significantly, however where changes have just been strongly recommended the cost increases have been seen to be more manageable.

- The multidisciplinary approach undertaken when implementing the system which involved each of the individual departments within the NYSDOT in the process has been seen as important in its success ensuring that the whole Department feels engaged in the process.

- Executive management commitment and willingness to dedicate Department personnel to work on devising and managing the sustainability effort is crucial to the efforts success.

7 Developing the framework

7.1 Introduction

The findings outlined in the previous sections of the report have been used to develop a sustainability framework which has been provided as a separate standalone document, 'Measures to Improve Sustainability, Framework Part 2: Framework'. This Section describes how the key findings from the literature review, workshop and case studies were used to develop the framework and this is illustrated schematically in Figure 13.

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┌─────────────────────────────────────────────────────────────┐
│                      The Framework                           │
└─────────────────────────────────────────────────────────────┘
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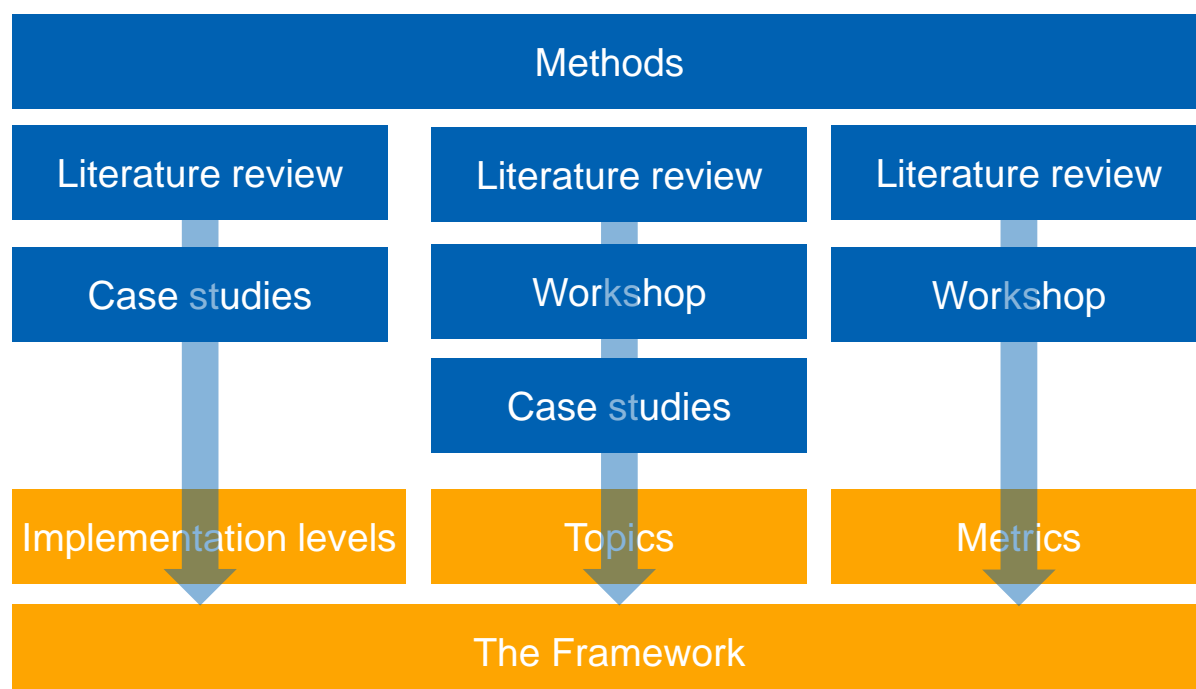
Figure 13: Development of the framework

7.2 Selecting the levels of implementation

NRAs are set up to deliver on their strategic functions, with their current targets and metrics focused towards achieving this. From the good practice case studies discussed in Section 6, we can see that this is the major focus for implementing sustainability within the NRAs, however they do also demonstrate that actions are taken at different levels of their organisations (board, programme and project), as shown in Table 9.

Table 9: How NRAs have implemented sustainability at the different levels

Level	Case study		
	Highways Agency (England)	**New York State Department of Transport**	**Commissioners of Infrastructure in the Netherlands**
Board	N/A	Support from the Commissioner.	Agreed an initiative on sustainable procurement in civil engineering which furthered objectives set by government.

