THE ENGINEER IS DEAD. LONG LIVE THE ENGINEER!

Dr Donald Charrett, Barrister, Arbitrator and Mediator

Owen Dixon Chambers East, Melbourne

ABSTRACT

Traditionally, the engineer 'wore many hats' in connection with a construction project—as promoter, designer, project manager, contract administrator, certifier, adjudicator and sometimes even arbitrator. A number of those functions were fulfilled as 'the engineer' under a construction contract, in which the engineer, although engaged by the employer, was expected to act independently of both contract parties in his/her administration of the contract. It is apparent that that role is largely defunct under many modern construction contracts.

The changing role of the engineer is illustrated by reference to case law and modern construction contracts. Examples are given of major problems which have arisen from an inappropriate contractual role for the Engineer resulting from inadequate definition, execution and coordination of the various engineering functions. It is suggested that, notwithstanding the changed role of the engineer, the definition and proper execution of these functions are as important to the successful outcome of projects as ever.

INTRODUCTION

Traditionally, the engineer 'wore many hats' in connection with a construction project—as promoter, designer, project manager, contract administrator, certifier, adjudicator and sometimes even arbitrator. A number of those functions were fulfilled as 'the engineer' under a construction contract, in which the engineer, although engaged by the employer, was expected to act independently of both contract parties in his/her administration of the contract.

It is apparent that that role is largely defunct under many modern construction contracts (e.g. ICE, FIDIC, NEC), as it is perceived (at least to the authors of many standard form construction contracts) that it is no longer possible for one individual/entity to satisfactorily discharge the manifold responsibilities implicit in the traditional independent engineer (or architect) role.

The paper uses several case studies to illustrate major problems which have arisen from an inappropriate role for the engineer resulting from inadequate definition, execution and coordination of the various engineering functions. It is suggested that definition and proper execution of these functions are as important to the successful outcome of projects as ever. Splitting the roles between different people is not necessarily an improvement because of the higher cost and increased time to resolve issues.

WHAT IS THE ROLE OF THE ENGINEER?

There are a number of roles fulfilled by an engineer in connection with a major construction project. The role of a particular engineer includes one or more of the following:

1. Promoting the functional and technical aspects of the project to potential project sponsors/ financiers/regulatory authorities.

2. Advising the employer at the concept stage of a project on possible options for project delivery, including suitable design and construction concepts, cost estimates and project procurement options (including appropriate forms of contract).

3. Calling tenders on the behalf of the employer.

4. Assessment of contractors' proposals and advising the employer on the most appropriate contractor to be contracted to execute the works.

5. Preparation of preliminary designs to refine concepts and enable more realistic cost estimates to be determined.

6. Preparation of design documentation in sufficient detail to enable contractors to determine appropriate construction methods and prepare accurate tenders for the construction costs.

7. Project managing the project on behalf of the employer, including monitoring progress, reporting on the contractor's achievement of contractual time, cost and quality obligations.

8. Preparation of 'for construction' drawings and documentation.

9. Technical review and inspection of the contractor 's work, including assessment as to whether the contractor's fabrication and erection methods will have any adverse impact on the suitability of the as constructed design to fulfil its purpose in accordance with the design assumptions.

10. Administering the construction contract on behalf of the employer, including an assessment of the contractor's compliance with the contractual requirements, and taking proactive steps to foresee and manage risks so that the contractor achieves the requirements of the contract.

11. Issuing instructions to the contractor on behalf of the employer, particularly with respect to variations.

12. Assessing the contractor's claims for time and money and certifying the contractor's progress to enable the employer to make progress payments as required by the construction contract.

13. Adjudication of contractual disputes between the contractor and employer.

In this paper the term engineer is used for the person/ entity providing one or more 'engineering' (including project management) services in relation to one or more aspects of a construction project, such obligations being defined under the engineer's contract with the employer. The term engineer is used for the person(s)/ entity who not only fulfils the contract administration role of the engineer (or architect or superintendent) under a construction contract, but also other roles of the engineer. In the sense used in this paper, the 'traditional' engineer usually fulfilled all the roles of both engineer and engineer.

