Fifth International Conference on Construction in the 21st Century (CITC-V)
"Collaboration and Integration in Engineering, Management and Technology"
May 20-22, 2009, Istanbul, Turkey

Sustainable Construction: Private Finance Initiative (PFI) Road Projects in the UK – The Reality

Rıfat Akbıyıklı
Sakarya University, Adapazarı, Sakarya, Turkey
rakbiyikli@sakarya.edu.tr

David Eaton
Salford University, Greater Manchester, UK
d.eaton@salford.ac.uk

Abstract
The construction, maintenance and use of buildings and infrastructures impacts substantially on our environment and is currently contributing significantly to irreversible changes in the world's climate, atmosphere and ecosystem. The construction industry is facing ever-increasing demands to improve its sustainability performance. Public sector clients are increasingly asking for a sustainable approach in their specification and procurement decisions. Sustainability is still seen as a novel concept within the construction industry in many parts of the world with no settled definition.

This paper, based on case study research, will describe the sustainability implementation in a series of PFI road projects in the UK. It is a follow up to the theory paper entitled "Sustainable Construction: Private Finance Initiative (PFI) Road Projects in the UK – The Theory", also presented at this conference..

Keywords
Built environment, Construction, Economy, PFI, Sustainability

1. Sustainability

In 1987 the Brundtland Report, also known as *Our Common Future*, alerted the world to the urgency of making progress toward economic development that could be sustained without depleting natural resources or harming the environment.

This paper provides a continuation of the original theoretical work presented in Sustainable Construction: Private Finance Initiative (PFI) Road Projects in the UK – The Theory.

2. The Construction Industry and Sustainability

PFI has a key role to play within procurement due to the scale of investment involved; the greater ease of influencing the small number of actors involved; and the way in which PFI contracts secure the long-term engagement of contractors. However sustainability considerations are not sufficiently embedded in the PFI process to ensure consistent delivery, and success is highly reliant on the motivation and expertise of individual public sector clients and private contractors (Green Alliance, 2004).

The construction industry needs to develop and implement innovative design and construction methods to reduce the social effects of its business. It needs to consider the economic impact of sustainable project implementation, environmental and social impacts of large scale projects, the efficiency of the resources and sustainable building and infrastructure design and materials.

Public sector clients are increasingly asking for a sustainable approach in their specification and procurement decisions. The UK sustainability strategy identified four main aims:

- social progress which recognizes the needs of everyone;
- effective protection of the environment;
- the prudent use of natural resources;
- maintenance of high and stable levels of economic growth.

3. Sustainable Development

Sustainable development applies at the political and macro economic level to communities. Sustainability is addressed on an individual project by project basis.

In this paper we will concentrate on two infrastructure projects.

4. The Role of Public Procurement in Sustainability

The policy and regulatory framework for the environment is likely to be toughened over time. In some cases this might involve change of law provisions within the signed PFI contract. Failure to consider sustainability issues when developing a PFI project, means a company can miss a once in a lifetime opportunity to reduce the whole life costs, since the contract may run for 25-30 years; but potentially even longer given the asset life. Public procurement can also play a key role in driving innovation in environmental technologies, by bridging the problematic gap between demonstration projects and market commercialisation.

The contract specification for a Public Private Partnership affords the opportunity and freedom to potential contractors to propose innovative solutions which integrate the design, construction, operation and maintenance of a new or existing public facility. In some cases, the main outputs of projects may be sustainable objectives, for example targets for recycling and composting in PFI projects for waste management, may require bidders as part of their method statement, to explain how they will comply with the environmental requirements in the specification. This might involve preparation of an environmental impact assessment by bidders of their proposed work. Throughout the PFI project the project team will be expected to develop and maintain a business case. The final business case will present all the relevant information which will enable a decision to be made about a contract award. The business case will therefore need to take account of the environmental requirements of the project, and in its final form, to provide an assessment of the preferred option with appropriate commentary.

The business case should demonstrate that any specified environmental standards are reasonable, achievable and cost effective. It will also need to present any cost assumptions relating to a Public Sector Comparator (PSC) for the project. The inclusion of sustainable technologies with what might appear to be higher up front capital costs will need to be explained in terms of their cost effectiveness over the lifetime of the contract and the environmental benefits they deliver (Green Alliance, 2004).

Sustainable procurement is about embedding the principles of sustainable development into spending and investment decisions across the whole of the public sector. Efficiency has always been an essential feature

of public spending, but better spending decisions – that take into account environmental and social as well as economic considerations – can deliver real value for money for the public purse.