Level	Case study		
	Highways Agency (England)	New York State Department of Transport	Commissioners of Infrastructure in the Netherlands
Programme	N/A	Following the "Forward Four" principles of Preservation First, System not Projects, Maximize Return on Investment, and Make it Sustainable. Consideration of how the projects in their five year capital programs contribute to the "Triple Bottom Line".	N/A
Project	Implementation of the value management system which includes the consideration of environmental issues.	The GreenLITES project level self-certification rating system.	CO_2 Performance Ladder used to show CO2 performance of companies in the tendering process. DuboCalc used to evaluate the environmental performance of materials and energy of projects.

The starting point for NRAs in terms of sustainability is the project level. At this point they are looking at the performance of the delivery of sustainability by the project or over the course of a maintenance programme. The metrics and measures, and the topics they cover, at this point reflect what an NRA wants to achieve through their performance measures.

A review of sustainability rating systems, undertaken as part of WP3 of the SUNRA project, provides an appraisal of project level systems[10]. Table 10 provides an analysis of the various topic areas covered by the 14 ratings systems. The topics analysed are those recommended as sustainability goals by the TRB (see Box 11). As shown in the table, the majority of the ratings systems cover the sustainability goals related to the environment pillar, while less consideration is given to the social and economic pillars.

The paper by NYSDOT (Nelson et al, 2011) suggests that there is a need to take sustainability thinking beyond both the operational/project "how" level and the more tactical "what" level, to the strategic "why" level. At the programme level, which could be linked with the "why", the NRA will review the reasons for delivering a project and will need measures that are able to measure its performance in relation to this.

At the board level, the NRA will wish to report on metrics and measures that demonstrate performance as an organisation. These metrics will focus on the outputs for users and the performance of the organisation.

In order to cover all of these requirements the framework therefore has been developed to have metrics at the project, programme and board level, for strategic function, corporate and users.

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[10] WP3 Deliverable 3.1 Best Practices in Sustainability Rating Systems

Table 10: Topics measured in project level rating systems

Topic area	CEEQUAL	HTMA SHMT	Ireland NRA System	Australia IS Rating System	VicRoads IVEST	Green Guide for Roads	GreenPave	Greenroads	FHWA INVEST	STARS	GreenLITES	I-LAST	BE²ST-in-Highways	Envision
Safety				✓		✓				✓				
Basic accessibility	✓	✓				✓		✓		✓		✓		
Equity/equal mobility	✓					✓		✓		✓				✓
System efficiency														
Security				✓										✓
Prosperity														
Economic viability										✓				
Ecosystems	✓	✓		✓	✓	✓		✓		✓		✓		✓
Waste generation	✓	✓		✓		✓	✓	✓			✓	✓		✓
Resource consumption	✓	✓		✓	✓	✓	✓	✓				✓		✓
Emissions and air quality	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓		✓

7.3 Selecting the framework topics

The literature review followed by the workshop enabled the prioritisation of metrics and the identification of key sustainability topic areas, both of which start to provide the basis for the framework. Table 11 shows the top ranked metrics for each category by the 14 topic areas that were identified at the Workshop. The case studies also provided some indication of priority topics.

Table 11: Top ranked measures for each topic area

Topic area	Top Ranked Corporate Metric	Top Ranked Strategic Function Metric	Top Ranked User Metric
Carbon	Reduction in carbon dioxide emissions as a result of NRA efforts	Carbon dioxide (CO_2) emitted by contractors	CO_2 emissions from transport
Cost	N/A	Operating cost	N/A
MRE	N/A	Material resource efficiency	N/A
Safety	Number of accidents involving personal injury at roadwork sites on motorways and expressways	N/A	KSI
Congestion/ travel time	N/A	Traffic flow	Congestion
Ecology	N/A	Habitat fragmentation	N/A
Air quality	N/A	N/A	Emissions of PM_{10}
Noise	N/A	N/A	Number of dwellings exposed to excessive noise
Road condition	N/A	Residual life of pavements	N/A
Water quality	N/A	Proportion of road with managed drainage	N/A
User satisfaction	N/A	N/A	User satisfaction
Modal split	N/A	N/A	Modal split of freight transport
Cultural heritage	N/A	Cultural heritage	N/A
Contract management	N/A	Contractors delivery of maintenance service according to contracts	N/A

In 2011, the Transportation Research Board (TRB) published a guidebook aimed at helping transportation agencies measure their sustainability performance. This guidebook was produced following extensive research examining sustainability performance measures for state departments of transport and other transportation in the US. The guidebook sets out 11 recommended sustainability goals that can be used by transportation agencies and under which measures can be developed. These are outlined in Box 11.

