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Transportation Research Procedia 14 (2016) 509 – 517



Transportation
Research
Procedia
www.elsevier.com/locate/procedia

6th Transport Research Arena April 18-21, 2016



Design of roads in harmony with wildlife

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Abstract

'Procedures for the Design of Roads in Harmony with Wildlife' or 'Harmony' is a project that aims to develop sustainable solutions to road transport challenges that are in harmony with wildlife. This paper summarises Harmony's work in the areas of Environmental Legislation and Guidelines, Project Appraisal, and Procurement Practices. The project mainly focuses on practices in the eight reference countries of Ireland, the United Kingdom, Belgium, the Netherlands, Hungary, Austria, Sweden and Denmark.

A review of Environmental Impact Assessment (EIA) and Appropriate Assessment (AA) is carried out. As part of this review, a database of over 80 Environmental Impact Statements (EIS) and Appropriate Assessment reports is analysed to identify the similarities and differences between countries in the implementation of the duties required by EU Environmental Legislation. It is found that the degree of implementation under the headings considered varies greatly between countries. It is concluded that increased guidance on monitoring be provided in all countries.

Project Appraisal for transport infrastructure is the process of assessing whether capital expenditure is justified for a project and ensuring that it is allocated to the best transport solution to achieve the objectives of that project whilst complying with planning policy and national and EU legislation. The project appraisal methodologies used in the reference countries are compared with the aim of identifying a set of tools to enable rational and sensible decisions to be made. The approach used in the UK is recommended for adoption by all Member States.

This paper then examines existing approaches to the procurement of road constructions in the reference countries. The different types of contracts used for procurement are described and the benefits and disadvantages of different contract types are discussed. Recommendations are then made as to which contracts are the most favourable for ensuring the environmental commitments of

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the Environmental Impact Statement are carried out. Early contractor involvement as well as construction contracts that incorporate maintenance, with monitoring, for an extended period afterwards were cited as key recommendations to ensure a good outcome for wildlife.

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Peer-review under responsibility of Road and Bridge Research Institute (IBDiM)

Keywords: road; procurement; wildlife; biodiversity; environmental impact; project appraisal

Nomenclature

AA	Appropriate Assessment
D&B	Design and Build
DBM	Design, Build and Maintain
DBFM	Design Build Finance Maintain
DBFO	Design Build Finance Operate
ECI	Early Contractor Involvement
ECO	Engineering – Construction – Operation
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
PPP	Public Private Partnership

1. Introduction

Development of road infrastructure has the potential to lead to considerable changes in land use. These changes have the potential to cause habitat fragmentation and ecosystem loss. The impact of road developments on biodiversity has become one of the central environmental issues when planning for road infrastructure. ‘Procedures for the Design of Roads in Harmony with Wildlife’ or ‘Harmony’ is a project that brings together a consortium of ecologists and engineers to develop sustainable solutions to road transport challenges that are in harmony with wildlife. As part of this paper, the Harmony work in the following areas is summarised and the project findings outlined:

- Environmental Impact Assessments
- Appropriate Assessments
- Project Appraisal
- Procurement

The planning process seeks to balance the need for transport with the need to minimize environmental impact. Environmental Impact Assessments (EIAs) and Appropriate Assessments (AAs) are important elements in the planning process of many road projects. All European Union (EU) countries carry out Environmental Impact Assessments and Appropriate Assessments to comply with the EIA Directive (2011/92/EU), the Birds Directive (09/147/EC) and the Habitats Directive (92/43/EEC).

Now that the relevant directives have been in place for a number of years and have been implemented throughout the European Union, the current situation is reviewed to analyse how the EIAs and AAs are being implemented across a range of European countries and how well they are complying with national and EU guidelines. This involves reviewing 87 case studies from nine different countries. This work was performed as part of Harmony Deliverable C (Ní Choine et al., 2015).

Project Appraisal for transport infrastructure is the process of assessing whether capital expenditure is justified for a project and ensuring that it is allocated to the best transport solution to achieve the objectives of that project whilst complying with planning policy and national and EU legislation. The process allows decision makers to ensure that the best alternatives are selected whilst delivering value for money to the taxpayer on all national road projects. It also assists in the prioritisation of projects that require public funding. Cost benefit analysis remains the main form of appraisal used throughout Europe. However, the monetisation of all impacts is not always feasible and attempting to monetise the impacts of road projects on nature and biodiversity can be difficult. However, the lack of monetary estimates for biodiversity impacts does not mean that these impacts can be overlooked in the decision making process. Therefore, it is important for the appraiser to decide on a way to assess these qualitative impacts in conjunction with monetary appraisal.

