Submission No 17

INQUIRY INTO RAIL INFRASTRUCTURE PROJECT COSTING IN NSW

Name: Mr Peter Martinovich

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Mr. Stewart Smith
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NSW Legislative Council General Purpose Standing Committee No. 3
Parliament House
Macquarie Street
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Subject: Inquiry into rail infrastructure project costing in NSW

The Legislative Council of the NSW Parliament (General Purpose Standing Committee No 3) has invited that I make a submission to the above enquiry, to which I have agreed. In making this submission, I would like to make it clear that the views expressed are my own.

The submission is based on personal experience as; the Deputy Project Leader and Design Manager of New MetroRail which successfully completed the rail expansion project in Perth undertaken between 2001 and 2007; one who in 1997 established and led the specialized team until 2002 that prepared the Master Plans which established the scope and cost estimates which were subsequently delivered by New MetroRail; and one who played a key role between 1993 and 1997, in the route definition and preliminary planning of the 71 kilometre rail extension from Perth to Mandurah.

Perhaps the success of the New MetroRail Project can be summarised by the following:

- A rigorous planning phase that established the scope of work to a high degree of certainty, to the extent that it was convincing to the State Government and endorsed by the majority of Stakeholders along the route, and ultimately, the population at large.
- Careful packaging of works and selection of appropriate contract models.
- Strong Project Leadership in implementing the project which embraced and faithfully delivered the required outcomes to the scope that had been established in the Planning Phase.

The breadth and time scale of what ultimately was defined as the New Metrorail Project would take more than there is time here to properly describe – and all of it is important across the activities encapsulated above. But perhaps, it is the planning phase up to the stage of final approval for funding to implement the project that is the most critical. But In saying this, I am aware this could be at odds with the commonly held emphasis that is placed on project management during implementation – and I am not in any way deprecating the need for the highest level of application and professionalism in that stage. Perhaps some reading of the introductory chapter of A.M. Wellington's "The Economic Theory of Railway Location" may add support to this view.

This submission therefore is mainly about the importance of the planning process that established the scope of works and cost estimate for the New Metrorail Project that was approved by the State Government of WA for implementation.

It is the best that could be done at this stage and if clarification is required, I would be happy to respond within my capabilities.

Yours Sincerely
M Peter Martinovich
Executive Director Infrastructure Planning and Land Services
Public transport Authority of WA
29 September, 2011

The Planning behind Perth's Expanded Rail System
Prepared for the Inquiry into rail infrastructure project costing in NSW, by The Legislative Council of the NSW Parliament (General Purpose Standing Committee No 3)

The most important aspects of a rail project are to thoroughly understand what the demand driver for transport is, then how best to address that demand in the most effective manner, and then develop what must be done to high degree of certainty. Attitudes such as "build it and they will come" have no place in the modern era of accountability and respect for taxpayer funds. Fundamental questions are;

- Who are they - how many of them are there?
- Why should the Government be concerned?
- Why should they come and where are they going?
- How will they come?
- When will they come?
- What must be done to attract them.
- At what cost?

No two rail transit solutions are necessarily alike and each one is probably a prototype. In Perth we have a very low density settlement pattern which could only be served effectively by a railway on the understanding that up to 90% of the catchment population would need to access the stations by car or by bus, and if that was so, what was required to make that happen in a way that would attract commuters.

Given the very high car ownership in Perth, the public transport had to provide benefits that could offset the convenience, the comfort, and the immediate response for travel that the car could bring.

What evolved was a system of large interchange stations generally at least 3 km apart, serviced by very rapid and very frequent train services.

The first essential step was to understand the nature and extent of the demand, and the type of public transport service that would be required in order to generate that demand and attract people away from motorcars, in order to reduce the high dependence on private vehicle commuting in Perth, and in so doing, provide a more sustainable way of commuting.

In determining the type of service, not everyone can be pleased, and there is in the town planning fraternity an idealised aspiration that the primary means of access should be by walking and not dependant on motorised feeders. But that is idealism and if a railway was built like that in Perth it would not work. Such a concept was considered in earlier planning and rejected. So a basic understanding of the divers of transport choice is essential.

Once the demand and the services were known, the serious business of sizing the infrastructure and rollingstock could be undertaken. With regard to the infrastructure on the route, the solutions were relatively straight forward after giving relevant consideration to environmental and social impacts.

Procurement of the rolling-stock was based on a specification of performance for the manufacture to supply and maintain over a 15 year period.

In planning the stations a large amount of public consultation was necessary especially those most affected in the immediate neighborhood – it is they who after all have to live with the outcomes. This was a very iterative process through which the essential facilities required could not be compromised but nevertheless they had to be supplied in a way that was acceptable and considerate of the local stakeholders. At times this led to some surprising results.

Overall an ultimate community acceptance of the project was absolutely essential for its success. Ultimately, it was the rigour of the work performed in planning, allied to the strength of community support that helped the Government's decision making process.

Also in regard to stations it became obvious that the only way to deliver the outcomes agreed with the community was to prepare a (clients design) which was then submitted to the private sector to construct, rather than adopting the design and construct model as for much of the route infrastructure.