1. Safety: Provide a safe transportation system for users and the general public.

2. Basic accessibility: Provide a transportation system that offers accessibility that allows people to fulfil at least their basic needs.

3. Equity/equal mobility: Provide options that allow affordable and equitable transportation opportunities for all sections of society.

4. System efficiency: Ensure the transportation system's functionality and efficiency are maintained and enhanced.

5. Security: Ensure that the transportation system is secure from, ready for, and resilient to threats from all hazards.

6. Prosperity: Ensure that the transportation system's development and operation support economic development and prosperity.

7. Economic viability: Ensure the economic feasibility of transportation investments over time.

8. Ecosystems: Protect and enhance environmental and ecological systems while developing and operating transportation systems.

9. Waste generation: Reduce waste generated by transportation-related activities.

10. Resource consumption: Reduce the use of non-renewable resources and promote the use of renewable replacements.

11. Emissions and air quality: Reduce transportation-related emissions of air pollutants and greenhouse gases.

Box 11: Recommended transportation sustainability goals (TRB, 2011)

When the 11 sustainability goals recommended by TRB are compared with the 14 priority topic areas that have been identified through this research (see Table 11), it is clear that there are very many similarities, with the majority of the issues overlapping, and this provides some indication that the work undertaken in this research is valid.

In order to provide for consistency with the work already completed in the US, as this research developed its framework it drew on both the terminology and the recommended sustainability goals in the TRB report. It nevertheless also recognised that there were additional priority topics identified within this research and ensured that these were also covered in the framework. Along with topic areas that were identified as important through the case studies. For detail on the topics selected for the framework see Section 7.5.

7.4 Selecting the metrics

As described previously in this report, the literature review identified a total of 270 (rationalised) metrics that are currently being measured by NRAs, along with a number of additional metrics and measures that are being recommended by wider research. The most commonly reported of the 270 metrics and measures, along with those recommended by the wider research were then put through a prioritisation process at the stakeholder workshop. The results of this process provided the team with list of metrics that were considered to be a priority and also a list of those metrics and measures which were not considered to be a priority. Where possible the metrics that were selected for inclusion in the framework came from the list of priority metrics that had been identified. Where there was a topic identified that did not have a metric on the priority list, a suitable metric from the larger list of metrics was selected or a metric was selected from those recommended as suitable measures by the TRB, as part of their 'Guidebook for Sustainability Performance Measurement for

Transportation Agencies'. In some cases where no suitable metric could be found, one was either developed by the team or it has been identified as a gap.

7.5 Structure of the framework

In order to ensure that NRAs with different levels of commitment and reporting capabilities can benchmark themselves against the framework, it is proposed that a staged approach is used for measuring performance. This is based on the approaches that have been set by other organisations (such as the RSSB[11] and DEFRA[12] in the UK), The framework has four levels, with one being the lowest and four being the highest (Figure 14). It is expected that NRAs will begin by achieving level one, before they then start to move up through the framework as they consider it to be appropriate for their organisation. The levels within the framework can be described as follows:

- Level 1 – the NRA is monitoring a number of its own current priorities in terms of sustainability.

- Level 2 – the NRA is monitoring a wide range of priorities in terms of sustainability.

- Level 3 – the NRA is monitoring wider issues that demonstrate its contribution to sustainable transport.