5. PFI and Sustainability

PFI is an innovative procurement route for the development of major highway works. PFI will be considered in the context of each major party of a typical DBFO scheme and set against the key criteria of appropriate quality. PFI is a vast topic, which limited the authors to focus predominantly on major highway works under the DBFO form of contract. A limited number of interviews were undertaken, due to restricted time. The size of the sample was not a fair and accurate reflection of the professions held within the industry, which restricted the scope and scale of information provided:

- The paper includes only two cases, this may have limited the results, as different case studies may have encountered different success criteria other than the A92 and Newport Southern Distributor Road projects;
- The fact that DBFO is a fairly new procurement system limits the amount of information and research that is available;
- A limited number of organizations are involved with DBFO contracts, which again limits the research information;
- The reluctance of interviewees to divulge confidential information may have restricted the research into drawing deeper results and conclusions.

6. Case Studies in PFI Road Projects

6.1 A92: Upgrading between Dundee and Arbroath – Scotland

Table 1: A92 PFI Road Project Description (Akbıyıklı, 2005; Eaton and Akbıyıklı, 2005)

Title:	A92 Upgrading between Dundee and Arbroath
Location:	Angus Council - Scotland
Country:	United Kingdom
Project cost:	£150,000,000
Sector:	Transport - Roads
Status:	Completed Nov., 2005
Sponsors & Concessionaire/Lead Manager	Claymore Roads Ltd. (Morgan= Est + Barclays Bank)/Morgan = Est
Purchaser:	Angus Council - Scotland
Contractual Package:	The DBFO (Design, Build, Finance, and Operate) Contract between Angus Council and Claymore Roads Ltd. The scheme is let under the Government's Private Finance Initiative (PFI) with a concession period of thirty years. The project sponsors executed capitalisation for the project privately.

The Construction Sub-Contractor's Early Solutions Together (EST) philosophy has been a guideline during the execution of the works to find the quickest, most effective way to make the A92 an efficient route.

Picture 1: A92 PFI Road Project under Construction
(Courtesy: MorganEST Rugby Office Archive)

The A92 between Dundee and Arbroath is a vitally important strategic route for the East Coast of Scotland, serving the towns of Dundee, Monifieth, Carnoustie, Arbroath and Montrose. It also serves as a major route for commercial traffic to these towns, and the ports of Arbroath and Montrose.

The existing single carriageway road carries up to 18,000 vehicles per day. The traffic volume increase and the accident record of the existing A92 and associated roads is considered to be a major factor in the continuing decline in economic activity in the area.

A consequence of the problems on the A92 is that traffic is currently diverting to the less suitable coastal corridor route – the A930. The affected local authorities - Angus Council and Dundee City Council - are aiming to improve the safety, quality of life and economic opportunity in the area by upgrading the A92 and carrying out other improvements within the A92/A930 route corridor.

Sustainable Solutions: The key requirement of the A92 construction was the large quantities of material needed to form the road structure. Redundant land in the form of a disused airfield provided a 'sustainable solution' for sourcing the necessary material which was recycled and used to form an improvement layer for the road. The unsuitable material from road excavation was used to fill the hole left in the airfield. The fill material was then covered with topsoil creating a new field that could be farmed.

6.2 NSDR: Newport Southern Distributor Road - Wales

Table 2: NSDR PFI Road Project Description (Akbıyıklı, 2005, Eaton and Akbıyıklı, 2005)

Title:	Newport Southern Distributor Road (NSDR)
Location:	Newport City - Wales
Country:	United Kingdom
Project Cost:	£200,000,000
Sector:	Transport - Roads
Status:	Construction completed in August 2004
Sponsors & Concessionaire/Lead Manager	Morgan-Vinci Ltd (Morgan Sindall Investment Ltd and the French construction group Vinci SA) have a 50/50 shareholding and equity stake
Purchaser:	Newport City Council - Wales
Contractual Package:	A DBFO (Design, Build, Finance and Operate) Contract between Newport City Council and Morgan – Vinci Ltd. The scheme is let under the Government's Private Finance Initiative (PFI) with a concession period of thirty seven years. The project sponsors executed capitalisation for the project privately.

The Newport Southern Distributor Road (NSDR) completed construction in August 2004. It is an upgrading project, consisting of alteration of existing roads to dual carriageway from Duffryn in the west to the Coldra roundabout in the east and includes a new bridge over the River Usk in Newport City in Wales.

