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PROJECT FINANCING

SUSTAINABLE SOLUTIONS

RE-ASSESSING THE PRIORITIES
ADDING VALUE THROUGH INNOVATION

Contents

A well-engineered project can be improved by a sophisticated legal and financial framework, but clever financing can never make a badly designed project feasible

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This document is relevant to private and public sector clients, financial organisations involved in funding privately financed projects, contractors who are bidding and managing consortia and engineering consultants who are planning and designing sustainable solutions for such projects.

José Rayagra
EFCA President
May 2001

Sustainable Solutions for Project Financing Introduction

Large-scale, privately financed projects are often very complex owing to the large number of stakeholders involved, the high costs and risks, and the long duration of project development and the contract period. Grouped under the term Design, Build, Finance and Operate (DBFO), they include Build, Operate, Transfer (BOT) projects, Build, Operate, Own (BOO) projects, as well as projects developed under Private Finance Initiative (PFI) terms, a system originally developed in the UK but latterly used in many other countries.

Financing such projects in the 21st century involves a range of stakeholders, and success depends on these parties uniting to secure the optimum result. The dynamics of all the key aspects of project financing must be considered by the various stakeholders in order to manage the crucial stages.

For all stakeholders, the success of a DBFO project can be measured by one yardstick: its sustainability over its entire lifetime. Any attempt to optimise specific aspects of the project independently of the rest will almost certainly upset the balance of the whole – and any project stakeholder looking for a short-term profit may not only provoke long-term losses for all stakeholders but also risks endangering the entire project.

Sound business plans, creative financing schemes and sophisticated contracts are simply the tools to make projects happen. Before they can come into play, the project must be conceived and designed to achieve success. The history and development of project financing shows that small misjudgements during the early stages can have a disproportionately large impact years down the line.

We believe that the time is ripe for a fundamental re-assessment of project financing. Only by getting back to the basic driving forces can we gain a clear picture of the true priorities which should characterise DBFO projects. We further contend that, while DBFO projects involve multi-disciplinary partnerships, consulting engineers have the necessary breadth of vision to act as the central pivot for such projects. We have the technical skills to understand the dynamics of design and construction. We have a clear overview of environmental and social aspects surrounding construction projects for the public sector. We understand the strategic issues that must be taken into consideration to achieve a successful outcome over two or possibly three decades.

To comprehend the true value of DBFO projects we have to go back to the fundamentals of success in large investment projects: the quality of the technology employed, the degree of innovation used to secure enhanced whole life costs for the user, and respect for the environment. These fundamentals are today articulated by the concept of sustainable development that encompasses social equality, the maintenance of economic growth and employment, protection and - if possible - enhancement of the environment, and prudent use of natural resources.

Sustainability considerations have fundamentally altered the nature of decision-making process on major projects. For example, concept and design, the procurement process, evaluation and selection criteria, key performance indicators and contracts will be all different when sustainability is taken into account.

Sustainability principles have to be applied over the full life cycle of DBFO projects from inception through to final disposal. As a general rule, the best course of action is to balance the sustainability principles against each other, so that outstanding performance in a single area is not achieved at the expense of the others. There are no perfect solutions. Instead, the objective should be to achieve a culture that permits a continuous improvement in proposed solutions.

Consulting engineers believe that their expertise and professional skills add value to the development and design of DBFO projects by leading the way to an improved balancing of risks and liabilities, the identification of benchmarks for long-term success for all stakeholders, and the creation of solutions that are sustainable for the environment, society and the resources used. These roles will be highlighted wherever appropriate in this review of the key aspects of private financing.

CHAPTER 1 | SUSTAINABILITY

As concern for the environment has risen over the past 10 to 15 years, forward-thinking industries have come to recognise that sustainability is one of the key factors governing their future viability. This is particularly true in the field of construction and engineering, where the work has a lasting impact on the environment, in the form of new buildings or infrastructure. This impact has to be carefully managed, both through the initial intense construction stage, and also over the facility's entire lifetime.

The main advantages of adopting sustainability principles for building construction and operation are:

- Reduced risks – less likelihood of health, safety and pollution incidents; reduced instances of delay and conflict during construction; reduced risk of public relations problems
- Protected and enhanced reputation – protection or enhancement of the client's reputation; better relationships with regulators; preferential status on bids
- Reduced or avoided costs – reduced operational costs through efficient use of materials, designing for energy efficiency and low maintenance, and good control systems; opportunity to employ flexible building systems capable of accommodating future requirements
- Increased opportunities to generate revenue – possibility of increasing usable floor area as a result of integrated design and reduced building service requirements, resale of demolition materials.

Kanata Hydro-electric Plant, Bolivia

Commissioned in 1999, the Kanata hydro-electric power plant in Bolivia is a Build/Own/Operate project developed by an Austrian consulting engineering group in co-operation with Bolivian partners. The engineering consultancy identified the project, prepared the feasibility study, successfully bid for the concession, designed and organised financing and construction works of the 7.4 mW plant.

These principles address the social, economic and environmental aspects of sustainable development.

Social aspects include

- Health & Safety – what steps can be taken to prevent accidents, improve working conditions, monitor work-related illnesses, and foster health promotion measures
- Staff – can the project is built under conditions that are fair to employees?
- Community – how does the project integrate with local needs? Is there dialogue with stakeholders? Can staff get involved with local initiatives?
- Equity and social opportunity – are there opportunities for local employment? Is the employee profile compatible with the social mix of the community? Are different religious beliefs respected?
- Amenity – does the project provide an amenity that improves the quality of life for staff and the local community?

Economic aspects include

- Corporate viability – can sufficient profitability be generated while delivering the appropriate quality of service?
- Legal compliance – have the implications of failure to comply with legal requirements been evaluated? Are sufficient financial and human resources available to deal with potential legal actions and their consequences?
- Investment – can the project attract inward investment and retain shareholders? Has the need to invest in pension schemes and training been taken into account?
- Risk assessment – have the risks associated with the selection and viability of a site been assessed? Have pollution risks been evaluated? Has adequate insurance cover been secured? In the event of adverse publicity, can the cost of damage to reputation be sustained?
- Initial project viability – can buildable projects be developed to meet the client's requirements, within accurate cost and time parameters, with good productivity rates while avoiding disruption and disputes?
- Ongoing project viability – can client satisfaction be delivered on an ongoing basis? Are whole life costing principles being used to obtain accurate future running cost predictions?
- Marketing opportunities – how can policies and achievements be successfully publicised, with a view to generating future work from previous successes?