Project Appraisal methodologies are compared in the reference countries. This was performed as part of Harmony Deliverable D (Gavin et al., 2015). The assessment aims to identify whether decisions for road development across EU Member States are giving due consideration to the important balance between the requirements to protect wildlife and other environmental factors as well as factors such as economy, safety and society. Recommendations are made as to the most effective processes that could be adopted by Member States.

The different procurement options available provide variable outcomes in terms of ensuring that environmental commitments of the Environmental Impact Statement are delivered and the objectives achieved in compliance with statutory obligations for wildlife protection.

A review of procurement practices in Europe is performed to identify how best to achieve favourable outcomes for wildlife in all major projects. This study included a survey of experts in the project procurement and management process to identify procurement practices that give good ecological outcomes which are cost effective. This work is described in detail in Harmony Deliverable E (Ó Catháin et al., 2015).

The eight reference countries used as the basis for the work in Harmony are:

- Austria
- Belgium
- Hungary
- Ireland
- Netherlands
- Norway (Denmark is substituted for the examination of EIAs, AAs and project appraisal as this work focuses on European Union legislation).
- Sweden
- United Kingdom

Additionally, to cover the full range of climatic regions in Europe, Greece is examined for the work on EISs, AAs and procurement in order to include a Mediterranean country. Germany is also examined for the work on project appraisal.

2. Environmental Impact Assessment

The EIA process is examined in nine countries across Europe. In order to do this, the relevant guidelines are analysed and comparisons are made between countries. Following on from this, a database of 87 EISs across nine European countries is analysed to identify the similarities and differences between countries in the implementation of the duties related to EU Environmental Legislation. As well as comparing approaches between countries, an audit is carried out to identify the degree of implementation on a 5 point scale under the following headings: Screening; Scoping; Identification of Habitats; Impact Assessment Methodologies; Mitigation Measures and Monitoring. It is found that the degree of implementation under the headings considered varies greatly between countries – see Fig. 1.

When the general trend across the reference countries is examined – see Fig. 2 – it is found that while there are high rates of implementation of screening, scoping and identification of habitats, EISs appear to carry out little or no monitoring. Although monitoring is not required by the EIA directive, it is recommended by many guidelines. It

should be noted, when examining the results of this audit, that it is very subjective as it depends on the expert opinion of several individuals.

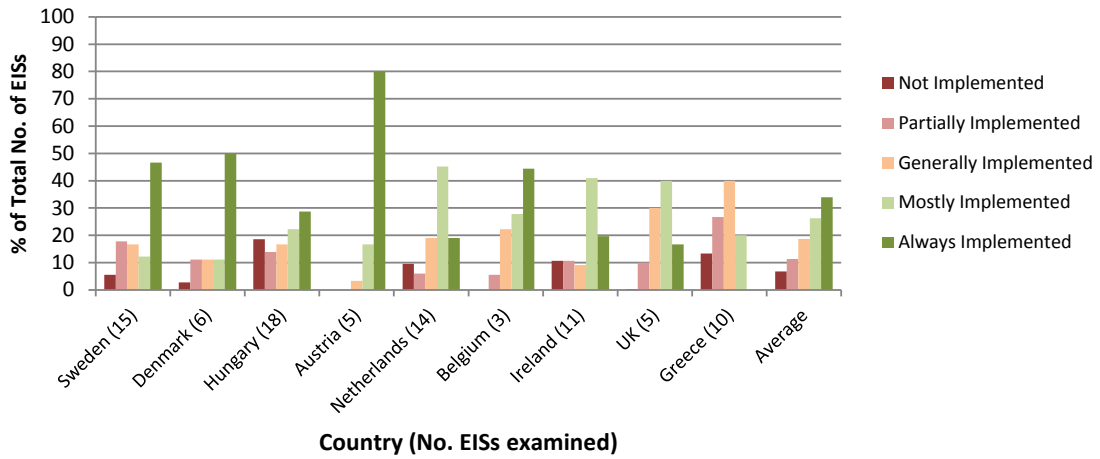


Fig. 1. Degree of compliance between EISs and guidelines averaged across the six headings considered.