- Level 4 – the NRA is monitoring issues that demonstrate its wider contribution sustainable development.
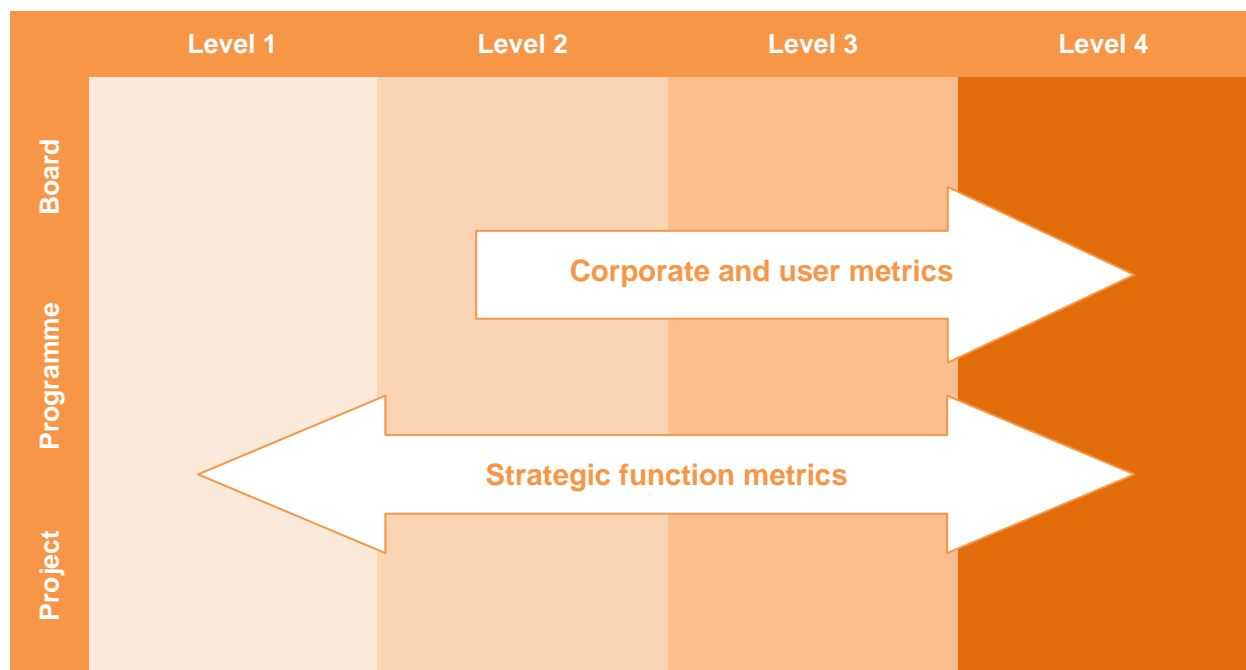
Figure 14: Structure of the framework

At the lower levels there is a focus on metrics that monitor the strategic functions of the NRAs, with the corporate and user metrics being introduced at the higher levels. The number of metrics reported at each level of the framework increases with those achieving level four monitoring the greatest number of metrics.

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[11] RSSB (2007) Developing metrics and benchmarking for sustainable development in the rail industry – second interim report

[12] DEFRA (2011) Sustainable procurement in government: guidance to the flexible framework

As the analysis has shown that it is important the NRAs integrate and monitor their performance in terms of sustainability at the different levels in their organisation, metrics are included in the framework at the project, programme and board level. The structure of the framework is such that NRAs achieving the lowest level of sustainability will only be expected to monitor performance at the project level, however as NRAs progress through the levels they will be expected to monitor performance at the project, programme and board levels.

The framework covers 24 sustainability topics which were identified either as priorities through the literature review (e.g. in the EU SDS or TRB's Sustainability Goals), workshop (as a priority or as an identified gap), or case studies (see Box 12). Those topics identified as priorities are monitored at all levels of the framework, whereas those topics identified through the EU SDS are only monitored at the higher levels where NRAs will be expected to be considering the wider issues of sustainable transport (level 3) and sustainable development (level 4). Under each of the sustainability topics a set of relevant metrics have been outlined which will need to be monitored by the NRAs.

1. Accessibility: TRB

2. Air quality: SDS, workshop (priority), TRB

3. Climate change adaptation: workshop (identified gap)

4. CO_2 emissions: SDS, workshop (priority), case study, TRB

5. Cultural heritage: workshop (identified gap)

6. Economic viability: TRB

7. Ecosystems: SDS, workshop (priority), TRB

8. Equity/ equal mobility: SDS, TRB

9. Global partnership: SDS

10. Good governance: SDS

11. Innovation: case study

12. Job creation & training: SDS, workshop (identified gap)

13. Modal split: workshop (priority)

14. Noise: SDS, workshop (priority), TRB

15. Prosperity: SDS, workshop (priority), TRB

16. Public health: SDS

17. Renewable energy: SDS, TRB, workshop (identified gap)

18. Resource consumption & waste: SDS, workshop (priority), TRB

19. Road condition: workshop (priority)

20. Safety: SDS, workshop (priority), TRB

21. Security: TRB

22. System efficiency: workshop (priority), TRB

23. User satisfaction: workshop (priority)

24. Water quality: SDS, workshop (priority)

Box 12: A-Z of sustainability framework topics (and where they originate from)

The following section discusses two wider issues relevant to the development of the framework.