Environmental aspects include

- Energy consumption – what steps can be taken to minimise energy use during construction and during normal operations? Is embodied energy taken into account in materials selection?
- Energy sources – can renewable sources be used? Does the design ensure that future owners can change their energy sources easily?
- Water – how can water use be minimised? Are better treatment and disposal methods available?
- Waste – can waste be minimised through good specification, efficiency in use, re-use and recycling?
- Transport – can dependency on private transport be reduced for the building's users? How can traffic be minimised during construction?
- Pollution – have steps been taken to minimise pollution to air, water courses and land?
- Habitat – how can the existing natural habitat be preserved/enhanced?
- Materials – has the type, abundance and future availability of materials been taken into account? Have the overall required volumes been assessed?
- Land use – can optimum utility of the available land be ensured? Have alternative methods of decontamination been reviewed?
- Noise and other nuisances – can they be minimised?

CHAPTER 2 | TECHNOLOGY AND INNOVATION

In the construction industry as elsewhere, technical innovation can be a two-edged sword. It can slice through problems, cutting time and cost, or it can create new problems which reverse all the potential benefits. However, innovation is probably the single most important factor in the achievement of progress. For that reason alone, project teams should devote significant time early in the design phase to considering whether an innovative approach can deliver a time or cost benefit.

Information technology and e-communication

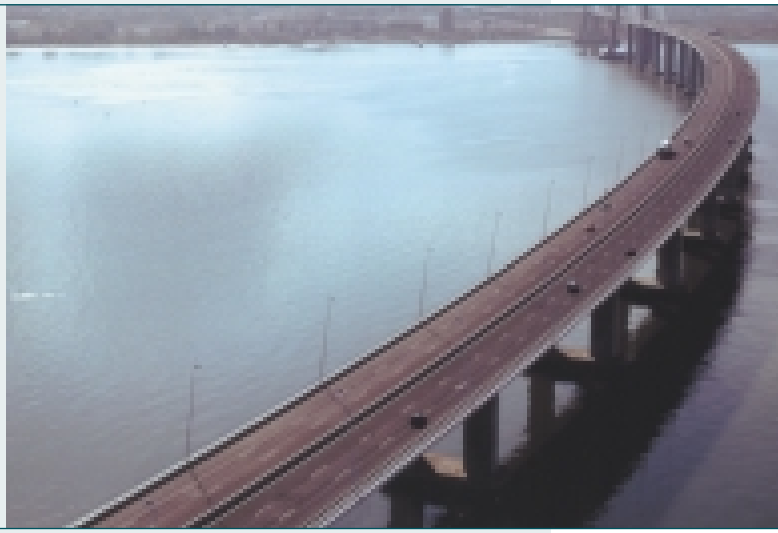
Technology has a major impact on DBFO projects, in terms of the time-saving potential of information technology, raised standards of predictive accuracy and its ability to underpin the development of genuinely innovative solutions.

The potential advances stemming from technological progress are now being boosted by vastly increased computing power and unlimited access to electronic communication channels. These developments inevitably mean that some of the established data exchange principles will become things of the past. For example, if everyone is working on a central e-communication model on the Internet, there is a common data set rather than an evolving model based on exchanged data. The faster the communication links to the Internet, the more useable these techniques become.

The rapid advance in the development of computer-aided design has brought us to the point where it is commonplace to simulate and visualise both the process and the performance of projects. The major advances are in the full 3D modelling of geometric spaces which has enabled engineers to enhance the accuracy of their estimates for energy use, load predictions, running costs and overall building performance.

Vasco da Gama Bridge, Portugal

The 18-kilometre Vasco da Gama Bridge over the River Tagus in Lisbon was built under a Design/Build/Finance/Operate contract in partnership with the private company Lusoponte. The total investment was approximately 1 billion Euros. The consulting engineering firm played a leading role throughout the project. They collaborated with financiers and lawyers to shape the project, defined the bidding process, secured local environmental protection and produced the detailed design. They are now continuing to assist the owner as the bridge moves into successful operation.



Renewable energy

Driven by concerns about climate change and global warming, governments are placing a heavy emphasis on sustainable development. Although CO2 emissions from power generating plants have been reduced by almost 50% in the last 10 years, they can be further reduced by developing highly efficient local generating units.

Renewable energy is seen as key to building developments in the 21st century. The use of combined heat and power is set to more than double over the next 10 years, and it is often DBFO projects with heavy heating demands and fairly constant electrical loads that will benefit from the implementation of such schemes. Promising alternative energy sources include solar power, wind power and photovoltaics, all of which are now receiving serious attention from the construction industry as generating technologies.

A range of other new technologies is currently being researched which, though not always seen as renewable, still offer ways of providing a good environmental solution for power generation. These include waste incineration plants, sewerage treatment plants, landfill gas and even geothermal energy produced as a by-product of tunnelling projects.

Energy efficiency in buildings

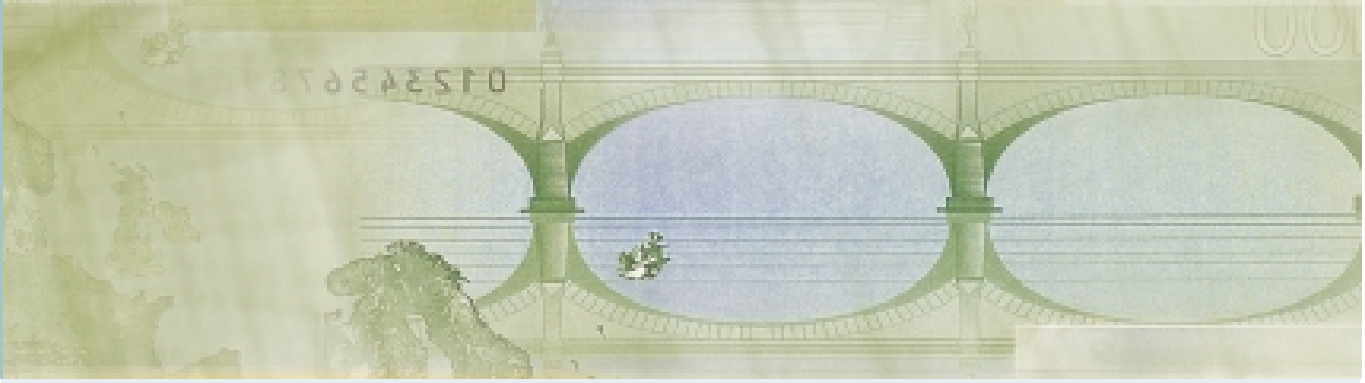
Energy efficiency is one of the most important factors for determining the whole life costs of a building. The design of a building or plant, the materials and equipment used, heat recovery systems and new heating and lighting technologies will have an important impact on the operation and maintenance costs. DBFO projects, in particular, are suitable to help these technologies to emerge since nowhere else is their contractual and commercial effect so evident.

