



# **A Note on the Employment Content of Major Road Improvement Schemes**

**Report to the Department of the Environment**

by

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*in association with*

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## Section 1

# Introduction

The Operational Programme on Peripherality (OPP) 1989 to 1993 contains a series of infrastructural investment measures designed to offset the effects of peripherality by reducing access and internal transport costs in Ireland. The measures include major investments in roads, and to a lesser extent in ports, airport and in rail facilities.

As part of the reform of the Structural Funds there is increased emphasis on monitoring and assessment of programmes including their socio economic impact. There is particular interest in the employment effects of various measures. DKM Economic Consultants the External Evaluator to the OPP were asked by the Department of the Environment to undertake a study on the employment impact of the OPP.

Expenditure on roads accounts for over 75% of total OPP expenditure while expenditure on major road improvement schemes accounts for over 60% of total expenditure. It was decided to begin with an examination of the employment effects of major road improvement schemes which is the subject of this report and to prepare reports on the employment impact of investments in port, airport and rail facilities at a later stage.

It is important to emphasise that this report deals solely with estimating the 'demand side' employment effects of expenditure on major road improvement scheme, including the second and subsequent round employment effects as incomes, wages and prices adjust to the changes in the level of roads improvement expenditure. The primary 'demand side' impacts reflect the increased construction activity which leads to increased employment in the building sector and in building related sectors and also to increased demand for building materials which in turn generates additional employment in the materials manufacturing and distribution sectors. There is only a small leakage to imports of building materials and construction plant and machinery. Significant compensation payments to private individuals are usually associated with major road improvement schemes and the expenditure of these transfers will have a positive employment impact.

Road investment also generates significant 'supply side' economic effects and the most important long term effects of road investment are on the supply side of the economy due to increased efficiency of the productive sector. Improved road infrastructure reduces the costs of the industrial and market services sectors below the level they would otherwise be. This improves the competitiveness of these sectors on foreign markets and increase their potential output in the medium term. In addition the cost of distributing goods within the economy will fall and there will be a decline in the costs and prices facing consumers. While the channels through which these

improvements in efficiency impact on the economy are well known, there is limited information on the magnitude of these effects. Nevertheless it is clear that the impact of major road investment schemes on the 'supply side' of the economy can be expected to have significant employment effects in the medium term. These 'supply side' employment effects of major road improvement schemes are not being measured in this report.

Given the difficulties associated with measuring the employment impact of major road investment schemes and the sheer number of projects involved it is not feasible to measure the employment impact on a project by project basis. The approach adopted instead is to estimate a general relationship between expenditure on major road improvement and the resulting direct, indirect and induced employment impact on the basis of a detailed survey of a small number of completed schemes. If the estimated relationship is sufficiently robust it can be used to estimate employment effect of total expenditure under the OPP major road improvement measure using the level of expenditure as a basis.

Our report is structured as follows:

**Section 2** defines various employment impacts of road projects, reviews the approach adopted to measuring the employment content of road works in an earlier 1980 study and proposes a new approach using the ESRI medium term macro economic model supplemented by up to date information on a number of major road improvement schemes,

**Section 3** presents some background information on the chosen projects and analyses the data collected on the various cost components of the schemes, together with data on direct employment levels and on nature and sourcing of material inputs used in each of these schemes. Estimates of the direct (on and off site) employment associated with £1m of road improvement expenditure are presented,

**Section 4** presents the results of our analysis of the indirect and induced employment effects of expenditure on major road improvement schemes using the ESRI macro economic model and

**Section 5** summarised the results of the project and presents our estimates of the total employment effects of expenditure on major road improvement schemes.