8 Wider issues for discussion

8.1 Introduction

Two wider issues which relate to measuring the sustainability performance of NRAs are discussed in this section.

The first is the issue of strategic communication and influence and how NRAs can use their influence to help to reduce the sustainability impacts of road users, over who they have no direct control, in the longer term.

The second issue discussed concerns the topics of value for money, life cycle and monetisation. Sustainability offers the opportunity to prioritise outputs based on the balance of economic, environmental and social drivers and getting this balance right should lead to a focus on long term business goals, such as value for money and reputation. Through sustainability, a programme of work can be evaluated based on its true value, highlighting the whole life cost and opportunities for capital savings (e.g. through material resource efficiency).

8.2 Strategic communication and influence

An NRA has significant indirect influence over its workforce and its users above its direct function. The NRAs objectives and the measures it reports influences how people use its network and what people offer the agency in terms of services will be influenced by these key messages.

There are a number of ways in which an NRA can exert this influence:

- Sign up to sector commitments;
- Support national and international initiatives;
- Establish key projects and exemplars; and
- Set a tone in corporate plans and reports that establishes sustainability as a core value.

NRAs may not be able to measure the impact of these 'soft' actions but they have an effect in creating cultural change and we should not lose sight of these activities when we establish our sustainability metrics.

8.3 Value for money, life cycle and monetisation

We have discussed value for money and life cycle costs as part of this document. Doing more with less is a key part of sustainable development but it is about considering how we do more in the whole with less. When we consider value for money, we should consider a whole life approach that takes into account the system as a whole and the requirements to manage and improve that system within the boundaries of sustainable development.

We could consider monetising sustainable development, i.e. costing the damage to the environment, the benefits to society, or the economic benefits. This project has not found a measure to monetise sustainable development effectively but this could be a consideration when details of each of the key topics are understood. This is not possible within our current understanding of the cost of sustainable development, as the future needs are not well understood and therefore difficult to price different aspects; for example, we are not able to value cultural heritage against biodiversity with any degree of accuracy.

Because future needs are not well known, we try to maximise sustainable development by associating each topic with current trends. For example, growth is considered by some to be

a key requirement of our economy and as such we build networks that promote growth, we wish to maintain biodiversity and as such protect the species that we know are rare and endangered, or we want to establish a more equitable society so we identify accessibility that encourages social norms. Sustainable development helps us to prioritise how we maintain our societies, economies and environment so that they meet the needs of a perceived future. Until that future is clearly understood, monetising is difficult to implement.

We therefore look to minimise the impact of the key sustainability topics within our current understanding and develop that understanding by measuring these topics and continuing to involve key stakeholders in the development of our understanding of future needs.

The issues discussed here will be considered in greater detail at a road project level during WP3 as the sustainability rating system is developed.

9 Conclusion

The aim of this work package was to develop a framework that would enable NRAs to measure their sustainability performance at a strategic level. A framework has been produced that it is hoped achieves this objective, following the completion of a literature review, stakeholder workshop and assessment of best practice case studies which all allowed for priority topics to be established, metrics to be identified and a structure to be put in place.

The structure of the framework developed allows NRAs to measure their performance against four levels of achievement, with one being the lowest and four being the highest. It is expected that NRAs will begin by achieving level 1, before they then start to move up through the framework as they consider it to be appropriate. Once they are achieving level 4, the NRA will be considered to be making significant contributions to wider sustainable development. In order to ensure that sustainability is being considered at all levels within NRAs, metrics have been developed for projects, programmes and the board. At the lowest level of the framework, NRAs are only expected to measure at the project level; however as they progress through the framework metrics are introduced at the programme and board levels. It is expected that NRAs achieving the highest level within the framework will be measuring a significant number of sustainability metrics at the programme and board level.