The NSDR - the new dual carriageway is located between junction 24 and 28 of the M4 – has been selected by the Department of Trade and Industry as a flagship case study in Newport (Newport Matters, 2004).

Picture 2: NSDR PFI Road Project and River Usk Bridge under Construction (Courtesy: MorganEST Rugby Office Archive)

The NSDR is recognised by Newport City Council (NCC) as its highest single priority scheme for the improvement of Newport's principal highway network. The NSDR scheme is designed to ease the congestion on the M4 and alleviate heavy traffic problems in and around Newport. This scheme is designed to improve the environment in the city centre, taking traffic away from residential areas, improving access to industrial areas in the East and South of the city and providing a new river crossing. NSDR is the biggest local authority PFI scheme in Wales.

The PFI (DBFO) scheme involves the design, construction, financing and operation and maintenance of a high standard distributor road around the periphery of Newport, including a major new crossing of the River Usk. The Operation and Maintenance Concession is for forty years.

The scheme generally follows the line of the exiting A4042 carriageway west of the River Usk with an offline section north of the docks, and similarly along the line of the existing A455 east of the river to the Coldra roundabout. A new crossing at the River Usk, forms the central part of the scheme, linking the two roads to provide a direct and continuous carriageway distributor road around the south of Newport.

The sole parties in the PA are Newport City Council (NCC) and Morgan - Vinci Ltd, SPV.
The PA (Project Agreement) took effect when it was signed on 29 March 2002 and terminates on the earliest of either:

- 37 years after the Scheduled Permit to Use Date (which is 36 months after the PA was signed), i.e. 01 April, 2042;
- Earlier termination on breach as provided for in the Agreement.

The *use of recycled and secondary aggregates* guaranteed security of supply and non-dependence on quarries. This minimised traffic movement through the route and minimised traffic disruption. As well as complying with a high technical specification, the materials used had to meet strict environmental guidelines. The environmental considerations were imposed as conditions of the planning permission

from the Local Planning Authority to protect the local environment, in particular the ecologically sensitive River Usk: a Site of Special Scientific Interest and Candidate Special Area of Conservation. The project won the Green Apple Award for sustainable construction and was crowned as National Champions for Environmental Best Practice in the Building and Construction sector.

During pre-commencement the Project Partners combined to maximise the use of project derived excavated materials. Opportunities were also sought to utilise locally available secondary aggregates from sustainable sources: by-products of the heavy industry historically located in the area. This has significantly reduced the environmental impact on the community by negating the demand for primary aggregates and reducing long distance haulage movements on the project. The NSDR Scheme saved a considerable amount of cost (£2.0 M) by using recycled material and secondary aggregates instead of purchasing primary materials (The Big Picture:WRAP, 2004). The specific cost savings by using recycled materials in highways maintenance and construction are:

- The avoidance of waste disposal charges and Landfill Tax through the re-use of recycled and secondary materials;
- The avoidance of Aggregate Levy payments, from which recycled and secondary aggregates are exempt;
- Reduced cost of transporting aggregates when recovered materials are available locally;
- New recycling techniques have demonstrated cost and performance advantages (ibid).

The project maximized the use of project-derived and locally – available recycled materials to produce *direct cost saving* (per tonne of aggregate) and *indirect cost saving* (from the avoidance of the waste disposal charges and landfill tax).

The re-cycled materials are used in general granular fill, capping and unbound sub-base of road building. The re-cycled materials are: concrete aggregate, asphalt, blast furnace slag, steel slag, pulverized fuel ash and spent railway ballast. These re-cycled materials produced well graded granular material (Class 1A); selected coarse graded granular material (Class 6F2); selected granular material (Class 6F3); and granular sub-base material (Type 1).

Using local and recycled materials was a contract requirement. Overall, 95% of all aggregates used in the Newport SDR are recycled and secondary materials. This success can be attributed to the geographical location of the principal stockpiles of recycled and secondary aggregates, the ingenuity of the site team, together with a favourable specification. The slag came from a former steel mill in the area, and using it helped pump money back into the local economy. Excavation fill from early work, including old curbing and other concrete or asphalt products, was also used.

In most construction projects, contractors focus on keeping up-front costs low. For this project, however, the lengthy concession period forced the team to think about costs relating to the entire life of the project. Because the project depended on toll income calculated on the basis of 68 percent road availability, using materials that required less maintenance and repair meant fewer highway closures and more toll revenue. This "whole-life costing" allowed the contractor to use some high-quality items such as stainless steel columns for the River Usk Bridge.