## Outline of Methodology

### 2.1 Definition of Employment Content

Before outlining the approach we adopted in estimating the employment content of major road improvement schemes it is important to define the three employment impacts measured in the study. The definitions used, which are very similar to the definitions used by Feeney in an earlier study (*'The Employment Content of Road Works'* B P Feeney , *An Foras Forbartha* 1980) are set out below :

#### *Direct Employment*

This is the employment directly involved in the planning and execution of the major road improvement schemes including employment associated with the design of the scheme and with the supervision of the work. On site direct employment includes all employment on the site. Off site direct employment includes employment associated with the design of the scheme and with the management of workers engaged on the site,

#### *Indirect Employment*

This is employment in the production and distribution of all materials and products used on major road improvement schemes. It is possible to conceive of various degrees of indirect employment effects. First round indirect employment effects might cover employment in firms producing materials/products used directly in a road construction project while second round indirect employment effects might cover employment in firms in producing materials used as inputs by first round firms and so on and

#### *Induced Employment*

This is defined as the employment which occurs as a result of the expenditure of the incomes associated with the additional direct and indirect employment.

The total 'demand side' employment impact associated with major road improvement schemes is defined as the sum of the direct, indirect and induced employment impacts.

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### 2.2 Review of 1980 Road Works Employment Study

In the past attempts have been made to estimate expenditure employment relationships for road works in Ireland. The study by B P Feeney (*'The Employment Content of Road Works'*, *An Foras Forbartha* 1980) yielded estimates of man years of employment per £1m of

expenditure for different types of road project. This employment estimate included the direct, indirect and induced employment effects.

It is worth considering the approach adopted by Feeney in his 1980 study in some detail. Returns were submitted by local authorities in respect of six major road improvement projects, one minor project and three bridgeworks. The returns were based on the bills of quantities drawn up by local authorities prior to the commencement of each scheme and updated to take account of the expenditure outturn. The returns listed expenditure on each operation associated with the scheme broken down between labour, materials, own machinery, hired machinery and other expenses. In addition detailed information was supplied on expenditure on materials by type of material.

The direct employment content of the projects was estimated through the labour cost data supplied by the local authorities. In the case of some projects local authorities supplied data on man years of employment while in other cases total direct labour costs supplied by the local authority were divided by the basic labour pay rates to yield an estimate of man days worked on a particular project. The first round indirect employment impact was estimated through the analysis of the type of materials bought and the employment generated in their production. Finally the induced employment impact was estimated using information on incomes generated directly and indirectly by each project and applying input/output coefficients.

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### 2.3 Proposed Methodology

Even if it were feasible to do so there are a number of reasons why it would be not be appropriate to apply the methodology used by Feeney. In developing a new methodology account was taken of the these factors as follows

- the proportion of major road improvement schemes carried out by local authority direct labour works has declined very significantly over the past fourteen years. All major schemes are now carried out by private contractors and awarded on the basis of competitive tender. Thus the option of approaching local authorities for information based on expenditure returns is simply not available,
- in estimating indirect employment Feeney did not considered it practical to go beyond the first round impact. Using the ESRI model it is possible to estimate all subsequent round effects,
- Feeney used a very crude approach based on input/output

coefficients to estimate the induced employment impacts. The ESRI model permits a more sophisticated approach to estimating the induced employment impacts and

- Feeney took account of the employment associated with the administration of land acquisition and compensation payments. However, the employment associated with the eventual expenditure of these capital transfers was not considered. Since capital transfers to the household sector account for a significant proportion of total expenditure on major road improvement schemes it is appropriate to consider the longer term employment impact of this expenditure. The ESRI model is suitable for this purpose.

The methodology we adopted involved collecting detailed information in respect of a small number of major road improvement schemes. The information collected included a breakdown of the total cost of the scheme into the major elements (ie compensation payments, labour costs, construction materials, machinery, other costs and VAT). In addition detailed information was collected on the breakdown of expenditure on materials by material/product category and on the breakdown of direct labour costs by the nature of the employment (eg professional/administrative, skilled/semi skilled, unskilled and secretarial/clerical). Information was also collected on man years of direct employment, both on and off site, associated with each scheme.