Building materials technology

Advances in materials technologies are facilitating the development of totally different constructional forms. Thanks to continuing research in this area, designers have a far greater range of materials to choose from in developing their solutions. This is opening up the possibility of slimmer, taller buildings and therefore better utilisation of land. In the energy field, further innovative advances in technology have given us fuel cells whose power output per cubic metre has increased 15 times in 10 years. Curved glass and flexible photovoltaic panels open up brand new design solutions. Major efforts are now being made to integrate these high-tech elements into building design.

Water and waste water

Technology can play a particularly important role in enhancing water and waste water processes within DBFO projects. To gain the full benefits, it is necessary to have a very sound knowledge of processing techniques, environmental impacts and relevant water laws. It is also essential that this expertise is brought into play early in the project so that it can feed into both the technical design and the process design.



The consulting engineer's specific and general knowledge means that he or she is well-positioned and well qualified to act as an intermediary/arbitrator between the public authorities who control the water supply and the end-user groups

In the water sector, a distinction exists between tax-driven and concession-driven DBFO configurations. In the tax-driven variant, government maintains its responsibility to collect fees and taxes. In the concession variant, fee collection becomes an integral part of the project design.

Transportation demand and revenue modelling

Transport projects are different in nature from other types of project. Their market is geographically fixed: for example, spare capacity on one road cannot be used to relieve congestion elsewhere in the country, unlike prisons or hospitals; in the case of roads, drivers are often unaccustomed to paying for a premium service – roads are traditionally regarded as a public good, and imposing a monetary cost on a particular route may well displace traffic onto less environmentally suitable, but free, routes.

When the user pays at the point of use, for example by buying a train ticket, or at a toll booth on a motorway or bridge or tunnel, this introduces a degree of uncertainty: will sufficient numbers of users be willing to pay enough money to make the project viable? On the other hand, it also gives the concessionaire an opportunity to be creative and innovative with regard to revenue generation as well as well with cost control. Some DBFO transport contracts are moving towards payments based on availability, safety and level of service targets, as well as on traffic levels, to deal with these issues.

The critical factors are:

- The availability of a wide database of existing travel patterns in the project corridor
- An accurate traffic forecast that anticipates road users' response in the event of tolls being imposed
- An accurate assessment of the willingness of the market to pay for the service
- Secure economic forecasts: GDP and travel demand are closely correlated
- A well-defined project in terms of pricing strategy, junction location (for roads), and phasing
- An attractive marketing policy which caters for both local and long distance traffic, discounts for frequent users, premium prices at times of exceptional demand, and easy payment systems
- Proper risk allocation between the public and private sectors.

The key to success in these areas is partnership between the public and private sectors, where each side is willing to accept the appropriate risk in an environment of mutual trust. It also means that tenders must be evaluated on a wider basis than narrow, short-term financial criteria, so that the most sustainable, long-term solutions are obtained.

A further element of operational efficiency is to ensure that the maximum capacity, and hence revenue potential, is being achieved from the infrastructure. In transport projects, this is increasingly leading to the use of microsimulation techniques for vehicular and pedestrian movement. Development of real-time simulation models enables operational conditions under varying scenarios to be assessed, thereby enabling optimal operational design.

The need to generate revenue profiles also requires innovation at the development stage. It is increasingly essential to "think outside the box" and to explore innovative mechanisms.

CHAPTER 3 | WHOLE LIFE COSTING

DBFO procurement methods require the successful consortia to take responsibility for managing the operating, maintenance and replacement costs over the contracted period. In these circumstances, the lowest capital cost often does not represent the best value choice when purchasing a capital asset. Whole Life Cost analysis considers capital, maintenance, operational, energy, replacement and disposal costs over the entire lifetime of an asset. By establishing the full cost of ownership, the route to securing best value is revealed.

Analysis can be undertaken at overall project level or down to individual equipment level. It can also be applied at any stage of a project, from concept through to implementation, occupation and disposal.

Research shows that the cost composition of an entire building project's life cycle is made up as follows:

- Operation and replacement costs:70-80%
- Construction costs:20-30%
- Design costs: 2-5%

Thus, an additional 1% expenditure at the design stage can save many percent throughout the whole project.

Whole Life Costing is a financial appraisal technique and normally uses Discounted Cash Flow (DCF) analysis to calculate future cost at today's prices. This enables results to be presented in terms of Net Present Value (NPV). As a financial model, it can be adapted to allow for differing rates of inflation, taxation on revenue, capital allowances and sensitivity analysis. It can be applied to any capital purchase that has ongoing operating and maintenance costs.

Worcester General Hospital, England

Worcester General Hospital is a 450-bed facility, currently being built under a £50 million Private Finance Initiative contract for a private consortium. On completion in January 2002, it will be leased to the state-owned National Health Service (NHS) for 30 years. The consortium will be responsible for maintenance and non-clinical services, while the NHS's sole responsibility will be to provide clinical staff and services.

Establishing the base line

To undertake a Whole Life Cost assessment, it is essential to establish all first costs and all future costs recurring over the asset life.

- First costs include actual asset costs and all the costs associated with installing and handing over the completed project.
- Future costs include all costs associated with operating and maintaining the asset over its anticipated service life. These include energy costs, planned servicing and maintenance costs, component replacement costs together with any costs for regularly replaced consumables.

Calculation and results

Once all first costs and future costs have been established, they are entered into a Whole Life Costing model and a total life cost calculated for the asset over its anticipated life. Once this exercise has been repeated for a number of asset options, whole life costs can be compared and the results analysed.

Benefits

The benefits of adopting a life cycle costing approach to DBFO projects include:

- Better management of DBFO consortia design development to ensure that best value facilities are provided.
- Encouragement for designers to consider the energy and running cost impact of design decisions.
- Lower facilities provider costs due to reduced energy and maintenance costs.
- Increased reliability of systems and services.
- Potential for lower first costs by adopting a best value approach to design, construction and operation.
- Reduced energy consumption with associated environmental gains.