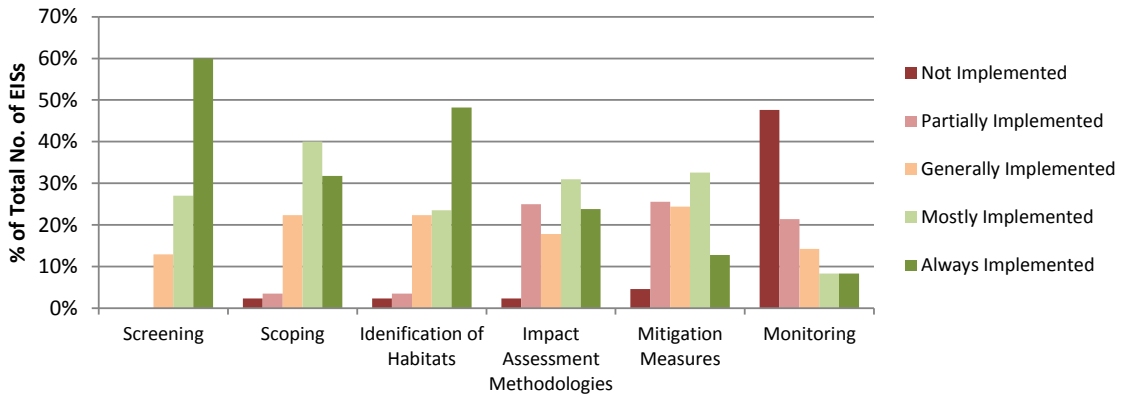


Fig. 2. Degree of compliance between EISs and guidelines under each heading, averaged across all countries considered.

The main findings and recommendation for EISs based on the work of the Harmony project are as follows:

- a) It is found that standardised guidelines are available for ecological assessment in most countries. However, guidelines dealing with specific habitats are less standardised across the countries considered. Only five of the eight countries considered have guidelines available for specific species or habitats. This presents an opportunity to develop a more standardised approach to guidelines for specific habitats and species.
- b) The terminology used within the EIS guidelines needs to be standardised in some countries. For example, there is no clear definition given for short, medium and long term impacts in six of the eight reference countries' guidelines. There is scope for an EU standard for terminology in order to reduce the potential for different interpretations.

- c) The competency requirements of an ecologist set out in the guidelines vary from country to country, a situation which is likely to improve with implementation of Directive 2014/52/EU: “Experts involved in the preparation of environmental impact assessment reports should be qualified and competent.”
- d) A significant proportion of the EISs examined did not use surveys carried out within the past two years. Field assessments are a fundamental aspect to any EIA and it is important that the information is up to date. Clear guidelines are required on timing of surveys for different species and habitats.
- e) One of the most important findings of the study is that cumulative impacts are not suitably addressed in a significant proportion of the EISs examined. Assessment of cumulative effect remains difficult as there is a great deal of uncertainty and a lack of guidance on how to properly assess the cumulative effect of a project, in particular when it is related to larger scale plans. While Strategic Environmental Assessment and Appropriate Assessment Guidelines are available, they appear at times to be too high level and difficult to assess within the EIS as part of a cumulative effect. It is therefore recommended that clearer pan European guidelines be developed to provide recommendations on how the cumulative effects of a project should be assessed.
- f) A large proportion of the EISs examined did not include an appropriate plan for monitoring. It is found that in general, although it may be included in the guidelines, it is not followed through as part of the EIA. It is concluded that clearer guidance highlighting the possible importance of monitoring is required. Directive 2014/52/EU states that “The type of parameters to be monitored and the duration of the monitoring shall be proportionate to the nature, location and size of the project and the significance of its effects on the environment”.

3. Appropriate Assessment

A review of AA reports was performed across the eight reference countries. The overall review examined three areas in each country:

- The guidelines for AAs.
- 39 AA reports related to road building and retrofit.
- The planning approval systems.

As part of the AA study, the reviewers were asked to give their opinion on the quality of the AA – see Fig. 3. The reviewers of the AA reports are generally positive about the quality, in particular, about the level of knowledge, skills and capacity of those undertaking the AA. It is suggested that a licensing system for AA report authors may help to get quality products but does not seem to be needed, since only two out of the eight countries reviewed have such a system.

On a negative note, it is found that most AA reports only describe the presence and distribution of habitat types and species and almost never describe the current state of the habitat type or species in the Natura 2000. Furthermore, in some countries (Sweden and Belgium), the field studies do not comply with guidelines or general knowledge about the best practice survey methods (e.g. season, minimum number of visits, recommended instruments etc.). Moreover, sometimes it is not clear what the sources of information are or how old the information is. For the competent authority to decide about a permit it should be clear on what information the assessment is based. It is also noted that the cumulative effects are not assessed properly in the AAs examined, a finding that is consistent with the EIA reviews carried out in Section 2.