Major manufacturers/suppliers were approached to provide information in respect of each product/material category on the breakdown between directly imported and domestically manufactured/processed goods and materials. Information was also collected on the cost breakdown of domestically manufactured/processed road materials between transport and distribution costs, wage and salary costs, purchase of domestically produced materials, purchase of imported materials, plant and machinery costs, fuel and power and other costs.

The three types of of employment impact were calculated as follows :

***Direct Employment*** : This was based on the returns for direct employment completed in respect on each of the major road improvement schemes surveyed,

***Indirect Employment*** : Employment generated in the production and distribution of all materials and products used on the road schemes has been estimated using the data supplied by manufacturers and the ESRI model,

***Induced Employment*** : The induced employment effects of the expenditure of all incomes and compensation payments associated with road schemes has been estimated using the ESRI model.

The use of the ESRI model is explained in more detail in the next section.

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#### 2.4 The ESRI Macro Economic Model

The ESRI macro economic model attempts to represent the pattern of actual economic relationships in the Irish economy in a consistent manner through a series of interlinked econometric relationships. The structure of the model is derived from economic theory and the coefficients in the behavioural equations are estimated on the basis of historic data. The model has been subject to rigorous estimation and validation procedures to ensure that the results obtained using the model are plausible, especially for the type of analysis being proposed.

Because the ESRI model attempts to describe the operation of the Irish economy in as comprehensive a manner as possible it is especially suitable as a tool for estimating, indirect and induced employment effects of expenditure on investment programmes. Essentially this can be done by preparing a benchmark simulation of the model over a 10 year period using the latest assumptions regarding the exogenous variables over the period (eg growth in the world economy). The results of the benchmark simulation are compared with the results of a simulation where the level of investment has been increased in the first year but all other inputs are unchanged. A comparison of these two sets of results shows the impact of the additional investment. The ESRI model can take account of different investment financing arrangements and calculate the net employment impact.

However, there are certain limitations to the use of the ESRI model due to the simplifying assumptions adopted in its construction. In the model an increase in non market government investment (which includes roads and sanitary services investment) will lead to an identical increase in non residential building output. The additional output generates demand for the various factors of production (labour, materials and capital) based on the estimated relationship between the demand for each factor of production, output, the price of each factor of production and the capital stock. Increased demand for materials and services in turn generates additional employment in the economy in general. The model incorporates estimates from the 1985 CSO Input/Output table on the distribution of the demand for materials and services associated with increased non-residential construction.

The model assumes that all non residential construction projects have the same labour/materials contents. It is obvious however, that the labour/materials breakdown is likely to differ between civil engineering and non-residential building projects and even across

different types of civil engineering projects. Another problem is that the model does not differentiate between different industries in the 'traditional manufacturing sector'. The model uses the employment/output relationship for this sector as a whole in calculating the increase in employment in the sector as a consequence of increased demand from the construction sector. However, the breakdown between the different industries of additional construction-related demand may be such that the use of the employment/output relationship for the entire sector may not be appropriate.

We have addressed these problems associated with the model by using actual data on the direct employment intensity of expenditure of road improvement schemes, on the value of materials used on these schemes (broken down into domestically produced and imported) and on the cost components of domestically produced/processed materials. The model parameters for these factors have been adjusted to reflect the actual data. The full indirect and induced employment impact of additional roads investment can be calculated in the normal way using the version of the model with adjusted parameter values.

The employment impact associated with the eventual expenditure of land acquisition and compensation payments has been estimated by simulating an increase in capital transfers to the household sector in the model. The model assumes that these transfers are initially saved by the household sector, but over a period of years they lead to increased household investment and consumption expenditure.