CHAPTER 4 | PARTNERSHIP AND CO-OPERATION

DBFO projects involve more stakeholders than any other type of construction project. The parties have to co-operate in order to achieve goals that may be 20 or 30 years away, a timescale so attenuated that these goals may not even be clearly defined when the project gets under way.

This requires innovative forms of co-operation based on partnerships that are specifically constructed to create a win-win situation. No contract, no project management technique, no project organisation can succeed without such partnership.

Put simply, partnership creates opportunities to add value to projects. When people from different disciplines work in isolation, they tend to create solutions that suit their own ends, sometimes to the exclusion of others. But when they work together in harmony, they create solutions that are mutually beneficial, to each other and to the project itself.

The main dynamics of partnership are a continuous focus on the client's needs, counterbalanced by a keen awareness of any circumstances surrounding the project which may effect its outcome. All successful partnerships are underpinned by a six-stage procedural structure which acts as a powerful driver of the entire project.

ELEMENTS FOR SUSTAINABLE DEVELOPMENT

Stage 1 – Strategy

When initial ideas are discussed and elaborated into proposals, it is essential that they are considered in the light of the overall goals and objectives, namely trust, responsiveness, quality and integrity. It is also essential that policies and procedures are defined to ensure that there is an agreed route for accomplishing the defined goals. Furthermore, decision-makers must bear in mind the nature and characteristics of the client to ensure that the project's objectives remain correctly aligned with overall objectives.

Stage 2 – Membership

It is important for the partners to develop the ability to identify companies whose skills and expertise are appropriate for certain project appointments and tasks. These firms should be selected on the basis of their qualification and experience to carry out the task in a way that is most likely to achieve the objectives stated in the strategy. This particular ability is beneficial to the project as a whole because it helps to cement the bonds between the parties and hence promotes the sense of collective interest.

Stage 3 – Integration

On a continuous basis, key members identify objectives, costs and benefits and redefine their strategy accordingly, either to continue as planned or to make improvements where needed. At this stage, individual companies are no longer separate entities and consequently each decision effects the whole team.

Stage 4 – Benchmarking

It is important for the team to carry out their tasks to a standard that is acceptable to the group as a whole. As a general rule, the group will initially look at the standards being achieved in competing companies. However, as the task progresses, the partnership will need to consider whether the standards should be revised upwards.

Stage 5 - Project development

Close co-ordination is vital at this stage, as tasks and functions must be carried out simultaneously to ensure that the final objectives are reached in the most efficient way.

Stage 6 - Feedback

The final stage involves an analysis of the entire process to identify any further improvements. It is important at this point to act quickly to resolve any recurring problems. This action in itself can stimulate the discovery of further opportunities for improvement elsewhere in the project.

CHAPTER 5 | PROCUREMENT

DBFO projects are a relatively new phenomenon, requiring the stakeholders to develop new working methods – and the procurement process is no exception. Because these projects are different, a radical new approach is required that recognises the partnership between the stakeholders, the contractual flexibility that must be built into the system, and the exceptional duration of DBFO project timescales. It is hardly surprising therefore that a faulty procurement process is frequently the root cause of failure in DBFO projects.

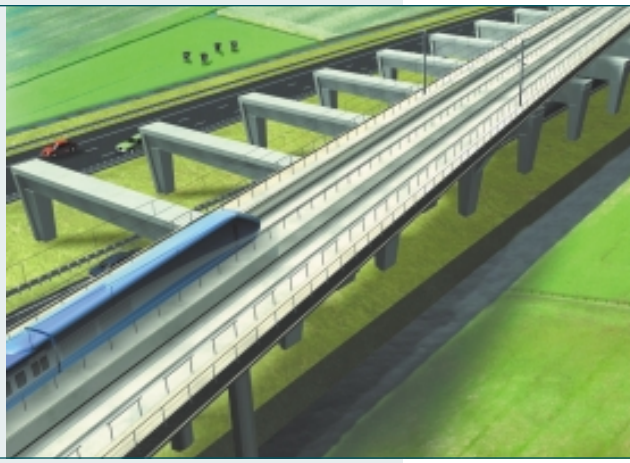
The process management system should be designed to deliver a quality-based process targeted at ensuring that the project's principal goals and parameters are attained. It should recognise that the definition of 'quality' will vary with the needs of each stakeholder. It should also provide sufficient creative space for the bidders to submit the most innovative proposals, in which technology, quality, schedule and costs are optimised. And it should be strict enough to allow for a transparent procedure, an undisputed evaluation of the bids and a clear contract to be concluded. The end-result should be a contract capable of delivering a project over a 20-30 year timescale yet sufficiently flexible to take advantage from future innovation.

Examples of competent DBFO procurement systems already exist. As a general rule, they are characterised by:

- The principles of the Value Based Delivery Process
- The provision of maximum transparency in selection criteria and evaluation procedures
- The engagement of technological experts of high integrity to manage not only the procurement but also the entire process.

The Netherlands - viaduct for Brussels-Amsterdam High Speed Rail Link

The transport connections between Amsterdam's Schiphol Airport and the port of Rotterdam are of great importance to the Dutch economy, as these traffic nodes represent crucial centres of commercial activity. However, increasing
road and air traffic has created massive congestion, prompting the construction of a new high-speed rail link between Amsterdam and Brussels to
relieve the situation. Consulting engineers have played an important role in this project, working closely with the Dutch Ministry of Public Works and other contractors to produce detailed designs.



