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Procedures for the Design of Roads in Harmony with Wildlife

Report on Procurement, Follow-up and Performance Indicators

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CEDR Call 2013: Roads and Wildlife – Cost efficient Road Management

Harmony

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Executive summary

This report presents a review of procurement methods for the construction of road projects across nine member states of the European Union to identify how best to provide for successful ecological measures that will achieve the desirable protections for wildlife. The report is based on a series of interviews that were conducted with key personnel at several National Road Authorities and a number of local companies that specialise in maintenance operations of road structures.

One of our main findings is that there may be specific advantages in Construction and Operation Contracts when these incorporate a maintenance function with appropriate monitoring. This approach ensures that there is a process for potential problems to be resolved adequately and quickly. However, there needs to be appropriate skills and budget allocations with the Contracting Authority to ensure the desired outcomes are achieved by full implementation of the contractual provisions for wildlife protections. As the wildlife aspects of a road project will usually be of very low monetary value, there probably needs to be a disproportionate weighting of payments associated with ecological performance indicators so that contractors are suitably incentivised to fulfil these obligations satisfactorily.

ECI (Early Contractor Involvement) type contracts which engage the Contractor before the Planning Stage and that carry through to Operation and Maintenance can be particularly well geared for successful wildlife protection as they provide continuity where monitoring is performed, throughout the entire process. This form of contract is relatively new and has been used to a limited extent to date. Therefore there is little real evidence as to the actual outcomes achieved by this procurement process. ECI only suits quite large projects for which the associated additional administration effort and costs are warranted. For projects of a suitable scale it is therefore preferable to adopt an “Engineering – Construction – Operation [ECO]” Contract, which should provide a best practice outcome for wildlife protections as this provides the continuity that can be lacking in other forms of procurement.

Based on our findings, international experience is that the best results for successful wildlife protection are achieved with Construction Contracts that incorporate maintenance for an extended period afterward with a monitoring programme. This puts an onus both on the Maintenance Contractor and on the Contracting Authority to ensure that the design of the wildlife measures is appropriate so that maintenance requirements are minimal and that any necessary remedial works are undertaken.

However, for most small to medium scale road construction projects, procurement will of necessity continue to be mainly by the Traditional Employer Design or Design & Build procurement options. In these circumstances the Contracting Authority must assign a continuous effort in terms of resources and expertise to provide the necessary level of attention to wildlife provisions throughout the lifetime of a road asset, so as to avoid the pitfalls that have occurred in the past where wildlife issues may have been largely neglected beyond the planning and construction stages.

Apart from the expected focus on best practice for procurement of new road infrastructure, Contracting Authorities must recognise that the proper maintenance of their existing assets is of greater importance in terms of overall scale of wildlife management objectives. There are

likely to be significant legacy issues on existing road networks in terms of deficient or absent wildlife protections which would need to be addressed by large scale retrofit programmes. The actual installation costs for additional wildlife mitigation measures may actually be quite small, but significant resources would be required to assess the appropriate needs and to collect information about real cumulative effectiveness. Thus significant national and regional level research programmes with field studies would be required as part of a general wildlife performance information database. Such measures may be undertaken as part of a more organised approach to road maintenance with suitable objectives for wildlife protection and enhancement. Thus "ecological performance indicators" should be developed and adopted as part of road asset management systems across Europe.

Appropriate ecological expertise is required continuously at each step of the project development from initial planning stage through to operation. Problems with existing roads may often be traced to a lack of involvement by suitable ecological experts at various points in the process. Preferably there should be a consistent monitoring role undertaken by the Contracting Authority for the whole life of a road project to ensure that wildlife protection measures are properly implemented, regardless of the particular procurement process adopted.

A major problem identified here is the lack of a unified scheme for follow-up studies, especially in contracts. These studies are largely neglected despite a clear consensus among the respondents of the interview study that a standardised and regular follow-up is essential to evaluate the success of the mitigation measures.

Key Performance Indicators (KPIs) are also discussed as part of the follow-up process to assess the effectiveness of a mitigation measure. It is found that the adoption of KPIs directly from economics to be applied to ecosystems is not straightforward. Here, an adjustment has to be made to reflect performance on a more general level, but which will not oversimplify the picture of a specific site's condition. Thus, the potential advantage of using KPIs is very much dependent on the careful selection of the specific indicators by a specialist.

In conclusion, it is recommended that appropriate involvement of ecological expertise is adopted at all stages in all major road construction and maintenance contracts across the European Union regardless of the particular procurement process adopted. Follow-up at the operational phase is essential to confirm that the wildlife measures are functioning properly. This needs to feed back into the maintenance contract to implement any necessary remedial measures. It is suggested that well-adapted (ecological) indicators be developed to improve the procurement, performance and evaluation processes.

1 Introduction

1.1 Background

Over the last 200 years, an enormous network of roads and railroads has grown all over the world. From the human perspective, this means a considerable increase in individual mobility on the one hand, but on the other hand it comes at the cost of a progressive fragmentation of the landscape surrounding us. Wildlife was until very recently not considered in the planning of infrastructure at all. However, transport infrastructure has an enormous effect on wildlife, causing the death of many thousands of animals each year, and contributing to a general decline of wildlife and natural habitats (Luell et al., 2003). That wildlife populations in Europe did not crash, but instead showed a mild comeback from the mid-20th century, however, has to be attributed to species protection, an active, targeted conservation, and not the least an extended legal protection (Deinet et al., 2013). In this context, the discussion about mitigation efforts for the protection of wildlife in Europe has to be conducted.

European countries are among those with the densest road network in the world. Since this network is likely to increase considerably in the near future – not at least in developing countries (cf. Laurance et al., 2014) – it is important to lead with a good example in construction, maintenance and follow-up activities to create a sustainable infrastructure throughout the continent. However, today there are large differences between the individual countries in how the transportation infrastructure is managed and maintained. For example, operation and maintenance can be delegated in part – or entirely – to private companies, and the amount of supervision by state or local governments varies considerably across Europe. In fact, most tasks concerning maintenance of roads (and other transport routes) are nowadays given to one or several private companies. These in turn receive the respective assignments in a more or less standardised procurement process, which is commonly repeated after a specified time frame and which has to comply with the European rules for procurement of public contracts (European Union, 2015).

1.2 Report Outline

The Harmony project brings together a consortium of ecologists and engineers to develop sustainable solutions to road transport challenges that are in harmony with wildlife. One important aspect of the study is a review of international procurement practices to identify how best to achieve favourable outcomes for wildlife in all roads projects. This study included a survey of experts in the project procurement and follow-up processes to identify practices that give good ecological outcomes which are cost effective. Recommendations will be given for best practice in a range of situations.

The Study Area comprises the following nine EU Member States (in alphabetical order):

- Austria
- Belgium
- Greece
- Hungary
- The Republic of Ireland

- The Netherlands
- Norway
- Sweden
- The United Kingdom of Great Britain and Northern Ireland

This report considers large motorway / trunk road construction and widening schemes. Additional studies would be required to establish if the findings of this study are applicable to other categories of project.

The general consensus among experts is that the Environmental Impact Statement is now generally accepted and included regularly in the Construction Works Contract. However, the different Contracting options available provide variable outcomes in terms of ensuring that these commitments are delivered and the objectives are achieved in compliance with statutory obligations for wildlife protection. For some forms of procurement of road works there may be clear gaps in the chain of actions for wildlife protection that give rise to risks of failure in wildlife protection measures. This report seeks to identify how to remedy such shortcomings with processes that will provide the necessary continuity and consistency of wildlife protections regardless of the procurement process adopted.

2 Questionnaire

2.1 *Methods of data acquisition and analysis*

The primary data this report is based on was collected using the so-called semi-structured interview technique (Edwards & Holland, 2013). In order to obtain comparable information for each country included in this study, a standardised questionnaire was designed to be used during the interviews. The questionnaire contained 27 questions, and for most of these, a number of multiple-choice-like answer possibilities. A small number of the questions provided for a free answer, with no pre-printed multiple-choice options. However, for all questions, additional comments could be given, and this was encouraged during the interviews.

The questions can be divided into two main parts, (1) Procurement and (2) Follow-up:

- (1) The part on 'Procurement' contained 10 questions, half of which covered 'general' topics and the other half 'qualifying criteria' and the 'evaluation of tenders', respectively.
- (2) 'Follow-up (post-construction, handover and maintenance)' consisted of 17 questions. The first six 'general' questions concerned follow-up and maintenance procedures, followed by six questions concerning the practical approach used by each respective institution. At the end, five questions covered the documentation of the practical measures and the handling of the resulting data.

The interviews were performed in person, via telephone or by sending the questionnaire to the respective person to be interviewed. If the interview was performed during a personal meeting, the conversation was recorded, and the interview later transcribed. The interviews were performed with key persons at National Road Authorities (NRAs) and in companies responsible for maintenance operations. Represented were ten countries in northern, central and southern Europe: Austria, Belgium (Brussels, Flanders), Germany (Saarland, Saxony-Anhalt), Greece, Hungary (three maintenance companies), Ireland, The Netherlands, Norway, Sweden, and the UK. In Belgium, Germany and Hungary, more than one interview was performed (on the administrative level indicated in parentheses behind the respective countries), resulting in a total number of 14 interviews.

Nearly all questions of the questionnaire were of a categorical type and consisted in the majority of cases of so-called 'polar' questions, which leave only 'no' or 'yes' as possible answers. Much of the remaining qualitative questions yielded answers that could also be categorized clearly. Thus, it was possible to code the answers in a data matrix, and to perform a semi-statistical analysis to look for similarities between the countries included in this study. For this, the interview texts were transferred to a spreadsheet and the data filtered for 'polar' answers, resulting in two possible character states, coded as 0 (no) and 1 (yes) for most questions. The remaining answers were coded with whole numbers (0, 1, 2, 3, etc.), depending on the number of answers given per question. The resulting data matrix is thus on a nominal scale, with the numbers as digits having no meaning regarding rank, interval or ratio. Questions 9 (due to ambiguous answers) and 10 (with an unclear classification of answers) were removed from the dataset for analysis. Also, one of the three interviews from Hungary ("National Infrastructure Development" company) was omitted due to multiple

missing data entries (NA, ‘not available’; the interview was presumably not performed personally).

For analysis, the data was then imported in the statistical software package R (version 3.1.2; R Core Team, 2014). We then performed a cluster analysis, since this is a useful method to find major differences and to identify possible groups (Everitt & Hothorn, 2010). Classification, in turn, is a prerequisite to discuss relationships between groups, and it is of fundamental importance in science (Everitt et al., 2011). Here, we used hierarchical (agglomerative) clustering to identify groups. This is a ‘bottom-up’ approach: starting with the single individuals (here: interviews), clusters are found successively at each higher level by grouping the closest individuals and groups together, resulting in one final, single cluster containing all individuals. The choice of division, which inevitably has to be made by the investigator, is thus somewhat arbitrary (cf. Everitt & Hothorn, 2010). However, the resulting dendrogram does provide useful information about relationships even without an (arbitrary) division into groups.