## Section 3

# Analysis of Data on Major Road Improvement Schemes

### 3.1 Selected Schemes and Information Requested

Detailed information was collected in respect of the following major road improvement schemes :

<u>Scheme</u>	<u>Description</u>
<i>N3 Navan Road</i>	Construction of 8.9km of dual carriageway from Dublin City boundary to Clonee Co Meath. The scheme which commenced in the second quarter of 1989 was completed in the final quarter of 1991. The total cost was £32.0m. Project management was by a private contractor.
<i>N11 Bray/Shankill By-pass</i>	Construction by single private contract of a 6km dual carriageway motorway by-pass of Shankill. The scheme commenced during the last quarter of 1989 and was completed in the final quarter of 1991. The total cost was £24.6m. Project management was by a single private contractor.
<i>N25 The Sweep</i>	Construction of 3.2km of single carriageway roadway commenced in the second quarter of 1991 and completed in the final quarter of 1992. Project management was by the local authority. The total cost was £6.0m.
<i>N8 Glanmire Bypass</i>	Construction of 7.5km of dual carriageway bypass of Glanmire which commenced in 1986 and was completed during the second quarter of 1992. Project management was by the local authority. The total cost was 334.5m.

Information was sought on the breakdown of the total cost of each scheme into the main cost items. Detailed information was also sought on the breakdown of expenditure on construction materials, on the breakdown of labour costs by type of employment and on man years of direct employment by type of employment. In addition, all the information supplied was broken down over the 10 major components of a major road improvement scheme.

### Cost Categories

*compensation payments* : expenditure on land/property acquisition and other compensation payments,

*labour costs* : The labour costs of those directly employed on the scheme both on and off site. Labour costs include wage, salary, PRSI, pension and insurance costs of persons engaged,

*materials* : expenditure on all materials and products used in the construction of the project (excluding reclaimable VAT),

*machinery* : expenditure on machinery including the cost of machinery hire, maintenance and fuel (excluding reclaimable VAT),

*other costs* : this covers an allowance for depreciation and profits and

VAT : vat paid at the building services rate of 10%.

### Material/Product Categories

stone, chippings,  
sand, gravel,  
cement and concrete products,  
bitumen/macadam,  
timber products,  
metal products,  
paints/marketing materials  
lighting/electrical equipment  
other materials/products

### Employment/Occupational Categories

Managerial, professional, administrative  
Skilled/semi skilled  
Unskilled  
Secretarial/Clerical

### Components of Major Road Improvement Schemes

Preliminaries, design and supervision,  
Land acquisition and compensation,  
Site clearance,  
Drainage,  
Bridgeworks,  
Earthworks,  
Road pavement, kerbs etc  
Fencing, walls and landscaping,  
Footpaths, finishing works etc  
Traffic signs, road markings, lighting

### 3.3 Survey Results

The survey results are presented under a number of headings below :

#### Breakdown by Component

	Individual Schemes		All Schemes
	Max	Min	
Preliminaries, design and supervision	15.1%	5.5%	10.8%
Land purchase & compensation payments	22.0%	6.7%	14.3%
Site clearance	1.7%	0.5%	1.0%
Drainage	13.7%	3.8%	7.1%
Bridgeworks	33.0%	0%	21.5%
Earthworks	29.6%	9.1%	17.6%
Road pavement, kerbs etc	30.2%	14.5%	19.5%
Fencing, walls and landscaping	9.9%	1.4%	6.1%
Footpaths, finishing works etc	3.2%	0.8%	1.2%
Traffic signs, road markings, lighting	1.5%	0.5%	0.9%
			100.0%

It is worth noting that over the four schemes expenditure on preliminaries and land acquisition accounted for 25% of total expenditure. Bridgeworks accounted for 22% of total expenditure, earthworks for 18% and road pavement work for 20%. There was considerable variation in the relative importance of the different components across the four individual schemes.