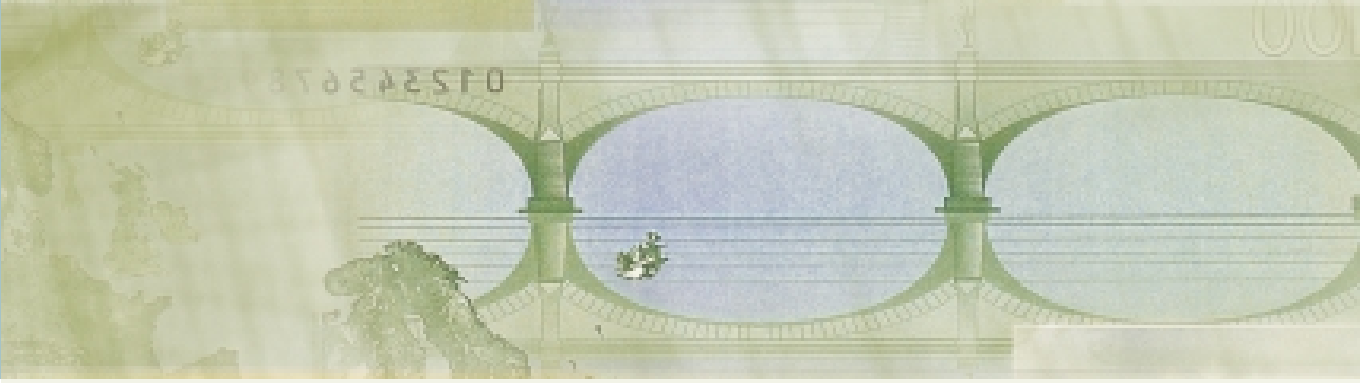
The success factors of the procurement process in DBFO projects can be summarised as follows:
• The project's financial, technical and social objectives should be clearly defined by the process manager before the start of the procurement stage.
• Bidding procedures should be appropriate to the nature of the project, and based on Whole Life Costings.
• Competition, innovation, creativity and flexibility in design, technology, management and financing should be promoted at the bidding stage, in order to exploit the effectiveness and efficiency of the private sector. However, sustainability and optimisation of added value remain the overall priorities.
• The establishment of a real-time communication/collaboration platform is imperative to provide fairness and transparency and to minimise the developing/bidding time and costs.

Principles

The four fundamental principles for a Value Based Delivery are

- To maintain **trust** and communication among all parties
- To assure **responsiveness** to the needs of all stakeholders
- To meet the Client's project **quality** objectives
- To protect the public interest by maintaining the highest degree of **integrity** throughout the process.

The Value Based Delivery Process is predicated on the notion that the consulting engineer has a unique perspective of how a project evolves from an identified need to reality, based on technical skills, understanding of design and construction, and the project's place in the end client's overall inventory.



VALUE BASED DELIVERY SYSTEM – THE 4 PRINCIPLES

Trust

The foundation of any successful relationship is trust - a complete understanding of and respect for each participant's needs, interests, concerns and goals. The only way to achieve such harmony is through open and honest communication. Any seed of doubt or suspicion has the capacity to prevent the relationship from achieving its full potential, and to limit the ability of the stakeholder partnership to remain focused on the ultimate objective.

The following tenets are essential to ensure that the project delivery method optimises levels of trust and communication:

- Recognise the responsibilities of every team member for setting project goals and providing the project's quality.
- Accept the judgement and expertise of participants who may have a greater understanding of specific factors.
- Provide for the open exchange of critical information among all participants.
- Establish a fair process of dispute resolution.
- Fully disclose any conflicts of interest, contractual relationships, and other situations that could compromise the project's goals and quality.
- Work to assure the public that the system fully addresses all quality and safety issues.
- Ensure that the legal environment encourages the testing of appropriate innovations, rather than restricting options to the accepted technologies.

Responsiveness

Trust and communication engender responsiveness. All stakeholders must have a full understanding of the factors that influence major decision-making on the project, and how these factors affect each other's needs, interests and responsibilities. While individual stakeholders may vary in knowledge, experience, resources or prestige, each has a crucial role to play in ensuring the project's success.

To achieve maximum responsiveness within the system, the following objectives should be pursued:

- Understand the processes and attributes of various project delivery methods and how they affect other stakeholders.
- Discuss behaviour patterns/restrictions of all stakeholders at the outset of the project.
- Identify and eliminate potential conflicts of interest early by ensuring that the client has sufficient design expertise, either in-house or through an independent consultant.
- Understand fully how the value based delivery process shifts responsibility and risk allocation among various stakeholders and clearly define the expectations for each.
- Fully document the client's expectations for project cost, life cycle cost, schedule and quality parameters at the outset of the project, and measure the appropriateness of every delivery method being considered for achieving them.
- Emphasise the importance of obtaining an independent knowledge base.
- Recognise the consulting engineer's responsibility to openly discuss with the other stakeholders issues related to design, cost, scheduling, quality and the public interest.

Quality

'Quality' depends on a vast range of factors, each of which may be assigned a different priority by individual stakeholders. The client must therefore establish the standard for 'quality' early in the project planning process, determining the relative value of key factors such as first costs, life-cycle costs, project schedule, innovation and scope certainty.

To achieve the requisite quality standards, the following principles should be adhered to:

- The client's quality objectives should be defined by professionally qualified in-house staff, or an independent consultant working in association with, or in place of, the client's in-house staff.
- A pre-planning process should be established to provide a baseline project scope and budget, a comparison of project delivery systems, selection of a preferred method, development of comprehensive acquisition strategy plans, and other preliminary criteria.
- A comprehensive acquisition strategy should be planned to include goals, objectives, evaluation factors, and relative weightings of the contract types, selection process/procedures, and schedule.
- Objective and reasonable comparative measurements of quality factors within each stage of the project should be adopted.
- Risks should be fairly and appropriately identified, evaluated and allocated between the client and other stakeholders.

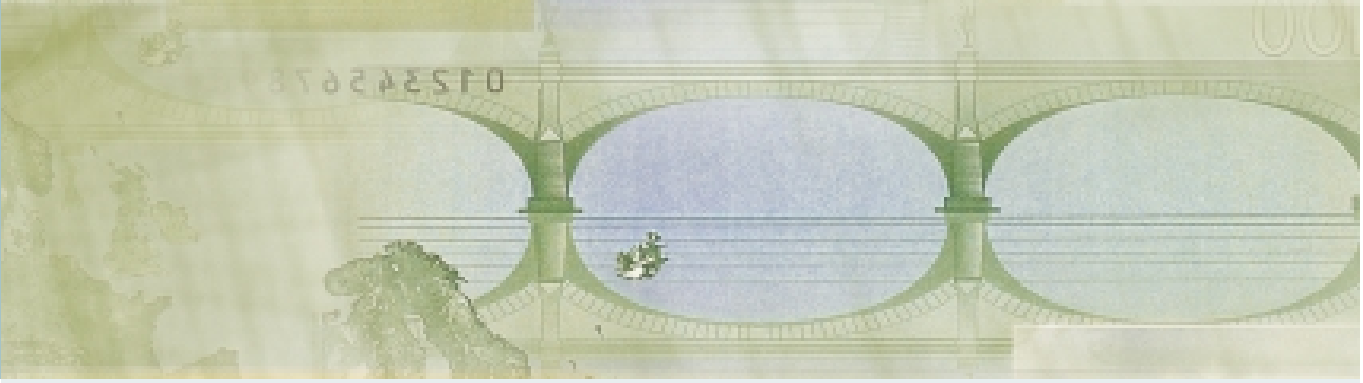
- Foreseeable risks should be identified, evaluated and assigned to specific parties and potential mitigation measures should be developed.
- It should be understood that best value construction can only be obtained with the best qualified teams who have been given a sufficiently detailed scope, preliminary drawings and the expected level of quality.
- Issues of both price and quality should be balanced carefully in the decision-making process. Price alone should never be the sole criterion.
- It should be recognised that low-bid contracts may create highly competitive conditions that work against the key objective of aligning interests toward a successful end-result.