England's most famous 19th–century engineer (and on one assessment its second most famous person[1]), IK Brunel, epitomised the traditional engineer. He nurtured a wide range of groundbreaking and visionary projects from conception through design to execution by contractors whose contracts he administered and adjudicated upon. However, as discussed below, he was not necessarily independent and impartial.

It is apparent that 1–6 above are functions carried out before the contract between employer and contractor (the contract) is entered into. Functions 7, 8 and 9 are essentially separate to any role involving the administration of the contract. In carrying out these functions, the engineer is undoubtedly acting as the agent of the employer (even if not in strict legal sense). Functions 10–12 are those involved in contract administration, whereas 13 is a dispute resolution role.

The question then arises as to whether the engineer acts as the employer's agent in carrying out all of these functions, or whether s/he has an independent and impartial role in carrying out some functions. These functions comprising the role of the engineer are categorised in the table in the Annexure.

THE ENGINEER'S HISTORICAL ROLE

The role of the engineer in any construction project is determined by the terms of the relevant contracts. As between employer and contractor, the terms of the construction contract are determinative. As between employer and engineer, the terms of the engineer's retainer (contract) are determinative. Thus, after the contract is executed, the engineer's contract may cover functions 7–13 above, whereas the construction contract will be confined to the contract administration and dispute resolution functions 10–13 only. Any conflict between the engineer's role as defined in the two contracts will almost inevitably give rise to difficulties.

A properly drawn up construction contract will define the contract administration role(s) of the engineer somewhere on a spectrum between acting as agent of the employer in all matters, and acting independently of the employer in relation to matters of time cost and quality under the contract. The following two cases illustrate each end of the spectrum.

In *Ranger v Great Western Railway Co*[2] the engineer (Brunel) was, in effect, the alter ego of the employer:

But here the whole tenor of the contract shows it was never intended that the engineer should be indifferent between the parties. When it is stipulated

that certain questions shall be decided by the engineer appointed by the Company, that is, in fact, a stipulation that they shall be decided by the Company. It is obvious that there never was any intention of leaving to third persons the decisions of questions arising during the progress of the works. The Company reserved the decision to itself, acting however, as from the nature of things it must act, by an agent, and that agent was, for this purpose, the engineer. His decisions were, in fact, those of the Company. The contract did not hold out, or pretend to hold out, to the Appellant [Contractor], that he was look to the engineer in any other character than as the impersonation of the Company: in fact, the contract treats his act and the acts of the Company, for many purposes, as equivalent, or rather identical. I am therefore of opinion that the principle on which the doctrine as to a judge rests, wholly fails in its application to this case. The Company's engineer was not intended to be an impartial judge, but the organ of one of the contracting parties. The Respondents [Company] stipulated that the engineer for the time being, whoever he might be, should be the person to decide disputes pending the progress of the works, and the Appellant [Contractor], by assenting to that stipulation, put it out of his power to object on the ground of what has been called the unindifferency of the person on whose decision he agreed to be bound.[3]

By contrast, in *In re De Morgan, Snell & Co. and Rio De Janeiro Flour Milling Co.*,[4] the chief engineer and the resident engineer (appointed by the chief engineer) were found to be independent of the employer:

I am clear that the resident engineer is not the servant of the company; that he stands in a position quite distinct from and different from that of a servant; that he is a person who has been selected by the chief engineer, and the chief engineer himself has been selected by the contracting parties, and in the event of any vacancy in the chief engineer's office it is to be filled up by consent, or by an independent appointment, and in the event of any vacancy in the resident engineers appointment that is to be filled up by the chief engineer. So that the appointment of the resident engineer is not the appointment of the company, and he is not in any sense a servant of the company. He stands in a position of much greater independence. He is a person who owes duties alike to the company and to the contractor; he is a person who is bound to be independent alike of the one and the other; he is a person who is bound to act impartially between the two contracting parties; therefore there is an entire misapprehension of the true view of the position of the resident engineer in the view which was taken by the arbitrator. ...