#### Breakdown of Total Cost

% Breakdown of Total Cost of Schemes	
Compensation Payments	13.5
Labour Costs (cost of direct on and off site labour)	24.6
Construction Materials	30.6
Machinery Costs	19.3
Other (depreciation, profits etc)	3.1
VAT	8.9
	100.0

Site acquisition and other compensation payments accounted for 13.5% of total expenditure on the four schemes. Expenditure on this item as a percentage of the cost of individual schemes ranged from a high of 21.5% to a low of 5.7%. Direct on and off site labour costs accounted for just under 25% of the total cost of the four schemes. Labour costs ranged from 28% to 19% of the cost of individual

schemes. Expenditure on construction materials accounted for 30.6% of total expenditure, machinery hire, maintenance and fuel accounted for a further 19.3%, other costs (ie an allowance for depreciation, certain overheads and profits) accounted for 3.1% and non refundable VAT accounted for 8.9%.

### Construction Materials/Products

	%
Stone, chippings	20.4
Sand, gravel	7.0
Cement and concrete products	21.4
Bitumen/macadam	22.7
Timber products	8.2
Metal products	13.0
Paints/marketing material	0.7
Lighting/electrical equipment	0.9
Other materials/products	5.6
	100.0

It is worth noting that a high proportion on expenditure on materials is concentrated on materials which are manufactured or processed in Ireland. The leakage to imported materials is relatively low.

### Breakdown of Direct Labour Costs and of Direct Employment

	% Breakdown of		
	Expenditure on Direct Labour Costs	Direct Employment Man Years	Labour Cost per Man Year of Direct Empl.
	%	%	
Managerial Prof/Admin	28.5	18.1	£28,856
Skilled/Semi Skilled	38.5	43.3	£16,331
Unskilled	27.7	33.7	£15,112
Secretarial/Clerical	5.3	4.9	£19,697
	100	100	£18,354

While the cost of managerial, professional and administrative personnel engaged directly on major road improvement schemes

either on or off site accounts for 28.5% of total labour costs this category only accounts for 18% of man years of direct employment due to their higher than average employment cost. Skilled, semi skilled and unskilled workers account for 66% of direct labour costs and 77% of direct employment in man years. Clerical and secretarial workers account for about 5% of both labour costs and employment.

### Expenditure on All Schemes Broken down by Component

	Total Expenditure	Expenditure on Construction Materials	Direct Employment Man Years	Direct Labour Cost	Labour Cost per Man Year of Direct Employment
Preliminaries, design and supervision	10.8%	1.6%	17.3%	24.9%	£26,404
Land purchase/compensation	14.3%	0.5%	0.3%	0.4%	£25,266
Site clearance	1.0%	1.1%	0.7%	0.9%	£24,725
Drainage	7.1%	8.4%	10.6%	8.9%	£15,386
Bridge works	21.5%	31.7%	25.4%	24.7%	£17,870
Earth works	17.6%	12.4%	14.2%	13.2%	£17,039
Road pavement, kerbs etc	19.5%	33.4%	19.8%	17.7%	£16,390
Fencing, walls and landscaping	6.1%	8.2%	8.4%	6.9%	£15,139
Footpaths, finishing works etc	1.3%	1.3%	2.0%	1.5%	£14,090
Traffic signs, markings, lighting	0.1%	1.6%	1.3%	0.8%	£11,391
	100.0%	100.0%	100.0%	100.0%	£18,354

It is of interest to note that the preliminaries, design and supervision component of major road improvement schemes accounts almost 25% of direct labour cost and for over 17% of direct employment.

### 3.3 Estimate of Direct Employment

The derivation of our estimate of direct (on and off site) employment per £1m of both total expenditure and of expenditure on labour for each component of a major road improvements scheme is set out in the table on the next page.

Overall, on the basis of data on the four schemes we estimate that £1m of total road improvement expenditure generates 13.4 man years of employment or one man year of employment per £74,600 of expenditure. In addition £1m of road improvement expenditure on direct labour generates an estimated 54.5 man years of employment or one man year of employment per £18,300 of expenditure.