All materials were tested to ensure they complied with Specification for Highways Work (May 2001) and chemical thresholds agreed with the Environment Agency. No departures from the Specifications for Highway Works were required.

The project provides demonstrable proof that, through the use of risk assessments, recycled and secondary aggregates that are environmentally acceptable and can be used in the vicinity of environmentally sensitive areas without adverse impacts.

The utilization of recycled and secondary aggregates on the project is shown in Table 3.

Table 3: Recycled and Secondary Aggregates in NSDR Project (Source: Information given by MorganEST – Rugby Office & WRAP, 2003)

MATERIALS	APPLICATION	AMOUNT (tonnes)
Spent railway ballast (unprocessed)	General Granular Fill	94,938
Spent railway ballast (processed)	Capping Layer	70,218
Spent railway ballast (processed)	Unbound Sub-base Layer	30,000
Blast Furnace Slag	Unbound Sub-base Layer	30,000
Steel Slag	Capping Layer	47,397
Excavations from Brownfield Land	General Granular Fill	122,062
Recycled Concrete Aggregate	Capping Layer	7,022
Recycled Asphalt	Capping Layer	50,908
TOTAL		**452,454**

In addition to the significant benefits for the construction project in using locally available recycled and secondary aggregates, a number of other benefits also accrued:

1. Reduced demand for conventional aggregates, reducing the environmental impact for the community;
2. Fewer long distance haulage movements reducing the environmental impact in the local community;
3. Encouraging innovation within Morgan Vinci;
4. Promoting environmental beneficial practices, namely sustainable waste management, within the construction industry.

7. Conclusion

The Concessioners' outstanding eco-friendly performance and drive to promote environmental best practice throughout the whole project cycles in the NSDR and A92 PFI road projects gave a series of successes at awards. The environmental effort on the entire NSDR project culminated in a 2004 Green Apple Award for Environmental Excellence in Construction. It marked the first construction award for Wales - and a fitting cap to the project effort.

Morgan Vinci, a joint venture between Morgan Est and construction company Vinci Grands Projets, took two prizes at the Green Apple Environmental Awards for its work on the Newport Southern Distributor Road (NSDR) The award is presented to companies which demonstrate environmental excellence and leadership in their sector.

Newport SDR also received the top award in the Environmental Best Practice in the Building and Construction Sector category for its use of excavations from contaminated land and the local secondary aggregate market. The project included some 460,000 tonnes of new engineering fill to construct around 9.5 km of road. By working with local suppliers recommended by the Environment Agency, around 95 per cent of the engineering fill was procured from secondary or recycled aggregate sources. Morgan Est's efforts to implement environmental best practice are combined in a process of continuous improvement and one of the most important areas it has been addressing is the re-use of materials. This sustainable approach also reduces materials purchase and transportation costs. Morgan Est is raising the profile of environmental best practice throughout its supply chain as part of its continuing process of vendor assessment. All members of the supply chain are made aware of Morgan Est's environmental policy and all sub-contractors that come on site receive an induction that covers environmental issues. Additionally

the company's procurement team is working towards ensuring that materials are purchased from verified sustainable sources. The team has also started to collect data to identify suppliers that have an environmentally sound record and follow environmental best practice (Interview, October 2004).

The use of recycled material did not incur additional capital or maintenance expenditure for the project; however, it did result in direct cost savings in construction costs (£1,034,135), carbon emissions (£106,481), avoiding landfill costs (£941,360) and health benefits from reduced emissions of PM10 (particles measuring 10mm or less).Overall, £2,098,801 was saved, offset by no costs, which amounted to 3.82% of savings of the total project cost or to £219,609 per kilometre of road constructed (Akbıyıklı and Eaton, 2005; DEFRA, 2006).

8. References

Akbıyıklı, R. and Eaton, D. (2005), *"Lessons Learned from Two PFI Road Projects in the UK"* In Proceedings of the Third International Conference on Construction in the 21st Century CITC-III, (Eds. Ahmed, S.M., Ahmad, I., Pantouvakis, J.P. and Zheng, J.), pp. 1064-1069, September 15-17, Athens, Greece.