It is important to note that the objective of this work package was not to develop new metrics and measures that would measure sustainability performance but to develop a framework within which that performance could be assessed. As a result this means that some of the metrics proposed at the various levels are not necessarily the most appropriate for measuring the priority topics and therefore require further development to ensure that the framework is as useful as possible. It is hoped that NRAs and/or other institutions will take it upon themselves to improve the metrics to ensure that what they are monitoring their sustainability performance as best as practically possible. The SBA KPI project, completed in May 2012, produced a benchmarking framework which outlined a process for developing new key performance indicators and it is suggested that this process could be used to make these amendments.

Acknowledgments

The project team would like to thank Debra Nelson, Paul Kreckler, Michael Rossi, and Lynn Weiskopf (New York State Department of Transport) for their contributions in developing the good practice case studies.

Glossary

Board level	At board level an NRA will set, monitor and measure corporate objectives. The board will report to stakeholders.
Corporate activities	Operational buildings and facilities run by the NRA such as offices, vehicles, etc.
Intervention point	Intervention points are stages within a project, such as assessment of need, design, and construction.
Metrics and measures	Metrics and measures are used to monitor a wide range of topics. They are used to enable strategic, programme and project management of key activities that relate to performance criteria required by their stakeholders.
National road administration	Any organisation at a national or regional level authorised by a Government to take responsibility for developing and maintaining some or the entire national or regional road network. The organisational characteristics of NRAs can vary considerably, for example, some NRAs may be responsible for managing other transport networks such as rail. Some NRAs may be directly part of National or regional Government or may be a separate Agency required to meet government objectives.
Programme level	At the programme level an NRA will be required to deliver the strategic objectives set by the board.
Project level	At the project level an NRA will be required to deliver projects that make up a programme. Project practices will need to align to corporate priorities.
Strategic function	The strategic function of an NRA is to manage the construction, maintenance and operation of their network. Often these activities are carried out by a supply chain.
User	Users of the road network.

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Appendix A: List of workshop attendees

Name	Organisation	Country
Dean Kerwick-Chrisp	Highways Agency	England
Geoff Richards	Department for Transport	UK
Åsa Lindgren	Swedish Transport Administration	Sweden
Susanna Toller	KTH	Sweden
Jon Krokeborg	Norwegian Public Roads Administration	Norway
Vincent O'Malley	National Roads Authority	Ireland
Jos Arts	Ministry of Infrastructure and Environment	Netherlands
Douwe van de Wall Bake	DHV BV	Netherlands
Dave Arran	Transport Scotland	Scotland
Stephen Thomson	Transport Scotland	Scotland
Sophie Cariou	Sétra	France
John Dent	Jacobs	UK
Simon Price	Rambol	UK
Ben Harris	TRL	UK
Clare Harmer	TRL	UK
Suzanne de Vos-Effting	TNO	Netherlands
Lennart Folkeson	VTI	Sweden
Henrik Gudmundsson	DTU	Denmark
Donald Bell	Halcrow Group Limited, a CH2M HILL COMPANY	UK
Chris Sowerby	Halcrow Group Limited, a CH2M HILL COMPANY	UK

Appendix B: Workshop agenda

Agenda

Defining Sustainability for National Road Administrations

14th May 2012

America Square Conference Centre
1 America Square
17 Crosswall
London EC3N 2LB

Time	Item	Speaker
13.30	**Welcome (Tea & Coffee)**	**All**
14.00	**Introduction** National Road Administrations have an important role to play in sustainable development. Ben will explain how the SUNRA project will help to define that role.	**Ben Harris, TRL**
14.15	**Defining Sustainability for NRA** The contribution of an NRA to sustainable development is defined by its sphere of activity. Henrik will introduce a summary of current research which defines the responsibilities and limits of a NRA's contribution.	**Henrik Gudmundsson, DTU**
14.45	**Break Out Session** Attendees will be asked to comment on the indirect and direct contribution of NRAs to sustainable development.	**All**
15.30	**Break**	
15.45	**The Role of Metrics and Measures** Measuring performance enables continual improvement. Ben will summarise research into how NRAs currently report on sustainability and discuss the priority areas for NRAs to report.	**Ben Harris, TRL**
16.15	**Break Out Session – KPIs** Attendees will be asked to review the key gaps between what is currently being reported and the recommendations of research in this area.	**All**
16.45	**Summary & Questions**	**Ben Harris, TRL**
17.00	**Close**	