One possibility to alleviate this problem is bootstrap resampling. For this, we applied the R package ‘pvclust’ (Suzuki & Shimodaira, 2014) to the data, which uses multiscale bootstrap resampling to produce a dendrogram with estimates of support for each division into clusters. In addition to this statistical analysis of the data, the interviews were thoroughly analysed by comparing the answers to each question qualitatively. After transferring all interview texts to a spreadsheet (with the rows corresponding to the questions/answers, respectively), the answers to each question were summarized, highlighting where there were differences or a consensus among the answers.

2.2 General findings of the quantitative analysis

Graphically (see **Figure 1**), the interviews fall into two clearly distinguishable groups, which each in turn can be divided into two subgroups. However, when considering the values received through bootstrapping and accepting the common threshold of 95%, only one cluster appears to be clearly supported by the data, which are the two interviews from Hungary. When lowering the threshold to 90%, we can distinguish four clusters, two of which are nested within each other.

In Figure 1 the grey number under each node indicates the cluster number according to the clustering process, starting on the lowest level. The red numbers left of each node are approximately unbiased (“au”) p-values in percent, computed using multiscale bootstrap resampling. The green numbers to the right of each node give the Bootstrap Probability (“bp”) value, also in percent, which is calculated using normal bootstrap resampling. In both cases, higher values indicate better support for the respective cluster. Values higher than 95% are considered statistically strongly supported. For further details, see Suzuki & Shimodaira (2014).

That is, firstly Hungary as ‘sister’ to Saxony-Anhalt in Germany, Austria and the Netherlands, secondly the Saarland in Germany as ‘sister’ to the UK, Greece and Ireland, and finally this second group – including Brussels – as a whole as ‘sister’ to Flanders, Norway and Sweden.

While the Bootstrap probability ('bp') values are generally low, with only the node connecting the two Hungarian interviews reaching a value higher than 95%, the approximately unbiased ('au') p-values – except for two nodes – reach all over the 80% mark. These two exceptions of the 'au' values, the split between Flanders and Norway/Sweden and the split between Greece and Ireland, still reach 70% and 72%, respectively. Thus, the clusters are fairly well supported, with four out of eleven (36%) splits in the tree having 'au' values higher than 90%, and nine out of eleven (82%) with values higher than 80%.

Regarding the similarity between interviews, some findings by means of this analysis are remarkable. While it is not surprising that the two Hungarian interviews cluster together on the left, and the two Scandinavian countries on the right, it might also be expected to find Ireland and the UK in near vicinity on the graph. However, it is interesting to find the interviews from two German federal states at quite a distance from each other in the dendrogram. In fact, one reason for this is most likely the federal structure of Germany, where federal states retain autonomy in many official matters of interest (pers. obs.). Also, Brussels and Flanders are fairly far apart, and even the neighbouring Netherlands do not appear close to these in the diagram.

However, since questions are not weighted here in any way, the result of the statistical analysis should be seen as an illustration of a presumably unbiased comparison of the interview data.

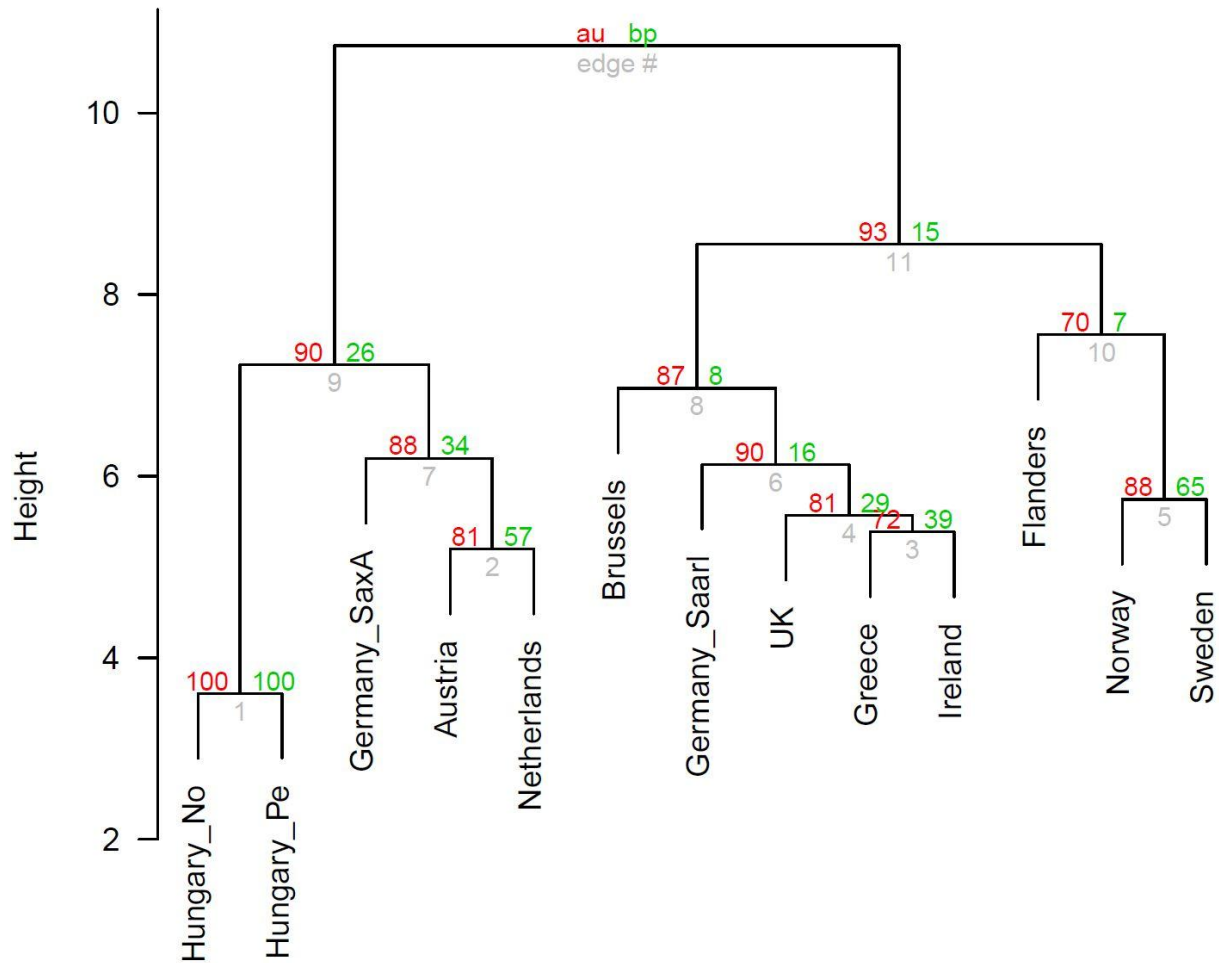


Figure 1: Cluster dendrogram illustrating the relationships between interviews based on the similarity of answers. Abbreviations: Germany_Saarl = Federal State institution for road construction, Saarland; Germany_SaxA = Federal State Road Authority, Saxony-Anhalt; Hungary_No = Hungarian Roads Management Company, Nógrád County; Hungary_Pe = Hungarian Roads Management Company, Pest County; UK = United Kingdom; au = approximately unbiased p-values (in percent); bp = Bootstrap Probability values (in percent).

3 Review of Procurement

3.1 Review of Expert Feedback

3.1.1 Permissible Procurement Strategies

The EU Procurement Directive 2014/24/EU permits five different types of procurement competition:

- Open;
- Restricted;
- Competitive Procedure with Negotiation;
- Competitive Dialogue;
- Innovation Partnership.

All of the above can include Qualitative Selections to establish the experience of the Contractor and Quality Assessments to measure the Contractor's proposed approach to the project, which can include specific measures for dealing with ecological protection and enhancement. The latter three options provide more scope for innovation by the contractor. However, the circumstances under which they can be used are more restrictive.

EU Procurement rules preclude consideration of past performance at the Tender Stage – past performance may only be assessed at the Qualitative Selection Stage.

3.1.2 Contracting Strategies

There are four different types of Contracting Strategies generally used for the construction and widening / improvement of large trunk road / motorway schemes across the study area. These are:

- 1) Employer Planned - Employer Designed - Contractor Constructed - Employer Maintained Contracts;
- 2) Employer Planned - Contractor Designed - Contractor Constructed - Employer Maintained Contracts;
- 3) Employer Planned - Contractor Designed - Contractor Constructed - Contractor Maintained Contracts (often with private funding and associated tolls or availability payments over a concession period); and
- 4) Contractor Planned - Contractor Designed - Contractor Constructed - Contractor or Employer Maintained Contracts.

These are generally identified as:

- 1) Traditional Contracts;
- 2) Design and Build [D&B] Contracts;
- 3) Design, Build and Maintain [DBM] – also including Design Build Finance Maintain / Operate [DBFM / DBFO] / Public Private Partnerships [PPP]; and
- 4) Early Contractor Involvement [ECI].

The analysis undertaken has identified that all of the above are in use across the Study Area, with an increasing focus on the latter two types – i.e. DBM and ECI. The following table summarises the use of different procurement types across the Study Area.

Table 1 Contracting Strategies in use within Study Area.

Country	Traditional	D&B	DBM	ECI
Austria		X	X	
Belgium	X	X	X	
Greece	X		X	
Hungary	X	X		
Ireland	X	X	X	X
The Netherlands		X	X	X
Norway			X	X
Sweden	X		X	
The UK	X	X	X	X

3.1.3 Permissible Procurement Strategies

Several experts commented that the EU Procurement Regime restricts the capacity of the Employer to fully assess the Contractor's ecological expertise, as this will only ever form a limited part of the Quality Assessment. The strict requirements that Qualitative Selection is retrospective and Tenders prospective limits the scope of the Contracting Authority to award Contracts taking account of past delivery, including with respect to ecological features. Most large Contractors can achieve, or can hire a subcontractor to achieve, the criteria of a Qualitative Selection, however, this does not necessarily lead to a successful outcome following project completion. The facility to consider past performance at tender assessment stage was included in the draft of EU Procurement Directive, however it was removed from the final Directive. A recurring theme among the experts is that this should be reconsidered, which is probably unrealistic in legal terms.

The importance of Quality Assessment was emphasised by several of the experts:

- Increased focus on Quality in tender requirements leads to more robust tender submissions of higher quality.
- The importance of Quality Assessment increases where there are particular environmental sensitivities – e.g. proximity to a Natura 2000 site.
- Where there is an excessive focus on price, the quality of the completed project reduces. However, the use of Quality Assessment across the Study Area is limited and some jurisdictions require Contracts to be awarded on cost criteria only.
- There is frustration with the robustness of the procurement process in some jurisdictions. There need to be clear and specific evaluation criteria such that Contracting Authorities can resist procurement challenges. When high quality requirements are challenged by a Contractor, legal adjudicators often take a precautionary approach, frustrating the objectives of the Contracting Authority.