Akbıyıklı, R. (2005), *The Holistic Realisation of PFI Road Project Objectives in the UK*, Research Centre for the Built and Human Environment, School of Construction and Property Management, Unpublished PhD Thesis, 468 pages, University of Salford, Salford, UK.

BRE (2001), Building Research Establishment *"The Business Case for Sustainability in the UK Property Sector: A Report by the Sustainable Construction Task Group"*. web: www.bre.co.uk. Accessed on 02.09.2008.

Brundtland Report. (1987), *"Our Common Future"*, United Nations Assembly, Report of the World Commission on Environment and Development. Annex to General Assembly Document A/42/427, 4th August.

CIB (1999), "Agenda 21 on Sustainable Construction", CIB Report Publication 237, CIB, Rotterdam, The Netherlands, July.

CIB (1999), *Agenda 21 on sustainable construction* CIB report, publication 237, CIB.

CIRIA (2001), *"Sustainable Construction Procurement"* Report CIRIA C571: A Guide to delivering environmentally responsible projects, London, UK.

CIRIA (2006), *"Sustainable Perspectives"* Available at: www.ciria.org accessed on 05.12.2008. (http://www.ciria.org/pdf/newsletter_sustainability.pdf) January. *Construction.* UK.

Crossley, R., (2002), *Reputation, Risk and Reward: The Business Case for Sustainability.*

DEFRA (2006), (Department for Environment, Food and Rural Affairs), Action Sustainability http://www.actionsustainability.com/resources/view_casestudy.asp?CaseStudyID=13) accessed on 18.12.2008.

DETR (2000), *Building a Better Quality of Life – A strategy for More Sustainable.*

DTI (2004), *"Sustainable Construction Brief 2"*, Department of Trade and Industry, www.dti.gov.uk/construction/sustain,Sustainable Construction Team, DTI, London, UK.

DTI (2006), *"Review of Sustainable Construction"*, Department of Trade and Industry, October, London, UK.

Eaton and Akbıyıklı (2005), "*Quantifying Quality"* http://www.rics.org/NR/rdonlyres/A37E17C2-C4FC-4F50-AE40-14F62E949BD3/0/PFI_Report.pdf

FIEC (2005), *"FIEC Principles for Sustainability"*, European Construction Industry Federation, 2005) Bruxelles, Belgium. **(**http://www.fiec.org)

Green Alliance (2004), *"PFI: Meeting the Sustainability Challenge"*, Green Alliance, July, ISBN 0 954 38 13 6 X, London, UK. Available at: www.green-alliance.org.uk accessed on 20.10.2008.

Highway Agency. (2004), *DBFO – Value in Roads: Road Projects – Design, Build, Operate & Finance.* Available at: (http://www.highways.gov.uk/roads/dbfo/dbfo_about.htm) accessed on 28.10.2004.

HM Treasury Taskforce. (1999) 'How to Account for PFI Transactions', Technical Note 1, June: Office of Government Commerce (OGC).

Kibert, C. (1999), "Introduction" in *Reshaping the Built Environment: Ecology, Ethics and Economics*, (Kibert, C. ed), Island Press, Washington, DC, p. 378.

Newport Matters, Winter 2004, p.7

Parkin, S. (2000), "Context and Drivers for Operationalizing Sustainable Development" in ICE, November, pp. 9-15.

Rodman, D.M. and Lenssen. N. (1995), "A Building Revolution: How Ecology and Health Concerns are Transforming Construction" Worldwatch Paper 124, March, pp.67, ISBN: 1-878071-25-4.

The Earth Summit. (1992), United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, Brazil. Available at: http://www.un.org/geninfo/bp/enviro.html. Accessed on 21.11.2008.

UN World Summit. (2005), UN Sixtieth Session, UN General Assembly, A/60/L.1

WRAP (2003a), Comparative Performance - Newport Southern Distributor Road, http://www.aggregain.org.uk ,Banbury, Oxon.

WRAP (2003b), Newport Distributer Road, AggRegain WRAP, Banbury, Oxon, UK http://www.aggregain.org.uk/procurement/case_studies/newport_southern.html , December.

WRAP (2004a), *"The Big Picture: Specifying recycled in local authority contracts for highways maintenance"*, The Waste and Resources Action Programme, Banbury, Oxon, July.

WRAP AggRegain (2004b), Case Study: "Performance of recycled and secondary aggregates in the construction of the Newport Southern Distributor Road", available at: http://www.aggregain.org.uk/applications7aggregain/casestudyresearch/index.rm accessed on 05.06.2004.