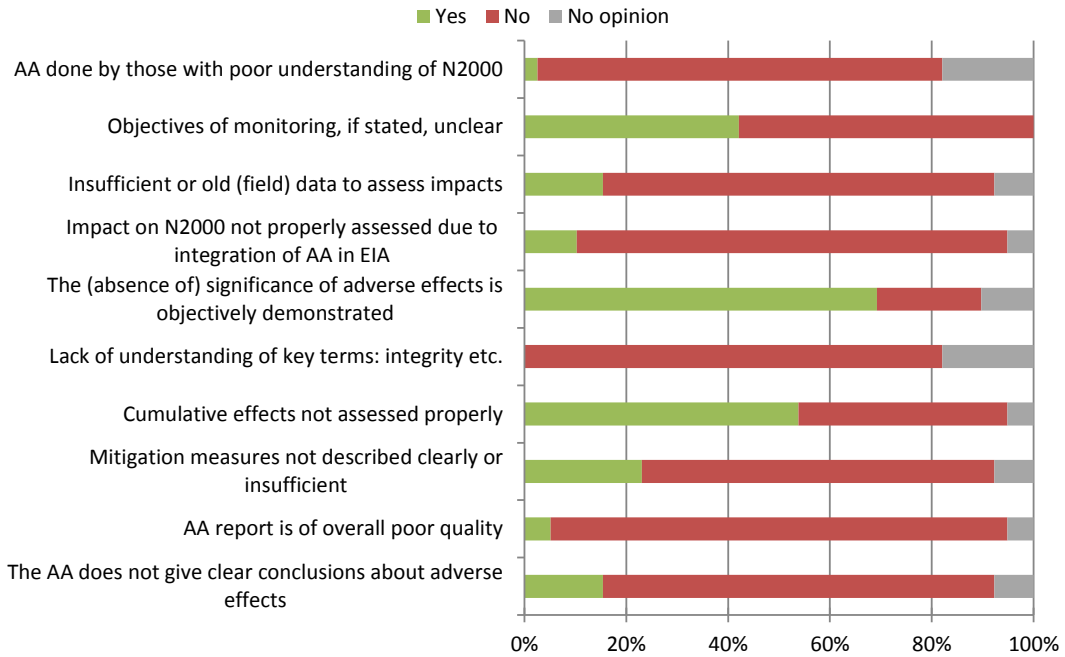


Fig. 3. The opinion of the reviewers about the AA's as a % of the number of AA's reviewed.

It is also found that compensatory measures are sometimes described while alternatives and imperative reasons of overriding public interest are not included which is a direct contradiction with Articles 6(3) and 6(4) of the Habitats Directive. Compensatory measures are only needed when adverse effects on the integrity of a Natura 2000 site cannot be excluded and the effects cannot be diminished enough by mitigation measures. In that case, Article 6(4) takes effect and an initiator should first prove that there is an absence of alternative solutions and explain the imperative reasons of overriding public interest that prevail to continue with the project or plan.

Of the AA reports reviewed, only the Swedish and Belgian reports, as well as a few Danish reports, include performance based mitigation measures. In recent years, many contracts for road building and retrofit are performance based. Therefore, it would be good to have the mitigation (and compensatory) measures described as performance based. This requires a different approach from the AA authors and perhaps further training.

It is noted that there is a lack of proposals for monitoring in most AA reports – see Fig 4. Monitoring of the effects or mitigation measures is not compulsory, but is advised in Europe. Monitoring will increase knowledge of the effects and of the effectiveness of mitigation measures. It is advised to add a chapter about monitoring to all AA reports.