There is a need to engage specialist ecologists in the preparation and procurement of large Works and Maintenance Contracts.

3.1.4 Contracting Strategies

Not all Contracting Strategies are in use in all of the countries within the Study Area covered in this report (see Table 1 above). However, by assessing the feedback from the entire Study Area, particular advantages and challenges associated with each were highlighted. In particular, the following feedback was received:

Traditional Contracts (Employer Designed)

- Traditional Contracts are in widespread use, especially for small and medium scale projects.
- This form of contract has the perceived benefit of continuity – i.e. the same organisation is involved in the whole project life-cycle, but it does not extend into the operational stage and therefore cannot accommodate monitoring and maintenance activities. (See later discussion of Maintenance Contracts).
- This form of procurement is limited to only the start of the life-cycle of a new road project. It is also vulnerable to a lack of commitment of suitable resources and expertise by the Contracting Authority which may have budgetary constraints imposed that fail to provide for the cumulative responsibilities for wildlife protection as the assets increase over time.

Design & Build (D&B) Contracts

- The implication of the feedback received is that D&B Contracts may be sub-optimal from an ecological perspective in the absence of a suitably strong financial incentive that is greater than the low cost of the wildlife measures. The Contractor constructs the road with a view to minimising cost only and without regard to the long term implications of the project performance or maintenance considerations.
- Similar to Traditional Contracts, D&B does not extend into the operational stage and therefore cannot accommodate monitoring and maintenance activities.

Design, Build & Maintain (DBM) Contracts

- There are variations of this form of procurement that may include a financial investment element such as Public Private Partnership (PPP) or Private Finance Initiative (PFI). However, for the construction and maintenance aspects these contracts are generally the same, except perhaps in terms of the length of the concession period which may be quite long extending to 25 years so as to enable a financial return to the Contractor.
- The Greek experience with DBM is that the Contractor is responsible for maintenance and this is in the Contractor's mind during the design and construction of the project;
- The Dutch and Irish experiences are that the maintenance period typically covers 20 – 30 years where the Contractor provides a financial investment, and the money needed to pay for maintenance during these years is set aside in the beginning as part of the overall financial arrangements. Hence, it is less susceptible to societal or political changes.
- On the other hand very long maintenance contracts can lead to complacency for perceived "peripheral" elements of the road asset. There needs to be a significant

weighting attached to the wildlife protection aspects of the contract in terms of monetary value or risk of termination due to poor performance.

- There is experience in some countries, such as Sweden, of Contractors doing as much as necessary, but as little as possible. It is therefore necessary to perform regular checks. However, representatives from Sweden do see advantages in the Contractor having an interest beyond the Construction Stage.
- The Belgian experience is that the Contracting industry can be ignorant of ecological issues and is dependent on Contracting Authority ecology advice, even in DBM scenarios.
- The Netherlands is moving towards DBM contracts.
- Ireland has several DBM (PPP) schemes in place. However, no further new PPP's are planned for reasons of overall budget management.

Early Contractor Involvement (ECI) Contracts

- In theory an ECI contract should provide a mechanism for good follow through on environmental commitments from the planning stage to completion of construction. It may or may not include the operation and maintenance of the finished road, which is a very important consideration for the successful management of the wildlife infrastructure.
- ECI has been used to a limited extent in the UK and Ireland, but usually these projects have not included the maintenance of the finished road beyond a fairly short defects period, which is a considerable drawback from the perspective of wildlife protection. There is insufficient knowledge or experience to draw clear conclusions as to the suitability of this procurement model for successful implementation of wildlife protections.
- The British (and to a very limited extent the Irish, with just one ECI to date) experience is that the out-turn product is much closer to the planning scheme – so it can be inferred that it is more effective at implementing the commitments of the Environmental Impact Statement;
- The Dutch and Norwegian experience highlights particular advantages to having all work, including advance surveys, undertaken by the same Contractor;
- The Swedish expert highlighted the performance specification aspect of the ECI Contract – i.e. that the Contracting Authority and the Contractor work together to design and achieve the objectives of the scheme;
- The use of ECI is relatively recent in Sweden and there is some anxiety about risk of reduction in Quality of outcome. The experience of other countries suggests that these concerns are unwarranted and that the Target Cost approach achieves co-operation and favourable outcomes.

Maintenance Contracts

- Maintenance contracts are increasingly common for mature networks that have accumulated over time. They enable a Contracting Authority to adopt a more organised and streamlined approach to maintenance of significant lengths of the road networks and to set performance targets as appropriate with monitoring for effectiveness. Payment incentives can be linked to achievement of targets. (This study has not identified any examples of Maintenance Contracts with robust

provisions for the wildlife infrastructure that could be assessed for effectiveness. A potential approach that could be adapted is for example the usual contractual requirement for defect repairs within a specified time period). These arrangements would be similar to those included in the operational elements of DBM contracts;

- Maintenance Contracts are usually for fairly short periods of between 5 and 7 years so that poor performance can be addressed at reasonable intervals if necessary.
- Contract Renewal events can provide an opportunity to adapt and improve performance requirements in light of research findings.;
- In Ireland the national road authority has recently put in place maintenance contracts for all of the motorway and dual carriageways (excluding PPP toll roads that have their own maintenance regimes) that form the spine of the national road network. These arrangements provide a mechanism to properly address the suitable performance of the accumulated wildlife mitigation infrastructure, which may have been installed by a wide variety of procurement methods.
- A Maintenance Contract can provide a means to identify and address any legacy issues. Furthermore, it could enable the retrofit of new wildlife mitigation measures based on current best practice to improve the ecological performance of sections of road that may have been constructed several decades previously.

Not all of the above options would be suitable in many cases. For most small to medium scale road construction projects, procurement will of necessity continue to be mainly by the Traditional Employer Design or Design & Build procurement options. In these circumstances the Contracting Authority must assign a continuous effort in terms of resources and expertise to provide the necessary level of attention to wildlife provisions throughout the lifetime of a road asset, so as to avoid the pitfalls that have occurred in the past where wildlife issues may have been largely neglected beyond the planning and construction stages.

Regardless of the particular form of procurement adopted, there are two key issues to be addressed:

- A. Delivery of commitments for wildlife mitigation measures needs to be validated through a robust engagement of suitable ecological expertise at each step in the process from planning, through design and construction.
- B. Formal arrangements for Maintenance are required with provision for regular inspection and evaluation of mitigation measures to ensure that they continue to perform in line with the commitments made at the planning stage. This process requires suitable ecological expertise both for the Maintaining Organisation and in the Contracting Authority for suitable overall supervision of such activity across the full road network.

3.2 International Best Practice

3.2.1 Procurement

Procurement is governed by EU Procurement Rules and the scope for innovation across member states is limited. The key innovations relate to the choice of contracting rather than procurement strategy.

3.2.2 Construction

The international experts provided a number of best practice examples, the findings of which are discussed below:

- The A12 Widening Scheme in the Netherlands was procured as a DBM Contract. The requirements were performance based – e.g. that an ecoduct suitable for a particular target species be provided in a given area. The DBM approach allowed the Contracting Authority to demand the Contractor to be thorough and achieve optimal results through innovation. Ecology was a key aspect of the tender Quality Assessment and, as a result, all tenderers, including the ultimately successful tenderer submitted high quality ecological plans.
- The N19g road project from Kasterlee to Geel in the province of Antwerp provides a new 8 km single carriageway road with no private accesses or traffic lights, only grade-separated crossings to remove all local traffic. The new road was built parallel to the existing road which passes through several urban areas and previously carried a significant proportion of non-local and freight traffic. The new road was constructed in a less urban environment of high ecological value. This allowed the existing road to be downgraded to local traffic only.
The project was procured as a three stage procedure. First a call was launched to develop a concept for the new road based on a program of requirements. The best 6 candidates were selected and given the opportunity to develop the details. Subsequently negotiations were started with the three last candidates. The contract type adopted was a DBFM (Design Build Finance Maintain) and financed as a PPP. The defragmentation measures were defined before the EIA was made with the result that they were an integrated part of the concept:
 - A tunnel for the traffic was built to cross a natural area (land dune);
 - 1 viaduct crosses the winter bed of an intact river;
 - 2 bridges for traffic crossing water (river and canal) with integrated green passages;
 - 3 tunnels for traffic with integrated green passages;
 - 1 big ecotunnel;
 - 7 small ecotunnels;
 - 6 adapted culverts.

These measures were integrated in the plans that were given to the contractors. Due to the DBFM character of the assignment it was possible for the contractor to make the design and the realisation in deliberation with the road agency, keeping in mind the maintenance of the end product. Since the building of the road was finished in February 2014 no problems have been reported.

- A2 Shore Road in Northern Ireland was procured as a D&B Contract. The Tender required the Tenderers to set out proposals how they would meet the objective of achieving a CEEQUAL Excellent award for this contract. The successful Contractor is currently in the process of submitting all of the necessary documentation as part of the application to demonstrate how sustainability, biodiversity and environmental

considerations were at the forefront throughout the Design and Build contract. (It should be noted that this project is in an urban area with limited ecological aspects).

- A6 Randalstown to Castledawson Dualling in Northern Ireland was procured as an Early Contractor Involvement (ECI) Contract. The contract, awarded in May 2015, will be carried out in two phases. The first phase involves the contractor working with Transport Northern Ireland on completing the detailed design stage, so that when funding becomes available the joint venture will be able to move onto site at short notice. The Tender required the Tenderers to set out proposals how they would meet the objective of achieving a CEEQUAL Excellent award for this contract. The successful Contractor is now being required to demonstrate how all design decisions will ensure compliance with the objective of achieving the award. (At this stage it is too early to know how successful the ECI procurement model will perform in terms of the eventual outcomes for the environmental aspects of the project. It would be useful to monitor this, and other similar projects to acquire further information in future).

It is evident from the foregoing that both DBM and ECI Contracts if properly managed and monitored may offer particular advantages over other forms of procurement, in particular:

- The DBM Contractor always has a mind to costs at the Maintenance Stage when designing and constructing the Works. In theory, the Contractor will therefore be conscious of designing and constructing the Works correctly so as not to have to undertake remedial Works later. This particular advantage does not accrue with either Traditional or D&B Contracts;
- With ECI, the Contractor is effectively cooperating with the Contracting Authority Team from an early stage. The Target Cost approach offers more flexibility than a fixed price Contract and this allows both the Contracting Authority and the Contractor to work together to deliver optimal outcomes. The expert feedback has indicated that the final scheme is much closer to the planning scheme approved by the Competent Authority and hence the predicted and residual impacts are closer to those assessed in the approved Environmental Impact Statement.