Integrity

The emergence of multiple project delivery systems has changed the organisation, roles and relationship between the end-client, the consulting engineer, contractor and other stakeholders. The level of service will vary according to the consulting engineer's role on the project team, but the quality of the work should never fall short of the profession's standard for quality, nor its responsibility to protect the public's health, safety and welfare. Consulting engineers have a duty to use their professional skills to balance the financial and commercial needs of the client against the legal and ethical standards that are a prerequisite of their professional status.

In order to keep this balance, the following tenets should be observed:

- Provide a clear understanding of what documentation will be required at any given stage, and provide forums for open discussion and constructive feedback.
- Clearly define the role and responsibility of the consulting engineer, which is to provide design documents based on knowledge and experience which is acceptable to client's needs, while remaining within the industry's legal and ethical bounds.
- As a team member, the consulting engineer must recognise that his/her design approach will vary from method to method, and must adopt a 'design to budget, to schedule, to objectives' mentality.
- Consulting engineers, particularly those serving as the client's adviser or representative, should be selected according to appropriate qualifications-based criteria.
- The client should agree contractually to respect the consulting engineer's obligation to protect the public health, safety and welfare and to co-operate with ensuring such compliance.
- Exercise due diligence that compares new technology, material, or timesaving procedure to the standard of care for similar projects.
- Respect and fulfil all contractual terms and conditions and performance standards as negotiated by the project team.
- Consulting engineers must understand that, in dispute resolution, they are part of the project team and, therefore, part of the proposals for solution.
- Only consulting engineers should be permitted to undertake the project design.
- A consulting engineer cannot be the representative of the owner or public while part of the DBFO team.



Key phases

A Value Based Delivery Process begins when the client, with appropriate professional design advice, publishes an explanation of what is required. From this, a plan to achieve the objective can be drawn up, and an optimal delivery method can be assigned to each element in the plan. Each delivery method requires its own appropriate procurement process, but generally the steps can be grouped under five key phases.

- Pre-qualification
- Invitation to tender
- Negotiations with preferred bidders
- Signing of the contract(s)
- Financial closing

Because DBFO projects vary greatly in terms of their magnitude and complexity, it would not be appropriate to recommend strict dates for the duration of different phases. However, we do recommend that all phases should be kept as short as reasonably possible and that special efforts should be made to achieve a concentrated procurement process.

Controlling the results

The client's main responsibility during the implementation and operation phase is to make sure that the end-result achieves the user’s best interest and fulfils the contracts.

The assignment of a controlling body responsible for the implementation of the contract principles and for safeguarding the end users' interests in the project is a vital part of the procurement process. Ultimately, these are the most important stakeholders in infrastructure projects.

Responsibility for ensuring that the project is successfully concluded in a manner that achieves optimum sustainability throughout its life cycle is a typical task for consulting engineers.

VALUE BASED DELIVERY SYSTEM – THE KEY PHASES

Pre-qualification
This phase requires the client to issue a clear description of the project, its principles and objectives, the legal situation, risk allocation, building permits, land acquisition, equity available from the client's side, technical definitions and constraints, and – very importantly – clear and transparent criteria for short-listing.

The process should be firmly managed from the start. Up-front definitions which are insufficient for bidding or which prove to be wrong or inconsistent with later developments are a major problem in DBFO projects.

The bidders should provide a full description of their team, their financial and legal partners, and comprehensive documentation of relevant competencies. They should also clearly nominate their Leading Partner who is not permitted to change during the construction process.

Invitation to tender and bidding
The quality of the process management starts to come through in this stage. It is also the last opportunity for the client to re-organise the whole process if the results of the bidding do not meet expectations. Failure to comprehend the process and entering into negotiations without a clear understanding of the details will jeopardise the success of the project. Although it sounds relatively simple, this principle is often not followed. Frequently mistakes made at this stage become magnified as the project continues.

Negotiations with preferred bidders
One of the most important tasks of process management during this competitive phase is to preserve the basis of trust between possible future partners. It is also essential to bear in mind that the quality of private financing projects is largely determined by the pre-award efforts of the bidders.

Bidders frustrated by the quality of the process will either not contribute up to their full potential next time or find other means of competition that do not serve the project's long-term goals of private financing. Limiting finalists to a minimum of three or five and paying unsuccessful bidders some proportion of their bidding costs not only demonstrates an appreciation of the efforts made and resources employed but also sends out a clear signal about the level of effort the sponsor expects from finalist bidders.

Signing of the contract and financial closing
The contract should be as short and as clear as possible. It is better to begin from fair principles and rely on balanced partnering to solve any subsequent differences of opinion which may arise due to unforeseen circumstances. Provided that all previous phases have been properly managed, it should be possible to achieve the contractual agreement and financial closing expeditiously.

CHAPTER 6 | RISK MANAGEMENT

Preparing and concluding contracts for a term of 20 or 30 years involves high risks which, in principle, are shared between the client and the concessionaire or contractor.

The first rule of risk management is to avoid and minimise them. In a large-scale construction project, this is the natural task of consulting engineers. They have the technical knowledge and the experience required to understand the dynamics of the project throughout its entire lifecycle, and are therefore in a position to determine precisely where, when and to what degree risk is present.

Even the best-designed DBFO projects contain many risks. To manage these risks effectively, it is necessary to allocate them to those parties who are best positioned to deal with them, according to their role in the project team and their commercial/legal status. Transferring risks 'to the other side' – to a party who is not logically suitable for accepting them – is usually the most expensive way in the long run. Either it costs too much or it ends up with disputes as soon as the risks become realities.

The duty to seek out insurance cover lies primarily with the party who has been nominated to accept the risk. However, it is possible that joint insurance packages for several or all project stakeholders may secure a better deal in the market.