... a misconception of the position of the engineer, analogous to the misconception that the arbitrator entertained with regard to the position of the resident engineer. He has not perceived the position which the chief engineer, as well as the resident engineer, may maintain. He is, in fact, not a servant of the company, but a person who has to do his duty between the two contracting parties.[5]

In contracts where the engineer had autocratic control over the work and the power to issue final and binding determinations, he was generally regarded as independent of both contracting parties:

The engineer is not, with reference to any difficulties that arise under a contract of this sort, the agent of his employers. He was not the agent of his employers in this case. He occupied a position of quasi–arbitrator, and even if he honestly made mistakes in the course of the discharge of his duty, it is perfectly clear that neither party to the contract could complain of that. It was his duty to do his best to act fairly between the parties, and as long as he acted in good faith his decision, in a case of this sort, would be final, and for any blunder, if any blunders were proved, neither party could claim that he had done wrong or made the other contracting party responsible.[6]

In that case, the engineer had a unilateral right to approve work and make a final adjudication on disputes, contained in the following clause of the contract:

It is to be distinctly understood that the specification is to receive its strict literal interpretation, and that the works are in all respects to be carried out in accordance with it and the drawings, to the satisfaction of the engineer: but it is hereby provided that in case any dispute, question or difference arises as to the value of any particular work not clearly stated in the bill or schedules, or with regard to any other matter or thing connected with the contract, such dispute, question or difference shall be decided by the engineer, whose decision and award shall be final and binding upon all partie'.[7]

Such a contract clause effectively made the engineer the judge in his own cause, since any dispute on the meaning of any of the contract documents would relate to documents prepared by the engineer, such as the drawings and specification. It is unsurprising that the courts

would see the potential for conflict of interest, and apply very strict standards of behaviour to an engineer with such power.[8] In *Mackintosh v Great Western Railway Company*, the contractual implications of an engineer (Brunel) who did not act impartially were put forcefully by Lord Cranworth:

To apply these observations [in Ranger v Great Western Railway Co [1854] 10 ER 824, 831 on the duties of the engineer] on a question as to the consequences of an erroneous or unjust certificate would be absurd. If the engineer is to be considered as the mere organ of the employer, as a partisan and not an impartial judge—as one who had a right, as he had an absolute power, to make his measurements partial, and in such a way as to serve the interests of the employer whose organ he was—the whole scope and purpose of the contract is violated.[9]

It is worth noting that Brunel, whilst unquestionably a brilliant engineer, had severe shortcomings as the engineer, well illustrated by the case of *Mackintosh v Great Western Railway Company*, finally resolved in 1864, after Brunel's death in 1859. Mackintosh was the contractor who took over several contracts when William Ranger became bankrupt after Brunel [the organ of the employer] withheld payments. Mackintosh experienced the engineer at his worst: Brunel imposed his own interpretations on the wording of contracts, always to the contractor's detriment; he insisted on quality in excess of that required by the contract; he failed to ensure that the site was made available to the eontractor on time, and withheld payments time and again on a variety of pretexts.

Mackintosh's case dragged through the courts for over 20 years before the House of Lords finally awarded the contractor £100,000 with 20 years accrued interest and all costs.[10]

THE ENGINEER AS AGENT OF THE EMPLOYER

In the absence of clear words in the contract to the contrary, the engineer is required to discharge his/her decision–making functions fairly, impartially and honestly (and arguably, reasonably), even if directly employed by the employer. This position was summed up by McFarlan J in the case of *Perini Corporation v Commonwealth of Australia*[11] as follows: 'the cases make plain that throughout the period of performance of all these duties, the senior officer [engineer] remains an employee of the government or semi–government body [employer], but that in addition and while he continues as such an employee he becomes vested with duties which oblige him to act fairly and justly and with skill to both parties to the contract'.[12]

Thus, whilst the engineer is the agent of the employer in many of his/her roles, s/he remains obliged to act in respect of decision–making functions in a manner which is independent, impartial, fair and honest. Judges have used a variety of other words to express the obligations of the engineer, including: 'independence and impartiality',[13] 'act in a fair and unbiased manner' and 'reach such decisions fairly, holding the balance between his client and the contractor';[14] 'he must be fair and he must be honest' and 'impartially and fairly';[15] 'honestly and impartially';[16] 'fairly, impartially and in accordance with the powers given to him by the conditions'[17] and 'to hold the balance fairly as between employer and contractor'.[18]