Contracts that involve Maintenance – be they DBM Contracts or standalone Maintenance Contracts – engender an element of supervision by virtue of necessity. That is to say, where a Contractor is undertaking maintenance and getting paid for it, it is necessary that the Contracting Authority must ensure that such Works are being undertaken. International Best Practice therefore appears to favour the procurement of Maintenance Works in performance based contracts.

3.3 General Recommendations for Procurement

3.3.1 Contracting Authority Lead Role

- 1) The Contracting Authority needs to have appropriate ecological expertise and to allocate appropriate time to this person to advise and inform project management personnel of how best to implement the statutory obligations for wildlife protection. This role will enable suitable provisions for wildlife protections to be included in model

contract procurement documents, as well as to undertake reviews of individual schemes at various stages of implementation.

- 2) At Project level the Contracting Authority should have ecological expertise engaged in a monitoring role throughout the life of the project, including an extended monitoring phase after completion of construction. This role can then be amalgamated in the network management process alongside routine operations and maintenance functions.

3.3.2 *Procurement Strategy*

- 3) The ability of Contracting Authorities to achieve optimal outcomes is constrained by EU Procurement rules – in particular the restriction to consider past performance at tender stage. It is recommended that consideration be given to removing this restriction, at least for Maintenance Contracts where track record is an important consideration to have confidence that the required outcomes have reasonable prospect of being achieved.
- 4) There would be environmental advantages to increased use of Quality Assessment in the procurement process and to include ecological requirements within the Quality Assessment – in particular where there are environmental sensitivities – e.g. in the case of proximity to a Natura 2000 site.
- 5) There is a need to engage specialist ecologists in both implementation and monitoring roles in the preparation and procurement of large Works and Maintenance Contracts.

3.3.3 *Contracting Strategies*

- 6) The review of international procurement practice has indicated particular advantages and disadvantages to the various existing practices. Especially those forms of procurement options which provide an inherent performance monitoring function appear to be better suited to actual achieve desired outcomes. The other forms of procurement require complementary actions by the Contracting Authority to achieve the same outcome for wildlife protections as noted for each below. The following explains the available options:

Option 1: Employer Designed:

- In this model all responsibility for wildlife protections rests with the Contracting Authority which will require to engage a full suite of expert ecological services for the design and monitoring of wildlife protections over the full life of the project.

Option 2: Design & Build:

- In this model the performance requirements of the wildlife measures are determined by the Contracting Authority. The design of the wildlife measures are undertaken for the Contractor by suitable ecologists. Monitoring of the works may also be undertaken by the Contractor for the initial performance period prior to handover to the Contracting Authority for ongoing maintenance and associated monitoring and remedial actions.

Option 3: Design, Build & Maintain:

- The wildlife measures identified at the Employer Planned stage need suitable ecological expertise for proper transfer to the next stages of Contractor Design / Contractor Construction / Contractor Maintenance.
- The Contracting Authority requires to provide an ecological supervision role to monitor compliance at all stages including appropriate actions during the operational phase in response to Contractor monitoring.

Option 4: Early Contractor Involvement (ECI):

- This works according to the following scheme: Contractor Planned - Contractor Designed - Contractor Constructed - Employer Maintained Contract. The option is similar to Option 2 in terms of the role of the Contracting Authority in the Maintenance stage.
- A further variant is Contractor Planned - Contractor Designed - Contractor Constructed - Contractor Maintained Contracts. This model places the least demand on the Contracting Authority in terms of ecological expertise, since this responsibility is transferred to the contractor, but still requires some involvement by the Contracting Authority to ensure that targets are achieved.
- An ECI Contract may operate on a target cost basis and would include consideration of Maintenance arrangements from the outset. This “Engineering – Construction – Operation [ECO]” Contract may or may not include a financing element.

Option 5: Maintenance Contract:

- The wildlife measures have previously been installed by other forms of construction contract, including legacy assets completed sometime in the past, and the asset is then maintained by a new Contractor with particular targets for management of the wildlife infrastructure amongst other duties.
- Condition Assessment of the infrastructure is undertaken at the outset to identify defects and need for enhancements.
- Retrofit measures may be ordered,
- The Contracting Authority requires to provide an ecological supervision role to monitor compliance at all stages including appropriate actions during the operational phase in response to Contractor monitoring.
- This form of contract may have greatest application and value on a network management basis for cumulative ecological outcomes. It also provides a direct and effective means for management of the asset with suitable emphasis on the ecological functions.
- The financial value of the ecological management tasks will be more significant in a relatively small value Maintenance Contract than in a much larger construction contract, and therefore the financial incentive to ensure suitable performance is more likely to be effective.

Where the design is undertaken or controlled by the Employer, there needs to be a Check process to ensure that the design is likely to achieve the desired outcomes. This may be

achieved through an independent checking process as is often applied for complex elements such as structures and earthworks. Another example is the Road Safety Audit procedure. A similar style Ecological Performance Audit process could potentially give greater confidence of a successful outcome. Such an audit could have 3 or 4 defined stages throughout the life of the project, with the final stage taking place after completion of construction and during the maintenance period.

In Contracts that involve design by the Contractor, there could be a Design Certification Process to ensure that the wildlife mitigation measures are designed by suitable competent persons. An auditing process could then provide independent verification of the design and construction to meet the required performance standards.

Sufficiently long performance periods of up to 5 years are necessary to enable the effectiveness of the mitigation measures to be monitored adequately and if necessary for corrective action by the Contractor. This is often a requirement for the landscaping elements of major schemes, and may be extended to include the wildlife measures. Operational contracts are well suited in this respect, and it is desirable that construction only contracts include an initial operational element in respect of these elements to achieve consistent outcomes in all procurement scenarios.

For each of the 5 contract types mentioned above, Table 2 outlines the responsibilities for the various stages related to mitigation measures through the life of a roads project.

Table 2 Responsibility Matrix: Provisions for Environmental Measures According to Works Procurement Process

	Activity	Responsible Parties in each Procurement Process Type				
		<i>Traditional Contract (Employer Designed)</i>	<i>Design & Build (D&B) Contract</i>	<i>Design, Build & Maintain (DBM) Contract</i>	<i>Early Contractor Involvement (ECI) Contract</i>	<i>Maintenance Contracts</i>
1	Environmental Assessment: Ecological, Hydro-Geological, Air Quality, etc	Employer			Employer & Contractor	Employer
2	Identify Mitigation Measures	Employer Designer			Contractor Designer	Employer
3	Design Mitigation Measures	Employer Designer	Contractor Designer	Contractor Designer	Contractor Designer	Employer Designer
4	Certify Designs - <u>Check</u>	Checker	Checker	Checker	Checker	Checker
5	Install Mitigation	Contractor	Contractor	Contractor	Contractor	n/a
6	Certify Installation	Employer Designer	Contractor Designer	Contractor Designer	Contractor Designer	n/a
7	<u>Ecological Performance Audit</u> - Annual for 5 Year Maintenance Period	Employer Designer	Contractor Designer	Contractor Designer	Contractor Designer	Contractor
8	Rectify Problems	Contractor	Contractor	Contractor	Contractor	Contractor
9	Supervision	Employer	Contractor Designer	Contractor Designer	Contractor Designer	Employer
10	Auditing	Independent	Independent	Independent	Independent	Independent
11	Management	Employer - Specialist Ecologist				

4 Follow-up (post-construction, handover and maintenance)

4.1 General aspects of follow-up

One important approach to ensure proper implication of wildlife-friendly measures is to include post-construction controls as an integral part of any project, which we refer to here as 'follow-up'. *Follow-up* is thus defined as any activity that checks and evaluates if a measure is fulfilling its purpose, also in terms of quality and sustainability (here mainly applied to structures such as artificial wildlife crossings). In this sense, *follow-up* comprises almost always some form of biological monitoring. However, *follow-up* is not to be confused with 'maintenance'. *Maintenance* activities have the purpose of keeping a structure functional, while a follow-up is checking the very function of the structure itself. In contrast to maintenance, follow-up activities are usually performed only during a specified period after construction, however, this can vary depending on the specific site conditions. This will be further explained in the relevant sections of this document.

Another point is the various terms often used to describe whether a mitigation structure is considered functional. If animals are considered, the term 'use' might appear appropriate. More neutral, however, is the term 'effectiveness' which signifies a more general, purely qualitative evaluation of the functionality of a structure from the perspective of the human observer. (In that way, 'effectiveness', i.e. functionality, is checked by observing 'use'.) The related term 'efficiency' denotes a more quantitative evaluation, but since it is often confused with 'effectiveness', it will not be used here. Thus, we should refer to 'effectiveness' to discuss the functionality of a structure, in the purely qualitative sense if it is used by animals or not. Quantitative evaluations will be designated as such when they appear in their context.

Guidelines and regulations are an important factor in the decision-making process, and this applies also to the following up (i.e. the 'follow-up') of road-related constructions. On the national level, however, there is no coherent system of guidelines throughout Europe. More than half (57%) of the institutions for which interviews were performed use some kind of guideline, but less than half (43%) indicated that these are ones specifically issued by the National Road Authority, and less than a third (29%) called those guidelines that they use 'handbooks'. In the remaining cases, legal documents such as government regulations might be used as a guidance (e.g. in Hungary). An exception appears to be the UK, where the Post Opening Project Evaluation (POPE) is a standard measure which is regularly completed with a report. Its purpose is mainly to compare the post-construction conditions with the original planning scheme. In essence, it appears that it is decided from case to case if, and then, what document will be used as a guideline. As one representative from Norway put it bluntly, there are clear instructions on how to build something, but none on how to check after construction if it works.

In regard to literature on follow-up in the construction sector, many, if not most of the reviewed articles are on the follow-up of environmental requirements during construction work (Varnäs et al., 2009). Environmental Impact Assessment (EIA) follow-up is generally seen as a phase within the EIA process (Morrison-Saunders et al., 2001), but Morrison-

Saunders and colleagues (2007: 3) argue that “EIA follow-up should be sustained over the entire life of the activity”, i.e. from EIA through operation. Indeed the phrase ‘EIA follow-up’ is used as a catch-all for a number of activities that have the objective of following up on the consequences of projects (Arts et al., 2001). According to the literature follow-up enhances the power of EIAs (Marshall, 2005), can improve the effectiveness of mitigation measures (Gallardo et al., 2015) and provides an opportunity to improve future EIAs (Morrison-Saunders et al., 2001). Some authors go as far as to say “EIA without follow-up can be termed as a futile exercise” (Nadeem & Hameed, 2010: 115).