After footpaths and finishing works, preliminaries, design and

contract supervision is the most labour intensive component with 21.6 man years of employment per £1m of total expenditure. This is followed by drainage (20.0 man years per £1m), by traffic signs, road marking and lighting (18.6) man years per £1m), by fencing, walls and landscaping (18.4 man years per £1m), by bridgeworks (15.9 man years per £1m) and by road pavement, kerbs (13.6 man years per £1m).

### Expenditure on All Schemes Brokendown by Component

	Surveyed Schemes		Direct Employment in Man Years	
	Total Expenditure	Direct Labour Costs	Total	Per £1m of Total Expenditure
	£m	£m		
Preliminaries, design and supervision	10.5	6.0	225.5	21.6
Land purchase/compensation	13.9	0.1	3.8	0.3
Site clearance	1.0	0.2	9.1	8.9
Drainage	6.9	2.1	138.4	20.0
Bridge works	20.8	5.9	330.2	15.9
Earth works	17.1	3.2	184.9	10.8
Road pavement, kerbs etc	18.9	4.2	258.1	13.6
Fencing, walls and landscaping	5.9	1.7	109.0	18.4
Footpaths, finishing works etc	1.2	0.4	26.3	22.6
Traffic signs, markings, lighting	0.9	0.2	16.7	18.6
	97.07	23.9	1,301.9	13.4

## Section 4

# Indirect and Induced Employment Impacts

### 4.1 Indirect Employment

Indirect employment associated with major road improvement schemes is the employment that arises in the production and distribution of all materials and products used on the schemes. First round indirect employment is the employment that arises in producing materials/products which are used directly in a road construction project while second round indirect employment is the employment in firms producing and distributing materials used as inputs by first round firms.

Data on the breakdown of expenditure on construction materials by product category together with information of the origin of materials (ie whether domestically produced or imported) which is based on information provided by major suppliers is given in the table below :

**Breakdown of Expenditure and Origin of Construction Materials Used on Major Road Improvement Schemes**

	Expenditure Breakdown	Imported Directly	Manufactured Processed in Ireland
	%	%	%
Stone, chippings	20.4	0	100
Sand, gravel	7.0	0	100
Cement/concrete products	21.4	5	95
Bitumen/macadam	22.7	5	95
Timber products	8.2	15	85
Metal products*	13.0	15	85
Other materials/products**	7.3	50	50
	100.0		

\* About 70% of expenditure on metal products is associated with bridgeworks and largely covers expenditure on reinforcing metal. The balance of the expenditure is associated with fencing.

\*\* This category covers paint, markings, lighting and electrical equipment and 'other' materials/products. We assumed a 50/50 breakdown between imported and domestically produced.

In relation to all materials/products information is required on the transport and distribution component of the total cost. In addition, in respect of the domestically produced/manufactured products and

materials, information is required on all the components of the cost of the materials concerned. This information which was sought from a number of major suppliers in each product category is set out in the table below :

<b>Origin of Materials/Products Used on Major Road Improvement Schemes</b>		<b>Material/Product Categories</b>						
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
Transport & Distribution		31	37	23	15	5	10	
Labour Costs		23	23	12	10	10	5	
Purchase of Domestically Produced Materials		13	10	50	31	65	0	
Purchase of Imported Materials		2	6	3	21	5	68	
Allowance for Plant & Machinery		8	6	2	5	5	5	
Fuel & Power		10	8	2	10	2	2	
Other (profits, depreciation)		10	10	8	8	8	10	
		100	100	100	100	100	100	
<b>Material Product Categories</b>								
<b>1</b>	<b>Stone Chippings</b>	<b>2</b>	<b>Sand Gravel</b>					
<b>3</b>	<b>Cement Concrete Products</b>	<b>4</b>	<b>Bitumen/Macadam</b>					
<b>5</b>	<b>Timber Products</b>	<b>6</b>	<b>Metal Products</b>					
<b>7</b>	<b>Other Materials/Products</b>							