In an integrated project procurement scenario, the role of the consulting engineer is significantly different from that which applies in a traditional framework. From being trusted advisers, they become contract-focused engineering contractors, involving themselves in the optimisation of the entire project cycle. They take responsibility for negotiating contractual relationships with other suppliers, and assume a risk profile that is potentially higher than would be considered normal in a conventional situation. The consulting engineer's primary objective is to add maximum value to the project by ensuring that core competencies are deployed effectively. This is balanced against a duty to reject risks that are not manageable or quantifiable within the timescale or are not fairly compensated. Whether riskier roles should be accepted depends on the nature and strength of the core competencies available and on whether a better ratio between premiums and risks can be obtained.

Yamula Dam, Turkey

Consulting engineers have played an important role during the feasibility study for the construction of a dam and associated hydro-electric generating facilities in Central Anatolia. The project, which involves 6 million cubic metres of rockfill, will be built under a Build/Operate/Transfer contract, with various alternatives of operation period and financing scenarios. Consulting engineers prepared final design and tender documents with a view to minimising construction costs, optimising the construction period and carrying out the works under FIDIC-type of contracts.

Liabilities per project function should be segregated as much as possible. Individual liabilities should be related to the added value that can be potentially accrued. The soundness of the financial position of partners and sub-contractors should be ascertained in advance. Premiums should be commensurate with the risks they relate to, and should be checked against prevailing market rates.

Risk awareness should be raised and maintained at an appropriate level. Upfront risk awareness and contract-driven attitudes are essential ingredients of the DBFO approach. Where applicable, these need to be developed and/or sharpened, corporate cultures need to be adapted, and a more energetic and direct attitude taken to structural risk assessment and management. It is also important to adopt a corporate risk policy for major projects, to commit management staff to the task, and to make risk information an integral element within the decision-making process.

CHAPTER 7 | KEY PERFORMANCE INDICATORS

FIDIC and EFCA believe that to fully benefit from modern project financing and procurement concepts, project delivery needs to be based on output-based procurement rather than on cost-prescriptive procurement. Within the European Union, the UK has shown the lead in adopting this approach.

A considerable amount of work has been undertaken to establish Key Performance Indicators (KPI) for the construction industry. These KPIs primarily address the construction of the completed project and have been specified for a number of project types:

- New-build housing – public
- New-build housing – private
- New-build non-housing – public
- New-build non-housing – private
- Infrastructure
- Repair, maintenance and refurbishment
- and an 'all construction' category.

Within each of the project types, the indicators against which the project has to be measured are:

- Client satisfaction – product
- Client satisfaction – service
- Defects
- Safety
- Construction time
- Construction cost
- Productivity
- Profitability
- Predictability – cost
- Predictability – time

Each indicator is provided with a benchmark against which the assessment can be made.

KPIs and DBFO procurement strategies

With the advent of DBFO procurement strategies, particular KPIs should be considered for each specific contract. These need to address both the construction element and the concession agreement. The central difficulty with standardising KPIs for such procurement strategies is the sheer diversity of the projects which are procured in this way.

Consider two typical projects:

a) A PFI hospital constructed under a straightforward design-and-build contract, but which also contains a concession agreement encompassing all non-medical services such as cleaning, laundering, building maintenance and equipment. The concession agreement revenue can be dependent either on patient throughput or on an annual contract.

b) A road built under a BOOT (build, own, operate, transfer) contract where the construction costs and concession agreement could be paid for either through toll charging or a road maintenance contract.

In the first example, the contractor, during the construction phase, can only guess at the revenue likely to be generated through the concession agreement. In the second example, however, the contractor can benefit in the concession agreement from life cycle assessments during the design phase, but takes the financial risk of toll revenue.

From a client perspective, KPIs such as defects may not be significant until or unless they are so extensive as to have an adverse effect on commercial or operational objectives, whereas if the client was also the operator, the KPI would be significant.

Ultimately, it is the performance of the concession agreement which will be critical to the client and to measuring the project's overall value for money. Accordingly, the service standard targets should be clearly stated within the contract and the concession agreement, so that they can act as a mechanism for gauging the contractor's reward.

KPIs must reflect these criteria and each will be dependent on the shared objectives of the client and the contractor:

- value for money
- predictability of costs
- predictability of time
- service level standards.

In comparing the contractors' bids for the project, clients should consider the following aspects in relation to KPIs:

- innovation
- previous track record
- value for money
- predictability
- service levels achieved.

Similarly, contractors should be considering the following in terms of KPIs:

- profit/value for money
- risk exposure
- certainty of costs
- certainty of time

In conclusion, there are currently three different types of Key Performance Indicators:

- Those by which a client wishes to judge its consultants, contractors or concessionaires.
- Those by which a consultant, contractor or concessionaire wishes to be judged against its peers.
- Those by which a consultant, contractor or concessionaire wishes to measure its own performance.

Some indicators will be common to all three, others will apply to one only. However, since we all rely on satisfied clients for future work, client satisfaction must take precedence over the other indicators which would otherwise be meaningless in the absence of such appointments.

CHAPTER 8 | PRINCIPAL ROLES OF CONSULTING ENGINEERS IN DBFO PROJECTS

It is almost impossible to think of any other investment project in which some many vital decisions have to be taken so early. The concession contract lays down the terms, conditions and roles that will govern a design, construction and maintenance operation that may last for up to 30 years. So it is essential to ensure that the foundations are properly laid. Much of the burden of making technical projects sustainable rests on the shoulders of the consulting engineers, whose professional skills and expertise give them the ability to make informed decisions on a wide range of strategically important issues.

They may undertake this work in one of three separate roles:

- as **independent advisers** to one of the main stakeholders
- as members of a **Special Purpose Team** formed by the private promoters
- or as **project leaders**.

As Independent Advisers ...

When a DBFO project is being prepared, consulting engineers may be appointed as independent advisers to the public authority, to help establish a framework for the project finance and to set out the regulatory and legislative constraints within which the project will be conducted.

The public authority frequently retains consulting engineers as independent advisers to conduct the technical and demand studies that shape the project and determine the requirements in terms of quality of service. The environmental assessment carried out by consulting engineers is central to the achievement of sustainability.

Consulting engineers may also help to create clear procedures for bid submission, public bid opening, transparent bid evaluation criteria and basic contractual documents for the negotiation stage.