As follow-up activities are already neglected for the most part, environmental issues take even less space within these. Follow-up is important not only to ensure that mitigation measures are installed but also to check if they have achieved the desired effect (The Countryside Agency, 2006). The general problem here is that construction and environmental considerations are not systematically connected. In our study, little more than half (57%) of the interviewed institutions indicated that they have post-construction follow-up activities at all. As is not unusual in such cases, a personal interest in a matter can be the reason for conducting follow-up activities (e.g. in Sweden). Often, tests are only performed as spot-checks (e.g. in Norway). Even in the UK, ‘POPE’ does not cover this kind of regular follow-up studies, and this is recognised as a deficiency.

A reason for this neglect of follow-up could be the absence of any commitment to it in the contract. When asked if a follow-up programme is usually integrated in the tendering, nearly two thirds (64%) of the interviewees answered in the negative. However, there are again variations, and in Austria, Hungary and sometimes in the Netherlands, follow-up might already be included in the tendering. In Norway it appears that the decision for a follow-up is very person-dependent, or might be decided according to a specific situation necessitating such a measure. A further possible reason for inadequate follow-up of environmental requirements is the use of ambiguous language such as, “greatest possible environmental consideration” in contract documents (Faith-Ell et al., 2006: 166).

A guide from the Norwegian Agency for Public Management & eGovernment (Difi) states the requirement that countries follow-up on all contracts: “Precedential case law from the European Court of Justice implies that public contracting authorities cannot impose requirements that they have no intention or ability to follow up on.” (Difi, 2012: 10)

When we come to the question of what types of contracts are usually followed up, the overall picture of little post-construction activities is confirmed. For both the construction and the maintenance contracts, in less than half of the institutions interviewed (43%) they are followed up. Interestingly, exactly the same percentage (i.e., 43%) of the institutions indicated that they follow up both. (This might actually be due to the way the question was asked or an inherent problem of the nature of multiple choice questions and answers.) In the Netherlands, maintenance of mitigation measures is always included in follow-up contracts as a post-construction measure. Monitoring – as a more long-term option of follow-up – is only included for new measures or research questions. Finally, in Sweden, third party control is usually applied.

In terms of Maintenance Strategies, there are relatively few specific Maintenance Guidelines or Handbooks with a focus on ecology across the Study Area. There are particular

requirements in certain Maintenance (including DBM) Contracts but these are often produced on a case by case basis. There is a reliance on the prevailing road and landscape design standards to address ecological needs. As regards the environment, follow-up of road maintenance contracts can have a dual role (Faith-Ell et al., 2006): (1) assessment of the contractor's environmental performance, and (2) consideration of how the environmental requirements influence the impact of the maintenance activities.

So what types of follow-up activities are actually performed in practice, and how much attention do these get? (See Table 3) Most important appears to be here the checking of a number of structures: culverts and underpasses, fencing, landscaping measures and the number of road kill, which receive all about the same attention (71%). Second to this comes the monitoring of the effectiveness (i.e. use by animals) of newly created measures for so-called target species (64%). Other issues that receive attention but are much less frequent are e.g. sight clearance (in Norway) and the monitoring of the water quality (in Greece).

EIA Directive 2014/52/EU has recently included monitoring as a requirement of EIA. This will increase the onus on Contracting Authorities to ensure that wildlife mitigation measures are functioning as planned and may lead to an adequate follow-up and monitoring. It has yet to be seen if the new Directive will improve upon the situation found in Tinker et al. (2005) where 50% of the mitigation measures suggested in the environmental statement were not translated into the conditions of planning. IEEM (2006) posited that building follow-up and monitoring requirements into such legal documents would increase their likelihood of implementation.

Table 3 Types of follow-up (post-construction) procedures usually performed. (Abbreviations: NA = No data/information available; Saxony-A. = Saxony-Anhalt, federal state of Germany.)

Country	Checking			Recording road kill	Monitoring use (target species)	Other/additional activities
	Culverts/underpass	Fencing	Landscape measures			
Austria	Yes	Yes	Yes	Yes	Yes	No
Belgium: Brussels	Yes	Yes	Yes	Yes	Yes	No
Belgium: Flanders	No	Yes	No	Yes	Yes	No
Germany: Saarland	Yes	Yes	Yes	Yes	Yes	No
Germany: Saxony-A.	Yes	No	Yes	Yes	Yes	Monitoring overpasses
Greece	Yes	Yes	Yes	Yes	No	Monitoring water quality and accidental spills
Hungary	Yes	Yes	Yes	Yes	No	Any tasks that include maintenance of roads
Ireland	Yes	Yes	Yes	Yes	Yes	No
The Netherlands	Yes	Yes	Yes	Yes	Yes	Checking overpasses and hiding/rest./breed. Sites
Norway	NA	Yes	NA	NA	NA	Checking wildlife fences Sight clearance
Sweden	Yes	No	No	No	Yes	No
The UK	No	No	Yes	No	Yes	No

4.2 Approaches to follow-up

This section deals with a number of exemplary scenarios and how issues are addressed in such situations. One important situation would be when unforeseen circumstances arise during the construction stage that had not been considered during planning. Such a situation could for example be the discovery of a protected species. When presented with this kind of situation, the interviewees answered quite differently. Often, a (complete) stop in the construction activities is the first step, and this was mentioned with emphasis in Austria and Hungary, but also in Ireland. In Greece, Ireland and Sweden, and to a certain degree in the Netherlands, Germany, Norway and the UK, consulting with a responsible (state) authority is required in such a situation. Otherwise comparable situations will generally be addressed pragmatically, and measures appropriate to the situation are taken.

As an important tool for infrastructure development, the Environmental Impact Statement (EIS) receives special attention during both the planning and the construction phases. Since the EIS is basically providing predictions based on a number of previously available parameters, it is essential to compare the predicted with the actual impact of the road development during and after construction. Such a follow-up does not seem to be a regular

practice in any of the institutions included in the present study. Based on the interviews, the approach once again appears to be seen very pragmatically. Usually, the responsible authorities are consulted in unforeseen circumstances, and plans might be altered (i.e., the contracts adjusted). In Greece it is compulsory to submit an annual environmental report to the Environmental Authority, which is a process considered to be in line with EIS requirements.

Table 4 Monitoring methods used to evaluate the effectiveness of mitigation measures.

Country	Visual inspection	Ink pads	Cameras	Not assessed	Other/additional methods
Austria	Yes	No	Yes	No	Interviews
Belgium: Brussels	Yes	No	Yes	No	“Snake plates”
Belgium: Flanders	Yes	Yes	Yes	No	Sand beds Pitfalls for insects
Germany: Saarland	Yes	No	Yes	No	Tracking of animal footprints
Germany: Saxony-A.	Yes	No	Yes	No	No
Greece	Yes	No	No	No	No
Hungary	Yes	No	Yes	No	Number of wildlife collisions
Ireland	Yes	No	No ¹	No	No
The Netherlands	Yes	Yes	Yes	No	Several additional methods ²
Norway	Yes	No	Yes	No	Application of some very detailed methods
Sweden	Yes	No	Yes	No	Sand beds GPS tracking
The UK	Yes	Yes	Yes	No	Ink pads and equivalent (clay)

The effectiveness of mitigation measures is usually tested by monitoring certain so-called target species. As is evident from the interviews, some kind of monitoring is done by all institutions included in this study (Table 4). All of them (100%) perform visual inspections, and three quarters (77%) also use cameras to monitor the use (i.e. the effectiveness) of structures by species. More than two thirds (69%), in addition, mentioned other methods of monitoring mitigation measures. For example, while only less than a quarter (23%) of the interviewed institutions answered that they use ink pads to track animals, several mentioned

¹ This is the answer provided by the persons interviewed with the questionnaire. However, according to other sources cameras were used in Ireland on 39 mammal underpasses over a two-year period to evaluate the structures’ effectiveness. This was part of “post-EIA” studies (V. O’Malley, Transport Infrastructure Ireland, personal information).

² This includes video, trapping (small mammals, reptiles, amphibians, and invertebrates), capture-mark-recapture methods, bat detectors, radio telemetry, sand beds, and – to a lesser extend – DNA sampling. Of all interviewed institutions, the representatives here provided the greatest detail.

additional methods for tracking, such as clay or sand beds. The method used depends here of course on the animal species to be surveyed, but since different localities comprise very often quite different habitats, the methods have to be adapted. The monitoring of species is also often performed in close cooperation with researchers, and then more sophisticated methods might be used.

In a worst-case scenario, mitigation measures might perform poorly. In this case, the structure in question would have to be improved (Table 5). How is this achieved by the interviewed institutions? – The major methods of amelioration appear to be planting or landscaping (77%), followed by improvement work done on ecoducts/passages (69%). Drainage is also very common as a measure, and was mentioned by about half of the interviewees (46%). As a specialty in Flanders, surrounding agricultural land might be bought to be added to the mitigation structure. However, care should be taken here with any generalisations. In the Netherlands, for example, only the effectiveness of mitigation measures is checked, but no quantitative measure is used to evaluate its performance. This points to the – actually widespread and structural – problem that is in fact the same as the aforementioned lack of follow-up activities, which should be performed with a standardised and integrated approach. One representative from Norway admitted that the development simply has (at present) not reached a point where this kind of evaluation – including improvement measures – has become a standard procedure.

Table 5 Improvement methods employed if mitigation measures perform poorly.

Country	New planting/ landscaping	Improving access routes	Drainage	Other methods/ comments
Austria	Yes	Yes	No	Inspection of regular maintenance of green areas
Belgium: Brussels	Yes	No	Yes	No
Belgium: Flanders	Yes	Yes	No	Buying agricultural land surrounding e.g. an ecoduct
Germany: Saarland	Yes	Yes	No	No
Germany: Saxony-A.	Yes	Yes	Yes	No
Greece	Yes	Yes	Yes	No
Hungary	Yes	Yes	Yes	Putting up road signs Testing new methods
Ireland	Yes	Yes	Yes	No
The Netherlands	No	No	No	Decided from case to case, or in exceptional situations
Norway	No	No	No	A monitoring/checking system is in development
Sweden	No	No	No	No
The UK	Yes	Yes	Yes	No

The performance of a mitigation measure has to be evaluated by using some kind of indicator or metrics that reflect its quality. This can be the quality (type) and/or quantity of a species using a structure (i.e., e.g. species and number of animals per time) or even so-called 'Key Performance Indicators' (KPIs). In terms of follow-up, the use of measurable objectives and triggering thresholds would be the ideal situation (IEEM, 2006). The results from the interviews showed that both qualitative and quantitative evaluations are being carried out, but presence/absence or count data predominate in the activities undertaken. However, counting data only is not considered to be sufficient for a serious data evaluation. Since it is a gross simplification, it was explicitly criticised by the representatives from the UK, Flanders, and the Netherlands. A rather detailed description of their monitoring work was provided by the Norwegian representatives. Here, a vast number of camera images were combined with data from GPS senders, trace traps, vegetation mapping and other methods, to name a few. Yet, as a concluding comment the interviewees remarked that this kind of measurements should be an integral part of mitigation projects, and not person-dependent 'one-off' activities.