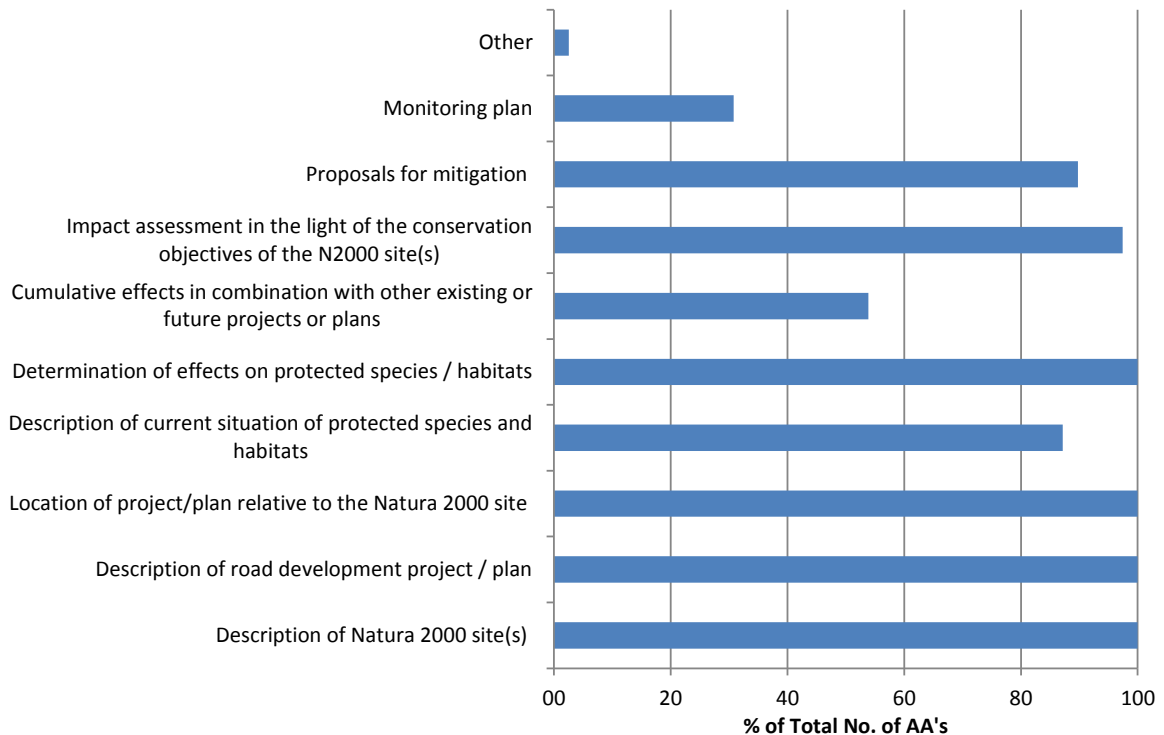


Fig 4. Topics discussed in the AA reports as a % of the total number of AAs reviewed for all countries (Other = Compensatory measures are described in one Danish AA).

4. Project Appraisal Guidelines

Project Appraisal for National Road projects is examined for the nine reference countries across Europe. The aim is to identify whether due consideration is given to the balance between biodiversity protection requirements, other environmental factors and factors such as economy, safety and society. Of the nine countries examined, the Netherlands, Germany, Sweden, the United Kingdom and Ireland all consider biodiversity as part of their Project Appraisal although not all in the same manner.

Of the methods used, cost benefit analysis is the most common form of appraisal used throughout Europe. An issue with this approach is that it can be difficult to monetise the impacts that road projects have on nature and biodiversity. It is important that the appraisal of the impact on biodiversity is carried out by appropriately qualified experts. Expert judgement should be used in the fields of landscape and heritage also. The level of detail given in the appraisal is dependent on the stage at which it is carried out.

Having reviewed the approaches used in each reference country, it is recommended that the WEBTAG (Web based Transport Appraisal Guidelines) provided in the UK be adopted by other Member States for the following reasons:

- Provides clear and concise guidance that can be followed and adopted;
- The appraisal process is kept as simple as possible without providing or requiring a level of detail that becomes onerous and complex for the appraiser and decision makers;
- The introduction of a worksheet allows appraisal to be carried out at all stages of development and takes into account the level of detail made available to it at any one stage;

- The provision of a biodiversity impact appraisal table should result in a more standardised and transparent system of project appraisal across European Member States.

5. Procurement

To examine procurement methods for the construction of road projects, experts were interviewed in the reference countries. It was found that there are four different types of contracting strategy generally used for the construction and widening/improvement of large trunk road/motorway schemes across the study area – see Table 1. The analysis undertaken has identified that all of the contract types are in use across the Study Area, with an increasing focus on the latter two types – i.e. DBM and ECI. Fig. 5 shows the contract types which are used in the reference countries.

Table 1. Type of contracts used in the study area.