The requirement of impartiality in the engineer's decision–making functions would require very plain words in the contract to negate it. For example, even in the case of an engineer's contract that specifically provided that the engineer was the agent of the employer in 'all matters relating to the design and construction of the project', the court found that in exercising his certifying functions under the construction contract, the engineer was required to act honestly and impartially and was not acting as the employer's agent in the strict legal sense.[19] The court also found, controversially,[20] that the superintendent's power to extend time was capable of being exercised in the interests both of the employer and the contractor (even after the contract had come to an end), and the superintendent was obliged to act honestly and impartially in deciding whether to exercise this power.[21]

The distinction between the obligations of the engineer as the employer's agent and that of the 'traditional' independent engineer in respect of the decision–making functions may be more apparent than real. Arguably, in cases where the contract specifically makes the engineer the agent of the employer, s/he may only be required to act honestly, not necessarily fairly or reasonably. However, even in cases that have considered the engineer's role as the employer's agent, the courts have used very similar words to those that have been applied to the obligations of the engineer. In a contract in which there was no engineer, the court found that the power of the employer to value variations 'in its sole discretion' was to be exercised 'honestly, bona fide, and reasonably'.[22]

In the *Peninsula Balmain Pty Ltd v Abigroup Contractors Pty Ltd* case referred to above,

Hodgson JA found that the project manager, acting as agent of the employer, was still required to exercise its certifying functions honestly and impartially. And in a case where the employer's representative took the place of the engineer in the ICE Conditions of Contract, the court nevertheless found that the employer was bound to act honestly, fairly and reasonably in arriving at its judgment, even where no such obligation was expressed in the contract.[23]

MODERN CONTRACTUAL PROVISIONS ON THE ENGINEER

The FIDIC Contracts[24] and the ICE Contract[25] are typical of the modern contractual approach to the engineer's role. The FIDIC Contracts' provision that the engineer 'shall be deemed to act for the employer' unless otherwise stated is explicit acknowledgement of the role of the engineer as agent of the employer. Of the many references to the engineer's function, the only vestige of the traditional evenhanded role as between employer and contractor is the requirement relating to determinations. in which the engineer is required to consult with each party in an endeavour to reach agreement. If agreement cannot be achieved, 'theengineer shall make a fair determination in accordance with the contract, taking due regard of all relevant circumstances'.[26]

The standard form contract for civil engineering government work in Hong Kong make it clear that the engineer is the agent of the employer in all matters, who is subject to the directions of the employer:

(a) The engineer shall carry out the duties and may exercise the powers specified in or necessarily to be implied from the contract.

(b) Before carrying out any such duty or exercising any such power, the engineer may be required under the terms of his appointment by the employer to obtain confirmation that the employer has no objection to the engineer's proposed course of action and, in the event of an objection, to act in accordance with the employer's direction. If the engineer is subject to any such requirements, particulars thereof shall be set out in the Appendix to the Form of Tender'.[27]

Some standard form contracts still do not explicitly state whether the engineer retains his/her traditional 'independent' role, or acts as agent of the employer. For example, current Australian standards include the following provision:

The principal shall ensure that at all times there is a superintendent, and that the superintendent fulfils all aspects of the role and functions reasonably and in good faith.[28]

A contract still widely used by State Governments in Australia contains the following 'neutral' definition of the role of the superintendent:

The work under the contract shall be executed in accordance with the contract and in accordance with any directions of the superintendent pursuant to the provisions of the contract.[29]

It is interesting to note that in this form of contract, the superintendent retains his/her 'traditional' role of first tier dispute adjudicator, to make the first decision on any dispute or difference raised by the contractor.[30]

By contrast, the FIDIC Contracts now provide for the first tier of dispute adjudication to be by means of an independent Dispute Adjudication Board.[31]

THE ENGINEER IS DEAD

Signs of the traditional engineer's terminal illness have been apparent for a considerable time. It is suggested that the following are some of the harbingers of his/her demise:

- the rise of project managers as a 'new' profession, distinct from engineering;
- the fragmentation of the engineer's design role into a number of 'packages', procured separately;
- selection of engineers based on competitive fee bidding;
- reduced engineer's fees as a consequence of competitive bidding, leading to reduced scope of work in the assessment of alternative concepts, less checking and reduced professional skills;
- increasing use of sophisticated computer programs for analysis, design and drafting, leading to a perception that engineering is being de–skilled;
- a competitive culture that finds it difficult to distinguish price from value;
- the rise in the influence of banks over project funding, and their desire for 'certainty' in project costs;
- the declining influence of engineers at the highest levels of government and private enterprise (at least in Western countries), and the increasing influence of accountants and financiers;
- a rise in litigation against engineer's negligence, both in respect of their design role as well as their contract administration role;
- reduced input from the design engineers at the fabrication/construction stage, often as a consequence of design and construct procurement in which

the contractor client wishes to minimise the cost of external consultants;

• changes in forms of contract which make the engineer the employer's agent in all matters;

• the rise of alternative forms of project procurement that do not require an engineer in the traditional sense, e.g. construction management.

Whether there is substance in many of these factors is very arguable. However, the importance of an appropriate role for engineers in project delivery is unarguable.

The consequences of inadequate involvement of the design engineers at the fabrication/ construction stage are illustrated by the disastrous outcomes arising from the failure of the Quebec Bridge during construction in 1907,[32] and the failure in service of Kings Bridge in Melbourne in 1965,[33] where the consulting engineers had a very limited role during fabrication and erection. These projects can be contrasted with the successful outcome of Sydney Harbour Bridge in 1932, where the design consulting engineer had an ongoing role in relation to fabrication and erection.[34]

The collapse in service of the New World hotel in Singapore in 1986 is a further graphic example of the impact of poor engineering, inadequate checking and a disconnect between the design and construction.[35] Following this tragedy, which killed 33 people and injured many more, the Singapore Government legislated to ensure that building designs were independently checked and every project has an engineer of record who has responsibility not only to ensure that the design is correct, but that the works are built in accordance with the design.

The collapse of the Heathrow Express tunnel at Heathrow airport in 1994 was directly linked to inappropriate contractual arrangements which precluded the design engineers from carrying out their appropriate functions. The cost of the failure of a project with a tender price of £60m was £440m, with the Contractor and specialist design consultant fined substantial sums for breaches of health and safety legislation.[36] Although the failure clearly had immediate 'technical' causes, Muir Wood suggests that the underlying causes of the collapse were the following contractual issues:

• An unfamiliar system of project management based on the NEC Contract was adopted 'without thought for the special measures necessary to ensure that the responsibilities placed on the contractor were fully specified, recognized and implemented'.

• Cost pressures on the specialist tunnel design consultant at tender time resulted in insufficient resources to provide even minimal control of the work, and it did not have appropriate powers of control over the construction.

• The system of Corrective Action Requests and System Defect Notices did not ensure full compliance with the requirements of design, nor did it lead to investigation of the extent of hidden defects of the section already built whilst these could still have been corrected.

• There was no contractual requirement on the contractor to investigate any suspected defect. In the event that it rebutted any quality concern expressed by the project management group, a major 'compensation event' would arise under the NEC contract.[37]

Both the Institution of Civil Engineers (ICE) and the

The lessons from past project failures emphasise the importance of retaining appropriate engineering input at all stages of a project, and ensuring that the contractual arrangements promote and do not inhibit or prevent appropriate communication of that input to all relevant contracting parties.

Federation of International Consulting Engineers (FIDIC) have apparently been overwhelmed by the realities of the current competitive and cost conscious environment and the sometimes irresistible pressures on an employed engineer, and have conceded the death of the independent engineer. This is not to say that the new 'engineer' does not have obligations to exercise her/his contract administration obligations in a reasonable and fair manner, however it is clear that the wording in many if not most current standard form contracts puts the engineer unequivocally in the position of representing the employer in all matters.

In government and aid funded major infrastructure projects around the world, the procurement authority is generally a government department. In many countries the majority of civil engineers have been employed by government, with limited capability available in the private sector. In these circumstances, it is unsurprising that the engineer administering a major construction contract has usually been a government employee, responsible not only for ensuring that the project is built on time and to the required quality, but also within the budget and available finance. For a government employee, future career promotion, continuing employment and even a retirement pension might well be contingent on the successful delivery of projects within budget. In such circumstances, it is perhaps asking too much of human nature to expect an engineer to fearlessly assert his/her independence as the engineer holding the balance between his/her own employer and the contractor, and rule against the employer in a disputed claim under the contract.