Traditionally, follow-up activities have mainly been a task for the national road authorities. According to the interview data, this is still largely the case, at least regarding maintenance, and there is little or no participation of other organisations in such activities. However, the Nordic countries (Norway and Sweden), are an important exception, because here all maintenance tasks are commissioned to consultancies. In the remaining countries in this study, only landowners and NGOs play a small role in maintenance activities. When exclusively considering the monitoring activities, the majority of the interviewed institutions (69%) use consultants for these tasks, with a smaller share done by NGOs (the latter usually on a voluntary basis, yet still 38%). As with the evaluation of mitigation measures' effectiveness, researchers (including students) might also perform monitoring tasks and thus contribute with data gathering.

There is consistent evidence of greater follow-up for contracts incorporating maintenance, either standalone or as part of a DBM Contract. There is an element of self-checking by the contractor in these cases, reducing the supervision burden on the Contracting Authority. Outside of Europe, Chile has follow-up inspections as final part of their performance based maintenance contract monitoring (Zietlow, 2004). The follow-up ensures that any non-compliance has been rectified properly. Inadequate financial and staff resources are often an impediment to Contracting Authorities undertaking follow-up measures and monitoring. Follow-up actions, including supervision, should be undertaken by specialist personnel with the appropriate training to ensure that environmental measures are correctly implemented and maintained. While monitoring is a requirement of the EIA Directive, there is no corrective action procedure built in. Therefore, it is the responsibility of the Contracting Authority to include for this in the Works or Maintenance Contract.

Where DBM Contracts are not used, maintenance typically falls to the Contracting Authority. There is increasing use of standalone Maintenance Contracts across the Study Area – for example in Ireland where all non-PPP [DBM] sections of motorway are now subject to Motorway Maintenance and Renewal Contracts. These contracts often cover an extensive length of road network consisting of numerous previous construction projects procured by various methods over many years and lacking consistency in wildlife protections. There are

opportunities for legacy wildlife problems to be addressed in such maintenance contracts, and these improvements may be undertaken alongside other works required for functional or operation reasons.

4.3 Documentation and use of follow-up data

Although collected in a standardised way, follow-up data is available from all countries except Greece. However, no reason for the latter's unavailability of data was given. As a general rule, the data should be available to the public, since – as was pointed out by a representative from the Netherlands – the so-called *Aarhus Convention* commits the public authorities in the member states of the European Union to publish all environmental information (European Commission, 2015b). One representative from Sweden expressed the situation – which is symptomatic for all countries here – as follows: In principle, everything is public and should be freely available, but *accessibility* is another thing (Table 6).

Table 6 Accessibility of follow-up data

Country	NRA access only	Restricted access	Public access	Comments
Austria	No	Yes	No	No
Belgium: Brussels	No	Yes	Yes	Public access to part of the data via a database
Belgium: Flanders	Yes	No	Yes	Only a small part of the data is publicly available
Germany: Saarland	Yes	No	No	No
Germany: Saxony-A.	No	No	Yes	No
Greece	No	No	No	(No data available?)
Hungary	Yes	Yes	No	Very limited access
Ireland	No	Yes	No	Data is available to interested parties
The Netherlands	No	Yes	Yes	Data is available upon request (Aarhus conv.)
Norway	No	No	Yes	Reports are published (with data)
Sweden	No	No	Yes	Data is available upon request (to researchers)
The UK	No	No	Yes	No

When looking at the availability of the follow-up data in more detail, we can conclude further: The general policy with follow-up data is to keep it available, but only to release it upon request. Direct access via the internet is in most countries very limited for an external user. As explained by the UK representative, one problem with this can be the lack of a unified database system. However, in Flanders and for some parts of the Hungarian Roads

Management (here: the Directorate for Pest County) access appears to be even more limited than that.

How are follow-up results used in the different countries? Generally, there are very mixed opinion on how to use the data (Table 7), but it appears to be mostly used for the planning of future follow-up activities and new guidelines (for both points 58% of the interviewees answered with 'yes'). Future contract procurement and feedback to client and contractor are the next most important issues (50% answered 'yes' to these each). However, there are two extremes: The Netherlands, where follow-up results are used for all options given here, and Greece, where the follow-up results are apparently not used at all. Making data from specific projects/countries available would create research opportunities that may generate insights into follow-up and good practice (Wessels et al., 2015).

Table 7 Use of follow-up results and data. (Abbreviations: Feedb. = Feedback to client and contractor, Fut. c. = Future contract procurement, Fut. f. = Future follow-up activities, Rev. t. = Revised tender process, New g. = New guidelines.)

Country	Feedb.	Fut. c.	Fut. f.	Rev. t.	New g.	Other/comments
Austria	Yes	Yes	Yes	Yes	Yes	E.g. proof of the public authority
Belgium: Brussels	Yes/No	Yes	Yes	No	No	Feedback is given if there is enough data
Belgium: Flanders	No	Yes	Yes	Yes	Yes	No
Germany: Saarland	No	No	Yes	Yes	Yes	No
Germany: Saxony-A.	Yes	Yes	Yes	Yes	Yes	No
Greece	No	No	No	No	No	No
Hungary	Yes	Yes	Yes	No	Yes	Cooperation with NGOs and research groups
Ireland	Yes	No	No	No	Yes	No
The Netherlands	Yes	yes	yes	Yes	Yes	Implementation in revised designs or requirements
Norway	No	No	No	No	Yes	Plan to include the results in "good handbooks"
Sweden	No	Yes	No	Yes	Yes	Results might be used by e.g. researchers
The UK	No	No	Yes	No	No	No

Our findings showed that very little emphasis is put on follow-up in general and particularly so for maintenance of ecological mitigation measures. As the only country, in the Netherlands maintenance of ecological measures is carried out on all road projects. The findings suggest that where a large ecoduct has been delivered as part of the road project these are in some cases followed up and maintained with good monitoring programmes.

However, in general standard ecological measures are rarely followed up from a maintenance perspective.

4.4 Status and improvement possibilities regarding follow-up

Follow-up studies are a necessary part of quality control and will help to improve practice (Seiler & Folkeson, 2006). From the previous sections it is quite clear that follow-up activities are to a large part neglected in the investigated countries. One question in the questionnaire raised this issue directly by asking the interviewees what status these have in their respective organisations. Interestingly, the opinion about follow-up activities was predominantly neutral. In only little more than a quarter (29%) of the interviewed institutions are these highly prioritized, for the majority (57%) they are neutral. However, it seems that this picture might be biased. For example, the Austrian representative indicated that follow-up activities are highly prioritised, because of it being a legal requirement. A similar answer was given for Flanders (in Belgium), but in contrast, the representative from Brussels said that it is not prioritised at present. However, the latter also admitted that follow-up is planned to be higher prioritised in the future. In conclusion, it is significant how a representative from Norway put it: “Everybody is aware of its importance but it is not prioritized.”

Examples from the EIA follow-up literature tell a similar story. There is a lack of implementation and there is concern about poor or inconsistent practice (Hunsberger et al., 2005; Jalava et al., 2015; Morrison-Saunders et al., 2007; Nadeem & Hameed, 2010; Ramjeawon & Beedassy, 2004). With regards to maintenance and maintenance follow-up the UK interviewee suggested that it is only prioritised when public safety is an issue which largely results in minimal maintenance to wildlife mitigation measures.

There appears to be little consistency regarding follow-up across member states, primarily as a result of limited Contracting Authority resources. The best outcomes are achieved where follow-up actions are undertaken by specialist personnel with the appropriate training to ensure that environmental measures are correctly implemented and maintained. Also studies have shown that so-called *Green (Public) Procurement* (cf. European Commission, 2015a) with performance based objectives can achieve better environmental outcomes over standard environmental requirements incorporated into the EIA report/EIS.

The Motorway Maintenance and Renewal Contracts in Ireland – although providing an opportunity for legacy wildlife problems to be addressed – rarely focus on the function or success of ecological mitigation. In consultations with one of these contractors in Ireland they were unable to provide photographic or historic reference to the maintenance of any culverts, tunnels, etc. with almost all maintenance focussing on maintenance of drainage and pavement, verge mowing and pavement and barrier repair.

When asked to identify improvement possibilities, the interviewees had immediately specific suggestions. More than a third of the representatives named a more systematic approach as a key issue, while improvement of both monitoring and follow-up activities was considered only second in importance. Seiler & Folkeson (2006) recommend the methodology for survey and data collection in follow-up be coordinated at an international level. It becomes quite clear from the interview data that a follow-up should be a standard (in all contracts), and that it should be reinforced, if necessary. At the same time, an early involvement of (professional)

ecologists is seen as an important improvement, too. Directly related to that is the problem to find or define ecological parameters, which reliably should show how road building and maintenance activities affect nature. Such parameters were by many representatives seen as a desideratum. This can be tied back to earlier stages in the project timeline and a similar issue arises in EIA follow-up caused by vague predictions of effects in the EIA and unclear aims creating a poor benchmark against which to measure implementation (Noble & Storey, 2005; Rafique Ahammed & Merrick Nixon, 2006). Some more specific answers should illustrate the differences further:

- The Greek representatives suggested that companies should have a bank guarantee to make sure that all mitigation measures that are planned within the EIS framework will be implemented.
- The representatives from the Netherlands made it very clear that all ecological aspects should be included from the start. Also, there should be a strategy which makes clear to the companies that they do not run any competitive risk when all ecological aspects are included.
- The Dutch representative further pointed out that DBFM contracts should be used preferentially, because then “the contractor is also responsible for the functionality of his product and has to keep it functional for a long time”.
- Performance based mitigation measures or DBFM (PPP) contracts where the contractor is given specific targets with financial incentives would be a way of not only ensuring that the measure is provided but by requiring the Contractor to prove the use of the measure by the target species they are also incentivised to undertake extensive monitoring.

4.5 *Follow-up: how to proceed in the future?*

4.5.1 *Discussion*

A major problem identified here is the lack of a unified scheme for follow-up activities, which are largely neglected. That this is the case despite a clear consensus among the respondents that a standardised and regular follow-up would be essential to evaluate the success of the mitigation measures is astounding. In other words, there are no clear guidelines on ‘what to do after’. However, it appears that the reason for this is not a shortcoming of European and national legislation, but rather an incomplete implementation and adaptation to national conditions. A solution to this problem could be to design a checklist or adapt a tool that can guide through the construction and/or maintenance processes, including follow-up (e.g. similar to the SUNRA tool; cf. Sowerby et al., 2014). Another recommendable example was provided by one of the representatives from Germany (Saxony-Anhalt). Here, an ecological construction monitoring is usually being performed during the construction process, which permits fast and professional acting in the case of unforeseen circumstances, but it does also provide the necessary background data for an evaluation of the mitigation measure’s performance after construction. For this, monitoring would just have to be extended until an agreed upon time after finishing the construction works. In general, a follow-up of the Environmental Impact Statement (EIS) – in essence a comparison before–after – should be compulsory.