Contract Type	Description
1. Traditional Contracts	Employer Planned – Employer Designed – Contractor Constructed – Employer Maintained
2. Design and Build [D&B] Contracts	Employer Planned – Contractor Designed – Contractor Constructed – Employer Maintained
3. Design, Build and Maintain [DBM] – including Design Build Finance Maintain/Operate [DBFM/DBFO] and Public Private Partnerships [PPP]	Employer Planned – Contractor Designed – Contractor Constructed – Contractor Maintained
4. Early Contractor Involvement [ECI]	Contractor Planned – Contractor Designed – Contractor Constructed – Contractor or Employer Maintained

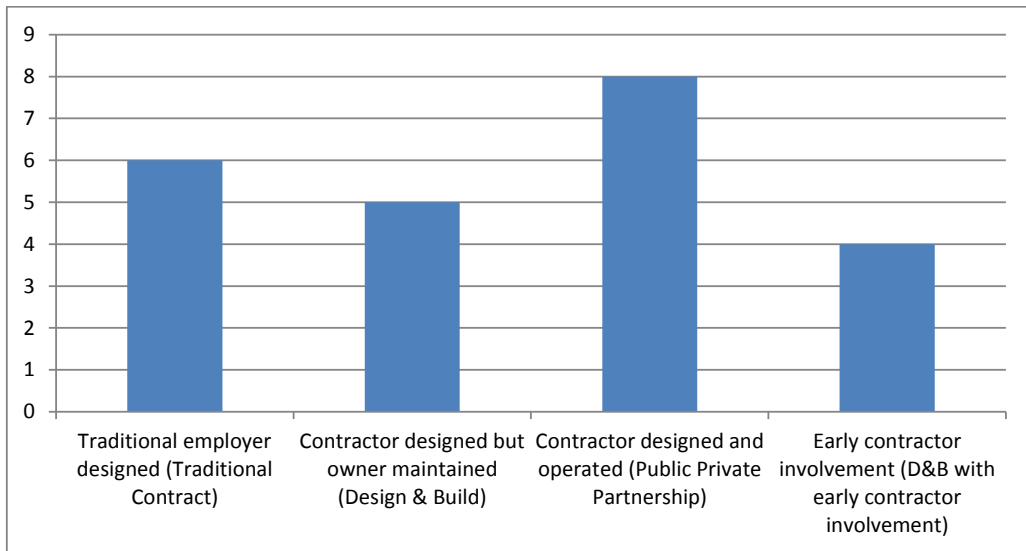


Fig. 5. The contract types in use in the nine countries examined according to results of the interviews.

Contracts which engage the contractor before the planning stage and that carry through to operation and maintenance are very appropriate for successful wildlife protection as they provide continuity and monitoring throughout the entire process. This form of contract is relatively new and has been used to a limited extent to date. It

also only suits quite large projects for which the associated additional administration effort and costs are warranted. For projects of a suitable scale it may be preferable to adopt an ECI Contract which operates 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.

It is found that the best results for successful wildlife protections are achieved with Construction Contracts that incorporate Maintenance for an extended period afterwards 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.

Appropriate ecological expertise is required 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.

Retrospective maintenance and improvement contracts are being adopted on large parts of the European Road Network. These contracts may include an element of Design & Build for improvement works. Large lengths of the road network covered by these maintenance contracts consist of legacy roads that were constructed several decades ago before the adoption of the Habitats Directive and other instruments for wildlife protection. The adoption of a more proactive maintenance regime on such roads provides an opportunity to identify and redress problems for wildlife.

In conclusion, it is recommended that appropriate involvement of ecological expertise is adopted at all stages in all major road construction and maintenance contracts in Europe, regardless of the particular procurement process adopted. Monitoring 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.

Acknowledgements

The research presented in this paper was carried out as part of the CEDR Transnational Road Research Programme Call 2013. The funding for the research was provided by the national road administrations of Austria, Denmark, Germany, Ireland, Norway, Sweden, Netherlands and UK. The authors would also like to gratefully acknowledge all those who shared their expertise as well as their EIA and AA reports.

References

- Gavin, S., Corrigan, B., Carey, C., Ní Choine, M., Wansink, D., 2015. Harmony Deliverable D – Recommendations on Appraisal Process & Report on Consultations (In press). CEDR Transnational Road Research Programme.
- Ní Choine, M., Gavin, S., Wansink, D., 2015. Harmony Deliverable C – Environmental Legislation and Guidelines. CEDR Transnational Road Research Programme.
- Ó Catháin, E., Carey, C., Mac Gearailt, S., 2015. Harmony Deliverable E – Procurement Report (In press). CEDR Transnational Road Research Programme.