Appendix C: Metrics and measures discussed at the workshop

User		Strategic function		Corporate	
Pillar	**Metric**	**Pillar**	**Metric**	**Pillar**	**Metric**
Social	Number of fatalities	Economic	Length of road network	Social	Accidents involving personal injury at roadwork sites on motorways and expressways
Economic	Volume of freight transport	Economic	Road condition	Social	Employee satisfaction
Environment	Greenhouse gas emission by Sector - transport	Economic	Length of new road completed	Social	NRA contribution to reduction in killed or seriously injured
Social	Number of accidents	Economic	Expenditure on roads	Social	Gender balance - female executives
Social	KSI	Economic	Operating cost	Social	Gender balance - female employees with higher education
Economic	Volume of passenger transport	Economic	Road network density	Social	Ethnic diversity - immigrant employees with higher education
Environment	CO2 emissions from transport	Economic	Expenditure on road construction	Social	Respond to written enquiries from customers within 15 working days
Economic	Traffic volume	Economic	Expenditure on road maintenance	Social	Implement Information Security Strategic Action Plan
Economic	Number of registered motor vehicles	Economic	Number of bridges	Social	Inform applicants for Blue Badges of our decision within 15 working days of receipt of their valid applications
Economic	Number of new motor vehicles registered	Economic	Return on construction expenditure	Social	Develop a plan to address issues identified in the NICS staff attitude survey
Economic	Modal split of freight transport	Economic	Number of truck parking spaces on the motorway/expressway network	Social	Reduce the average annual level of absenteeism due to sickness
Economic	Cars per 1,000 inhabitants	Economic	Length of road constructed/re-surfaced	Social	By July 2010 to have developed new organisational structures for the Roads Service
Social	Number of casualties	Economic	Traffic flow	Social	Complete the transfer of powers to the local councils in support of the Review of Public Administration
Social	Number of accidents involving personal injury	Economic	Funds allocated for construction schemes to eliminate bottlenecks	Environment	Reduction in carbon dioxide emissions as a result of NRA efforts
Economic	Congestion	Economic	Total stoppages on the state road network	Environment	Travel carbon footprint for staff:

User			Strategic function			Corporate	
Pillar	**Metric**		**Pillar**	**Metric**		**Pillar**	**Metric**
							Commute and Business travel
Economic	Total motor vehicles		Economic	Development for the length of road with reduced bearing capacity caused by spring thaw		Environment	Carbon dioxide (CO2) emitted by NRA
Economic	Modal split of passenger transport		Economic	Reduced travel time by car between rural areas and main towns		Social	Number of responses to complaints from NRA
Environment	Consumption of biofuels		Economic	Reduced travel time by car between regions and surrounding areas			
Environment	Percentage of energy consumption of transport over GDP		Economic	Width and type of pavement			
Environment	Energy consumption by transport mode		Economic	Type of road			
Economic	Travel time variability		Economic	Residual life of pavements			
Economic	Km travelled by road		Economic	Transport infrastructure investment			
Economic	Vehicle ownership per capita		Economic	Reduction in travel speeds because of new road project openings			
Social	Road user satisfaction		Economic	Contractor delivery of maintenance service according to contracts			
Environment	Emissions of PM10		Economic	Deployment of asphalt compared to expenditure			
Environment	Noise complaints		Environment	Cultural heritage			
Environment	Number of dwellings exposed to excessive noise		Environment	Carbon dioxide (CO2) emitted by contractors			
Environment	Number of AQZAs in road network		Environment	Proportion of road with managed drainage			
Environment	Length of road network within AQZA		Environment	Number of managed drainage outfalls			
Social	Number of complaints from stakeholders		Environment	Outfalls with water quality treatment			
			Environment	Material resource efficiency			
			Environment	Number of wildlife crossings on the network			
			Environment	Habitat fragmentation			
			Social	Population/ km new road/lanes			

User		Strategic function		Corporate	
Pillar	**Metric**	**Pillar**	**Metric**	**Pillar**	**Metric**
			constructed		
		Social	Population/ km ITS/ICT constructed		
		Social	Length of road affected by schemes to reduce congestion and improve journey time reliability		

NB: The metrics in black are currently in use, while the metrics in green are recommended by research for use by NRAs.