The meaning of the terms ‘maintenance’ and ‘follow-up’ should not be confused. *Maintenance* encompasses the technical activities to keep the structure in question working and has no time limit. *Follow-up*, on the other hand is usually the evaluation or checking if a structure is fulfilling its purpose and usually includes some biological monitoring. The latter does in most cases not have to be continued indefinitely, but only for a certain time after construction. *Monitoring* of biological activity should actually be considered an integral part of any follow-up study, but since it is often performed independently by researchers in scientific projects, the opportunity of cooperation – e.g. between the National Road Authority and researchers at universities – should be used to keep a high standard using up-to-date scientific methods and equipment.

One issue that had been raised by many respondents, and which is also reflected in the literature (Faith-Ell & Arts, 2009; Faith-Ell, 2005; Faith-Ell et al., 2006; Grant-Muller et al., 2001; Hunsberger et al., 2005; Nadeem & Hameed, 2010; Rafique Ahammed & Merrick Nixon, 2006; Slotterback, 2008), was the need for clear and easy to measure parameters to evaluate the performance of mitigation measures. The use of so-called “Key Performance Indicators” (KPIs), however, is not “best practice” if they are adopted directly in the economic sense. As stated by several interviewees, the performance of an ecosystem depends on many factors that are difficult to evaluate, much less to quantify – especially within the relatively short timeframe of a typical construction project. Many measurements are done to evaluate newly built mitigation structures, but these consist for the most part of simple count data, which has – not at least scientifically – little informative value and even less explanatory power. Count data has to be supported by other means of data gathering, and it should be planned for long-term observations. Ecosystems are complex structures and experience naturally qualitative and quantitative fluctuations. “KPIs”, when they are used as often in business administration – i.e. applying gross (over)simplifications – will fail to document such fluctuations. Thus it would prove disastrous when trying to evaluate the “performance” of an ecosystem through which a transportation corridor is cut using too simplified indicators. Some kind of performance indicators could – and should – of course still be used, but it should be kept in mind that possible, natural long-term fluctuations – for example of population sizes – have to be taken into account for such evaluations. To be useful, ‘KPIs’ have to be re-shaped, away from their origin as an economic tool, to fit real-life conditions that are based on carefully evaluated primary data. (The issue with KPIs is further discussed in a separate section further below.)

As stressed by several interviewees repeatedly, many follow-up activities that are carried out depend on personal convictions, i.e., they are only performed due to the personal commitment of an employee (usual at the National Road Authority), yet they provide crucial information. Much of the monitoring is performed this way, and the data thus collected needs an experienced ecologist for analysis. To maintain this highly valuable experience and expertise, long-term planning is essential. Consequently, long-term planning should also include information policy. Despite the commitment to the Aarhus Convention (European Commission, 2015b), structured information on environmental issues regarding the road network is not widely publicly available. Here, the creation of a unified database system for information retrieval would be crucial to raise public awareness on the issue of roads and wildlife. Public participation could also trigger a positive response and feedback, and will most probably result in more respect for the environment.

4.5.2 Recommendations

- (1) The international evidence suggests that follow-up studies are rarely undertaken where there is no particular requirement for maintenance. Therefore, greater use of Maintenance Contracts will most probably lead to increased maintenance and better environmental outcomes.
- (2) A standardised tool or guidelines would help the implementation of legislation to ensure standardised and regular follow-up. This could for example be implemented as an electronic application.
- (3) The *Aarhus Convention* commits the public authorities in the member states of the European Union to publish all environmental information. A unified, accessible database for information retrieval would simplify the access to information and allow for easy comparisons across Europe.
- (4) Both Maintenance Contractors and Contracting Authorities should have access to ecological expertise, either in-house or engaged, to ensure the environmental objectives of projects are achieved.
- (5) Contracting Authorities need to be adequately resourced in order to undertake follow-up measures. Follow-up actions including supervision should be undertaken by specialist personnel with the appropriate training to ensure that environmental measures are correctly implemented and maintained.
- (6) Contracts should include some performance based criterion such as the achievement of CEEQUAL award for the project to focus the Contractor on environmental performance throughout the construction life of the project.
- (7) In respect of existing roads, there are clear advantages to the procurement of maintenance contracts, as it increases the focus of both the Maintainer and the Contracting Authority. Further study may be warranted to understand the relative costs of public and private sector maintenance.
- (8) The adoption of the ECO Contract Model (“Engineering – Construction – Operation”), outlined in Section 3.4.3 (*Contracting strategy*, Option 4), addresses the maintenance needs of major road schemes from the outset, in turn ensuring a medium to long term view on the effectiveness of landscaping features and ecological performance.

5 KPIs and other indicators of performance

5.1 *Indicators as economic and ecological concepts*

One issue that was repeatedly mentioned during the interviews, in particular by individuals with a background in ecology, was the perceived need for parameters that effectively give a measure of a transportation-related environment's condition. In other words, the coincident opinion was that indicators, that reliably show how nature is affected by transportation infrastructure and traffic, are clearly a desideratum. This is especially true when the functionality of a mitigation structure or its effect on the surrounding environment are to be examined. In reality, however, it is difficult to find and define such indicators, because they would have to be qualitative as well as quantitative, be measurable within reasonable limits of effort, and – the most important – constitute an easy access to essential information on the functioning of an ecosystem.

The choice – or design – of such indicators is inevitably dependent on local circumstances. Ecosystems are *per se* complex structures, and any generalisation – which is always a simplification – is accompanied by a loss of understanding (cf. Begon et al., 2006). It is also important to separate *cause* from *effect* when interfering with an ecosystem, and if necessary, provide indicators for both. In most cases, human influence will provide the cause, while the effect will have to be measured on the environment. For example, the amount of salt needed to maintain a road operational during winter can easily be measured, but it is more difficult to quantify the effect of the salt on roadside vegetation. Thus, should plant individuals be counted, or their density, or species diversity, or something completely different? Is it enough to choose one parameter?

In some cases, cause and effect can also be reversed. The crossings of wild boar at a particular locality along a road, for instance, can theoretically be measured with the right study design. The number of wildlife accidents with wild boar, however, is very much dependent on the rate of them being reported by road users. Thus, measurements of the cause and of the effect will be of very different quality, resulting in widely differing confidence in the data.

A good set of indicators would nevertheless provide some guidance for the planning of infrastructure and mitigation measures. An attempt to provide a theoretical background for making the choice of indicators easier has been made by proposing the use of so-called 'Key Performance Indicators' (KPIs). KPIs are a concept taken from economics, where they are widely used in business administration (e.g. by the DEFRA, 2006). As a general concept, KPIs might have the advantage of providing an unbiased, generalising approach, but to what extent a method taken from economic theory is applicable within the field of science is debatable.

It should be noted here that the term 'indicator' is used by both ecologists and economists. In ecology, there are attempts being made to define "ecosystem health indicators" (Begon et al., 2006), while in economics, the emphasis is mainly on "performance" (e.g. DEFRA, 2006), which rather emphasises productivity. As indicated by the term 'performance indicator',

especially KPIs were originally used to provide a simplified measure of a company's production output. However, their concept has been – and still is – widely misunderstood, and KPIs have even been misused in economic contexts (Parmenter, 2007).

According to Parmenter (2007: 5), KPIs should be defined along seven characteristics:

- (1) they should not be financial;
- (2) they have to be “measured frequently”;
- (3) they should be “acted on” by the management;
- (4) measures and necessary “corrective action” have to be understood “by all staff”;
- (5) “the individual or team” has to be held responsible;
- (6) they should have a “significant impact”; and
- (7) all KPIs should have a “positive impact”, ideally affecting “all other performance measures in a positive way”.

If we want to use this *economic* definition of KPIs to evaluate the impact of a measure on an ecosystem, we first have to test whether these definitions are applicable. Regarding the ‘health’ of an ecosystem, the first two points may be used. Relevant metrics would undoubtedly be non-financial, and the effect of measures *has* to be evaluated frequently and repeatedly to obtain reliable data on ecosystem functioning. The third point is critical and not applicable in ecology, since indicators of the functioning of ecosystems cannot be defined or changed by managers or other persons higher in a hierarchy, unless they have detailed, first-hand knowledge and experience with the local ecological conditions. In contrast, if the *same* KPIs are used on *all* structural levels of an organisation, each member who is involved should have the necessary background and knowledge as required by point four. Point five, however, has to be discarded, because performance indicators as they are supposed to be used here – in an ecological context – can only be used as a metric, while the responsibility will lie with the person or institution that affects the environment. (In fact, responsibility is highly unclear as long as different contracting options are used in procurement.) While point six is applicable in an ecological context – the desired selection of indicators should include those with the widest-ranging impact –, the last point, seven, is irrelevant here, because all indicators should *per se* be non-judgmental.

5.2 Indicators in infrastructure and transportation projects

Gudmundsson (2004) summarised the requirements and limitations of performance indicators when applied to sustainable transportation. Although the paper is not strictly about maintenance or follow-up, the author discusses some fundamental considerations. According to his investigations, the definition of any indicator is dependent on the underlying data, which has to be collected beforehand.³ In turn, the availability of data will influence the

³ This creates actually a major problem for the use of performance indicators. Data for a site, which has been collected before building e.g. a road or putting a mitigation structure in place, will not necessarily correspond or be transferable to a set of standardised, general indicators. In fact, most data available might neither be of the same quality nor cover time frames that allow for comparisons using such indicators. However, while this does not make the development of suitable performance indicators impossible, the shortcomings with the method have to be kept in mind.

choice of the indicators. However, “different types of indicators convey different types of messages” (Gudmundsson, 2004: 46). In his definition, “operational characteristics of indicators” include:

- (1) a representative picture of the whole;
- (2) a reasonable simplification of complexity;
- (3) adaptability;
- (4) a sound scientific and technical foundation;
- (5) an adoption of international standards; and
- (6) a regular update.

Depending on the so-called “user group” Gudmundsson (2004) recognises that each of them – “scientists, analysts, decision-makers and the general public” – should get only the information that is needed for their purpose. Thus, one important conclusion here is that a universal indicator that works on all levels does not exist.

Nevertheless, attempts have been made to use performance indicators in environmental contexts specifically regarding the maintenance of infrastructure. Faith-Ell et al. (2006) studied how environmental requirements were implemented in Swedish road maintenance contracts. Although “a serious effort to integrate environmental aspects into the contracts” was made, only little of it was realised in practice. This was mainly due to deficits in the information flow – especially to sub-contractors and to the public, confirming the problem of communicating complex matters through all levels of a ‘hierarchy’ (see below) – and because follow-up was largely ignored. Obviously, follow-up studies are crucial if one is to evaluate if environmental requirements have been complied with or if mitigation measures have a positive effect on an ecosystem. Although performance indicators appear to have been used, their implementation was not of any use.