China - wastewater treatment plant

Under a joint venture, DHV Water and Degrement of Holland has completed a turnkey contract for the China Hainan Trade Corporation to design and build a 300,000 m3/day wastewater treatment plant in Sichuan Province. The project scope included process design, engineering works, procurement and installation of mechanical and electrical equipment, supply and installation of instrumentation and process control equipment, project management, supervision, and commissioning.

After preparing and managing the procurement process for the client, consulting engineers may also play a role as controlling agent, representing their client's interests in the design, construction and operation phase.

As members of a Special Purpose Team …

The development of a DBFO project is based on a particular procurement procedure, which allows private sector participants to introduce into their bids specific expertise and innovations which may be advantageous to the operation of the project. For that purpose, multi-disciplinary groups are combined to form a Special Purpose Team (SPT). The role of the consulting engineer is to develop competitive ideas and to prepare the engineering detail in a programme composed of the following stages and tasks:

Tender stage

This stage involves:

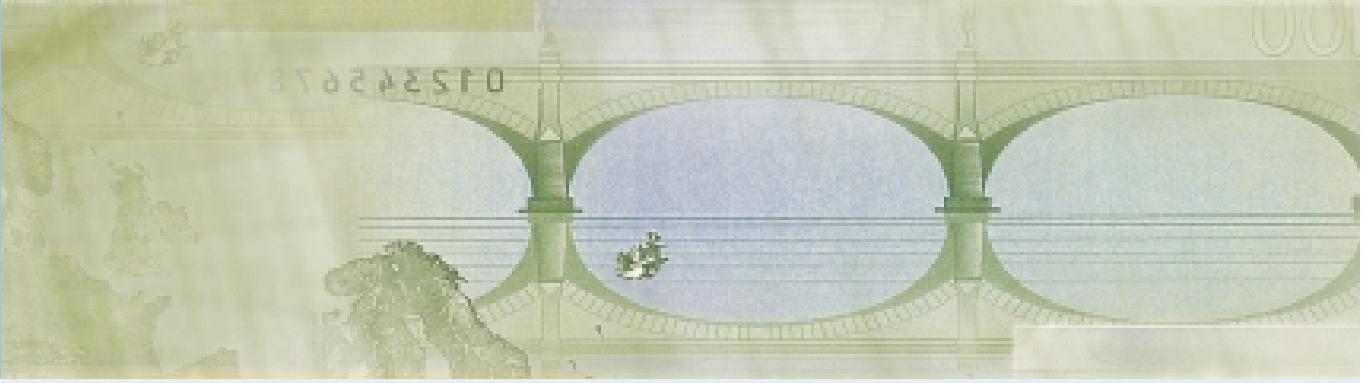
- A review of the tender documents
- Analysis of the risk involved in the business equation.
- Development of technical feasibility studies for new works and inventory of existing infrastructures when a transfer process is included
- Development of alternative technological solutions, innovation, sustainability elements and whole life cost saving aspects as the competitive edges for the SPT´s proposal
- Definition of the maintenance and operation programmes
- Estimation of all construction, operation and maintenance costs
- Provision of assistance to funding institutions by auditing the cost evaluations made by designers
- Provision of assistance at negotiations until financial closing is reached and concession agreement signed.

Design/construction stage

When the financial closing and the concession contract are agreed, consulting engineers are responsible for undertaking detailed design, supervision services, construction management, cost control and audit on behalf of funding institutions within the SPT.

Operation and maintenance stage

When the new facility starts operations, consulting engineers are responsible for designing new additions or refurbishing existing works during concession period. They may also be involved in the management of the facilities, in the role of advisers to the concessionaire.



As Project Leaders …

There is no doubt that the early stages of a project are critical to its long-term success, and it is at this stage that consulting engineers can make a vital contribution. Among the strategic questions that require hard answers are:

- Should the public authority bear the full weight of responsibility for the project until a concessionaire takes over once the facility is commissioned?

- Are the project developers, bidders and investors responsible for identifying the business opportunity and driving the project forward until the concession agreement is concluded?

- Should a DBFO project be driven by the interaction of the public authority's requirements and market forces? Or should it be strictly controlled? Are the same procedures appropriate for different projects, countries, jurisdictions? Or should they be tailored to individual circumstances?

Project continuity

The three separate roles presented here do not preclude the possibility of a consulting engineer fulfilling more than one. Under the concept of 'novation', an engineer who has previously fulfilled the role of Independent Adviser may be re-assigned by the owner to the Special Purpose Team or as Project Leader to preserve and cascade his or her knowledge of the project's previous development and its goals. Under these circumstances, the owner would then appoint another engineer to take over as Independent Adviser.

In conclusion ...

For project financing to move forwards to meet the changing demands of society, stakeholders must work together to achieve sustainable solutions. These solutions involve a range of tools dealing with technological innovation, risk management, whole life costing and benchmarking, all of which are to be found in the consulting engineering industry. It is self-evident that their management should be entrusted to those who best understand how these factors interrelate – consulting engineers.

Their responsibilities start with a clear definition of what is required and a process framework that is appropriate for the project. They can continue to contribute expert advice until financial closing is reached, on fair terms within a reasonable timeframe and at reasonable costs and risks.

By giving consulting engineers the leading role, the stakeholders are entrusting the project direction to professionals who are focused on the factors that genuinely determine success. These factors prepare the grounds on which multi-disciplinary teams can devise sophisticated contracts and refined financing schemes.

To optimise a project and create a win-win situation requires knowledge, strength and fair unbiased management during the development and procurement phases. With such a strong foundation, the DBFO management can ensure that the overall quality of the project meets the expectations of all stakeholders, makes proper use of market mechanisms for procurement, and is ultimately acceptable to the public.

Such a management structure is in the best interests of all project stakeholders. The terms and remuneration schemes must be clearly spelled out from the start. Consulting engineers are quite prepared to accept their share of the risks and responsibilities in DBFO projects, provided that they are given a share of the profit that is proportional to those risks and responsibilities.

Manzanillo International Terminal, Canal Zone, Panama

Manzanillo International Terminals (MIT) is located near the Panama Canal's Caribbean entrance. The privately financed, built, owned and operated container terminal is the largest in Latin America. Through careful planning, innovative design and fast-tracked construction programming, the consulting engineers overcame challenges of poor soils, difficult working conditions and fast-growing business requirements.

A list of further reading matter on related topics can be found on the European Federation of Engineering Consultancy Associations website - www.efcanet.org

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