LONG LIVE THE ENGINEER!

The morphing of the traditional independent engineer into the engineer as agent of the employer is not yet universal, as there are still some standard form contracts in use which retain the engineer's evenhanded role between employer and contractor. However, it is suggested that these are now in the minority. There are pragmatic reasons to recognise the reality that it may be very difficult for the engineer who faithfully looks after the employer's interests in project management and in design to 'change hats' and act independently of the employer's interests when it comes to administering the contract. However, as the cases show, even as agent of the employer, the engineer must still act fairly in making decisions and giving determinations. Such a role still requires real professionalism by the engineer.

The possibility or even the perception of the engineer's bias to the employer's interests in contractual decisions and determinations requires that the contractor has an avenue to appeal decisions of the engineer believed to be wrong. Historically, the contractor has ultimately been able to challenge the engineer's decisions in arbitration, although recently this has become more time consuming and expensive. The recent rise of the use of Dispute Boards in major projects has proved to be an effective way of heading off disputes, or if a dispute is unavoidable, by providing for a quick adjudication by experienced independent engineers, knowledgeable in both the relevant type of construction, and the specific project. Similarly, the widespread use of adjudication to provide a quick and economical method of dispute resolution, even if only provisionally binding, can be a cost–effective and speedy mechanism for the application of independent engineering judgement to the facts of a contractual dispute. It should be recognised however, that both Dispute Boards and adjudication involve more time and cost than the determinations of an independent engineer, and frequently involve lawyers and other professionals such as 'claims engineers' at a much earlier stage than previously.

The emphasis in many modern construction contracts is on promoting cooperation between the contracting parties, with the contract terms structured to promote effective management of the work. NEC3 is perhaps the best example of this type of contract, which requires the employer, the contractor, the project manager and supervisor to act 'in a spirit of mutual trust and cooperation'. Alliancing contracts take such cooperative working to a new level, by aligning the contractual objectives of all parties, and rendering the independence of the engineer moot.

Finally, the technical challenges posed by modern construction contracts require engineering skills of the highest order in design as well as in construction. The lessons from past project failures emphasise the importance of retaining appropriate engineering input at all stages of a project, and ensuring that the contractual arrangements promote and do not inhibit or prevent appropriate communication of that input to all relevant contracting parties.

ANNEXURE—THE ROLE OF THE ENGINEER

	Agent of Employer		The Engineer		
	Project Manager	Designer	Contract Administrator		Adjudicator
			Agent of Employer	Certifier	
Pre–construction	1. Promoting the functional and technical aspects of the project to potential project sponsors/ financiers/regulatory authorities. 2. Advising the employer at the concept stage of a project on possible options for project delivery, including suitable design and construction concepts, cost estimates and project procurement options (including appropriate forms of contract). 3. Calling tenders on the behalf of the employer. 4. Assessment of contractors' proposals and advising the employer on the most appropriate contractor to be contracted to execute the works.	5. Preparation of preliminary designs to refine concepts and enable more realistic cost estimates to be determined. 6. Preparation of design documentation in sufficient detail to enable contractors to determine appropriate construction methods and prepare accurate tenders for the construction costs.			
Construction	7. Project managing the project on behalf of the employer, including monitoring progress, reporting on the contractor's achievement of contractual time, cost and quality obligations.	8. Preparation of 'for construction' drawings and documentation. 9. Technical review and inspection of the contractor 's work, including assessment as to whether the contractor's fabrication and erection methods will have any adverse impact on the suitability of the as constructed design to fulfill its purpose in accordance with the design assumptions.	10. Administering the construction contract on behalf of the employer, including an assessment of the contractor's compliance with the contractual requirements, and taking proactive steps to foresee and manage risks so that the contractor achieves the requirements of the contract. 11. Issuing instructions to the contractor on behalf of the employer, particularly with respect to variations.	12. Assessing the contractor's claims for time and money and certifying the contractor's progress to enable the employer to make progress payments as required by the construction contract.	13. Adjudication of contractual disputes between the contractor and employer.

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