If the performance of an ecosystem, and especially the effect on it by a construction or maintenance measure is reduced to a few indicators only, there is a risk of choosing a set that is not meaningful. However, there is an even higher risk when indicators are used as performance measures, e.g. by a subcontractor, as ‘measures of performance’. Thus, providing performance indicators as an incentive to fulfil certain ecologically relevant obligations can have *unintended consequences* (in the sense of Merton, 1936), especially if e.g. a contractor has no background to understand the meaning and the consequences of using a specific indicator. In the worst case, such indicators – used and seen as incentives – can become so-called *perverse incentives*. This kind of incentives result in undesirable outcomes, which are contrary to the original intention to establish such an incentive. Such unintended effects are well-known and have been reported in many contexts. The consequences of perverse incentives have been especially problematic in biodiversity conservation (Gordon et al., 2015), which is directly related to the topic of wildlife mitigation discussed here. For example, to comply with environmental legislation is relatively often found to be less profitable by landowners than to engage in species protection. This results in some cases in deliberately and actively lowering the conservation value of privately owned

land by the landowners themselves, even by actively harming (protected) species⁴ (Polasky et al., 1997; Adler, 2010). More recently, invasive species have become another focus of attention. In this latter case, perverse incentives can have far-reaching economic consequences, which partly explains the more immediate actions now being taken (Fenichel et al., 2014).

5.3 Indicators: concluding remarks

The major problem of using KPIs or other performance indicators as “numerical targets” is their nature as being simplifications of complex systems and tasks. There is an obvious danger to believe that “what gets measured gets done”, an argument that also can be turned around, leaving the question if everything that remains unmeasured will also not be evaluated or done. Indicators, even those representing numeric ‘target’ values, can provide a guidance, but they are only meaningful when used between individuals who entirely understand their meaning, that is, communicated on the same level or with an immediate supervisor. For the complex tasks of public services – of which the maintenance of the transportation network is a part of – simplifying, generalising KPIs are entirely unsuitable (Barratt, 2011).

Despite this, an economic perspective is important in resource management and conservation planning. At the same time, ecosystem health – a social construct, but which can be reflected in human health – has to be assessed for planning, for which there is a need of reliable indicators. An ecosystem manager can have a few, but sometimes may have only a single indicator available to assess the system’s condition. However, the use of such indicators presupposes experience and a deep, scientific and ecological understanding (Begon et al., 2006; for a discussion of indicator *species* – as a concept in biology – see Fairweather, 1999). On the other hand, some economic terms are now widespread and can be very useful to convey the importance of functioning ecosystem. One of these is the concept of ‘ecosystem services’, which is part of the strategy to put “price tags” on elements of natural systems. This has, at least in part, led to a revaluation of benefits obtained from ecosystems (Chichilnisky & Heal, 1998; Daily, 1997; Millennium Ecosystem Assessment, 2005; Begon et al., 2006). However, it remains extremely important to study and understand the relationships between human society and nature correctly in order to draw the right conclusions (Raudsepp-Hearne et al., 2010).

⁴ This might even mean removing a discovered protected species without reporting, or considerably reducing the number of individuals encountered.

6 Conclusions

Based on the considerations above, we provide a number of recommendations:

- (1) Ecological expertise in all parties involved in project delivery is essential for the successful implementation of environmental measures from the preparation of contract documents through to the monitoring of road operations. The Contracting Authority requires access to suitable ecological expertise to enable it to fulfil its duties properly.
- (2) The increased use of Quality Assessment, including ecological requirements, in procurement would provide environmental advantages. However, as this is only a small part of the assessment process there is no guarantee that it can have a decisive influence on the appointment process, and it is doubtful if that would be appropriate in the overall project management process.
- (3) Construction and Operation Contracts that incorporate a Maintenance function with appropriate monitoring may be preferred as this ensures that there is a process for problems to be resolved.
- (4) Contracts which engage the Contractor before the Planning Stage and that carry through to Operation and Maintenance could be particularly successful for wildlife protection as they provide continuity and monitoring throughout the entire process, but there are not enough completed projects to provide confirmation of this.
- (5) Performance based mitigation measures of a DBFM (PPP) contracts where the contractor is given specific targets with financial incentives may be a way of not only ensuring that the measure is provided but by requiring the Contractor to prove the use of the measure by the target species they are also incentivised to undertake extensive monitoring. This also requires the Contracting Authority to monitor to validate the results.
- (6) Maintenance Only Contracts have potential to be particularly effective for the satisfactory management of existing infrastructure to achieve ecological outcomes and may be used to improve the quality and functionality of wildlife measures.
- (7) Follow-up studies need to be an integral part of all mitigation projects.
- (8) Follow-up studies should be performed or supervised by experienced ecologists, who ideally are permanently employed to ensure:
 - a. a continuation of competence throughout the lifecycle of the project up to and including the maintenance phase;
 - b. the build-up of local knowledge;
 - c. develop performance indicators, which will be locally applicable.

With the involvement of ecological expertise and financial incentives we can ensure a long-term strategy, a continued personal commitment and the supervision of ecological performance, and not the least a considerable reduction of administrative expenses. A failure (i.e., not meeting the targets) through misunderstanding or misuse of KPIs or other generalised indicators can thus be avoided.

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Appendix A Procurement and Follow-up Interview

Harmony Task 2.1, 2.2, 2.3 Review of Procurement Approaches and Follow Up Contracts

Telephone Interviews

Date: _____
Name of interviewer: _____
Name of interviewee: _____
Organisation: _____
Title and role in organisation: _____
Telephone: _____

Task 2.1: Procurement Approaches

Task 2.2: Follow up of Construction Contracts

Task 2.3: Follow up of Maintenance Contracts

Task 2.1: Procurement

General

1. What guidelines/handbooks/regulations do you follow to ensure that the ecological side of things are addressed in the procurement process?

- | | |
|--------------------------|------------------------------------|
| <input type="checkbox"/> | National Road Authority Guidelines |
| <input type="checkbox"/> | Handbooks |
| <input type="checkbox"/> | Other |

If other, please specify:

2. What form of contract for road projects, mitigation measures and their maintenance do you use?

- | | |
|--------------------------|--|
| <input type="checkbox"/> | Traditional employer designed (Traditional Contract) |
| <input type="checkbox"/> | Contractor designed but owner maintained (Design & Build) |
| <input type="checkbox"/> | Contractor designed and operated (Public Private Partnership) |
| <input type="checkbox"/> | Early contractor involvement (D&B with early contractor involvement) |

In your opinion what are the pros and cons of using these methods?

3. Are separate contract procurements required for early works (in advance of the main contract), e.g. archaeology, geological investigations?

<input type="checkbox"/>	Yes
<input type="checkbox"/>	No

If yes, please provide further explanation:

4. What is the period of responsibility of the main contractor for maintenance and monitoring contracts after completion of construction contract?

<input type="checkbox"/>	<1 year
<input type="checkbox"/>	1-3 years
<input type="checkbox"/>	3-5 years
<input type="checkbox"/>	>5 years

5. How are decisions on mitigation measures in the Environmental Impact Statement transferred to the main construction contract, e.g. requirement to build mammal underpasses? Do you expect contractor to refer to the EIS or do you set up a separate schedule of commitments?

Qualifying criteria / evaluation of tenders

6. Does the client involve ecological experts when:

(a) Formulating requirements

<input type="checkbox"/>	Always
<input type="checkbox"/>	Sometimes
<input type="checkbox"/>	Never

(b) Evaluating tenders?

<input type="checkbox"/>	Always
<input type="checkbox"/>	Sometimes
<input type="checkbox"/>	Never

7. Is the Contractor required to demonstrate their ecological expertise or environmental technical competence in the procurement e.g. In an essay or by way of CV?
8. Are there requirements for the contractor to adhere to certain environmental standards, e.g. ISO or EMAS?
9. What percentage of the quality mark or selection criteria is usually allocated to ecologically friendly performance (if any)?
10. Can you identify improvement possibilities concerning procurement processes (please provide as much detail as possible)?

Task 2.2 + 2.3: Follow-up (post construction and handover)

Note: Follow up includes management and monitoring of mitigation measures

General

11. Are there any formal regulations, handbooks or guidelines, etc. that you use for your following up post construction contracts or mitigation measures?

- National Road Authority Guidelines
- Handbooks
- Other

If other, please specify:

12. Are your post construction follow-up activities connected with any Environmental Management System, environmental policy, legislative obligations or similar?

13. Is this normally used or just a once off / occasional use?

- Always/Often
- Sometimes
- Never

14. Is the follow up programme usually integrated in your tendering?

- Yes
- No

15. What types of contracts do you commonly follow up?

- Construction Contracts
- Maintenance Contracts
- Both

16. What types of follow up (post construction) procedures do you usually perform, e.g.

- Checking culverts/ underpasses for obstructions
- Monitoring use of new habitats/underpasses etc by target species
- Checking fencing
- Checking landscaping measures
- Recording road kill
- Other

If other, please specify:

Approaches

17. If unforeseen circumstances arise during construction, how are they addressed (e.g. uncovering an unexpected protected species)?

18. In a contract how do you address actual impact of the road development in contrast to predicted impact of the EIS?

Example 1: Predicted impact= no impact on mammals; Actual impact= high level of mammal road kill; Action= install an overpass.

Example 2: Predicted impact = no impact on calcareous grasslands adjoining the road; Actual impact = loss of calcareous grasslands; Action= amendment of management plan, creation of new management plan.

19. What type of monitoring methods do you use to evaluate the effectiveness of mitigation measures?

- Visual Inspection
- Ink pads
- Cameras
- Do not assess
- Other

If other, please provide description of method:

20. How do you improve the effectiveness of poorly-performing mitigation measures?

- New planting/landscaping
- Improving access routes into ecoduct/passage
- Drainage
- Other

If other, please provide description of method:

21. Can you mention some indicators or metrics that you use, e.g. quantitative/qualitative data, key performance indicators (e.g. badger kill on roads, number of passages, bird counting, population trends, presence of butterflies)?

22. Do organisations external to the Road Administration have a role in the follow-up, e.g. consultants, NGOs, landowners?

For Maintenance:

- Consultants
- NGOs
- Landowners
- Other

For Monitoring:

- Consultants
- NGOs
- Other

Documentation and use

23. Is follow up data available?

- Yes
- No

24. How available is the follow-up data?

- NRA access only
- Restricted access
- Public access (e.g. online)

25. How do you use the follow-up results?

- Feedback to client and contractor
- Future contract procurement
- Future follow-up activities
- Revised tender process
- New guidelines
- Other

If other, please provide description.

Status and improvement

26. What status do follow-up activities have in your organization or in the client and the contractor organisation?

- Highly prioritized
- Neutral
- Not prioritized

27. Can you identify improvement possibilities concerning follow-up?