With regard to infrastructure planning generally, having identified the requirements, the approach adopted was to prepare designs up to at least a 10% final design stage in order to prove feasibility and define the scope for the work that had to be done. In this way, a reliable cost estimate could be prepared on a firm basis with minimal dependence on the need for contingencies.

Currently in Australia there is much emphasis on achieving costs to a level of P50 or P90 as indicators of the certainty within which the ultimate cost of the project would ultimately be achieved. My concern here is there is a danger of compounding contingencies to cover uncertainties which ultimately has the potential to explode the final project estimates. This can be further exacerbated if these blown out estimates are treated as the base rather than the ceiling price during the tendering and procurement phase. I have seen evidence already of processes that purport to meet the P90 objective, but which do not provide the certainty implied.

The demand for cost estimates that will not be exceeded can only done in one way – by adding enough "fat" to ensure the outcome. This comes perhaps at great cost not only for a particular project, but also sets precedents for future projects, and perhaps prevents projects even being considered.

There is a risk involved in all cost estimating and it is not resolved in the costing process, just as insurance should never be a means of risk mitigation. The solution to the problem of costing probably best lies in defining what is going to be built, and how, to the extent that uncertainties are minimized as much as is practical. The closer what is built (and how), conforms to what was envisaged (and how), the closer will be the correlation between estimate and final cost.

The need to allow for contingencies must be minimized by reducing uncertainty as to what and how it will be built. This can only be done by producing designs to a sufficient stage where there is a reasonable guarantee that the system will work, that risks have been identified, reduced or eliminated, and from which a firm basis for quantification of materials and labour can be made. This requires dedicated project teams who are intimately familiar with the requirements of any particular field that needs to be considered be that; railway engineering, signaling, communications, environmental, geotechnical architectural and structural. At the height of the planning phase, the teams that I led included highly experienced discipline managers in each of those fields, who in turn engaged additional support, to develop solutions and reduce uncertainty.

Not always understood in the planning and delivery of rail projects is that these are not just infrastructure projects but rather the delivery of completed systems of a number of complex disciplines that must be integrated successfully to ultimately make the trains run safely and efficiently. This is fundamentally different to the procurement of road infrastructure with which comparisons are sometimes made.

An important task in the planning phase therefore, is the need to identify and expose interfaces between disciplines and how they will be addressed. This is also a critical input in determining the options and selecting the final contract models for tendering.

Many of the leading contractors who are awarded major contracts, are based on civil / structural business enterprises and they do not always appreciate, make allowance for, and accommodate the integration of the civil/structural infrastructure elements with the signaling, overhead power and communication requirements, each of which have their own special problems that need to be addressed, and each of which ultimately has to be successfully integrated with all of the other elements that make up a rail system.

And then all this must be done in accordance with the requirements of rail safety regulation. It is for these reasons more than any other that the planning and design of rail systems must be done by

specialists with a full appreciation of the need to address all these factors if a successful system is to be delivered within acceptable time and cost boundaries.

Finally, only after all the requirements have been identified, service and performance levels defined, infrastructure and rolling stock needs sized and quantified, and risks defined and treated, can a serious attempt be made to provide cost estimates. In this phase there is as much danger of padding to ensure every conceivable eventuality is covered, as there is to omit critical factors, to the detriment of the project ultimately. The only way an estimate can be produced to a level of risk **"as low as is reasonably possible" (ALARP)** is to do or the necessary work in the planning phase **where the opportunity to make change is maximal, and the cost to do so, minimal.** The ALARP principle which is widely used in risk mitigation is perfectly suited for use in this subject. In all risk, the danger is uncertainty and the solution is to define it, quantify it, and then put in place measures to reduce it to acceptable levels. The preparation of cost estimates for the delivery of rail infrastructure systems must follow a similar line to reduce uncertainty by engaging in the definition of what is going to be built, why and how, and with minimal uncertainty.

A major issue in project managing the construction phase is the selection of appropriate contract delivery models. Project management in Perth was undertaken by a dedicated team. This insured that the government remained not only an informed client, but a critically represented client as well. Although it may be possible for government to outsource tasks, there are critical responsibilities that are retained, no matter what assumptions may otherwise be made.

A key requirement in management of project implementation is to respect the rigour of the work done in arriving at the finally approved scope and cost estimates upon which authority to implement the project was based. In that regard, the pressure on project management is reduced to work in accordance with what has been stipulated, and not having to become creative as far as scope is concerned. A close analogy of the requirements over a project life may be found in aviation where the rule is to ***"plan the flight; and then fly the plan".***

With respect to final cost outcomes of Perth's New MetroRail Project, was that although the rail expansion project was undertaken through an extremely volatile period between 2001 and 2007, when there were major increases in the cost of materials and contract services. The overall cost of the project was contained within an escalation rate of just 17% between August 2002 and April 2008, compared to a Perth Building cost rise of 53%. In taking into account final settlements to may 2010, the escalation in cost for the project since August 2002 was 22%, compared with a 68% rise in the Perth Building Index.

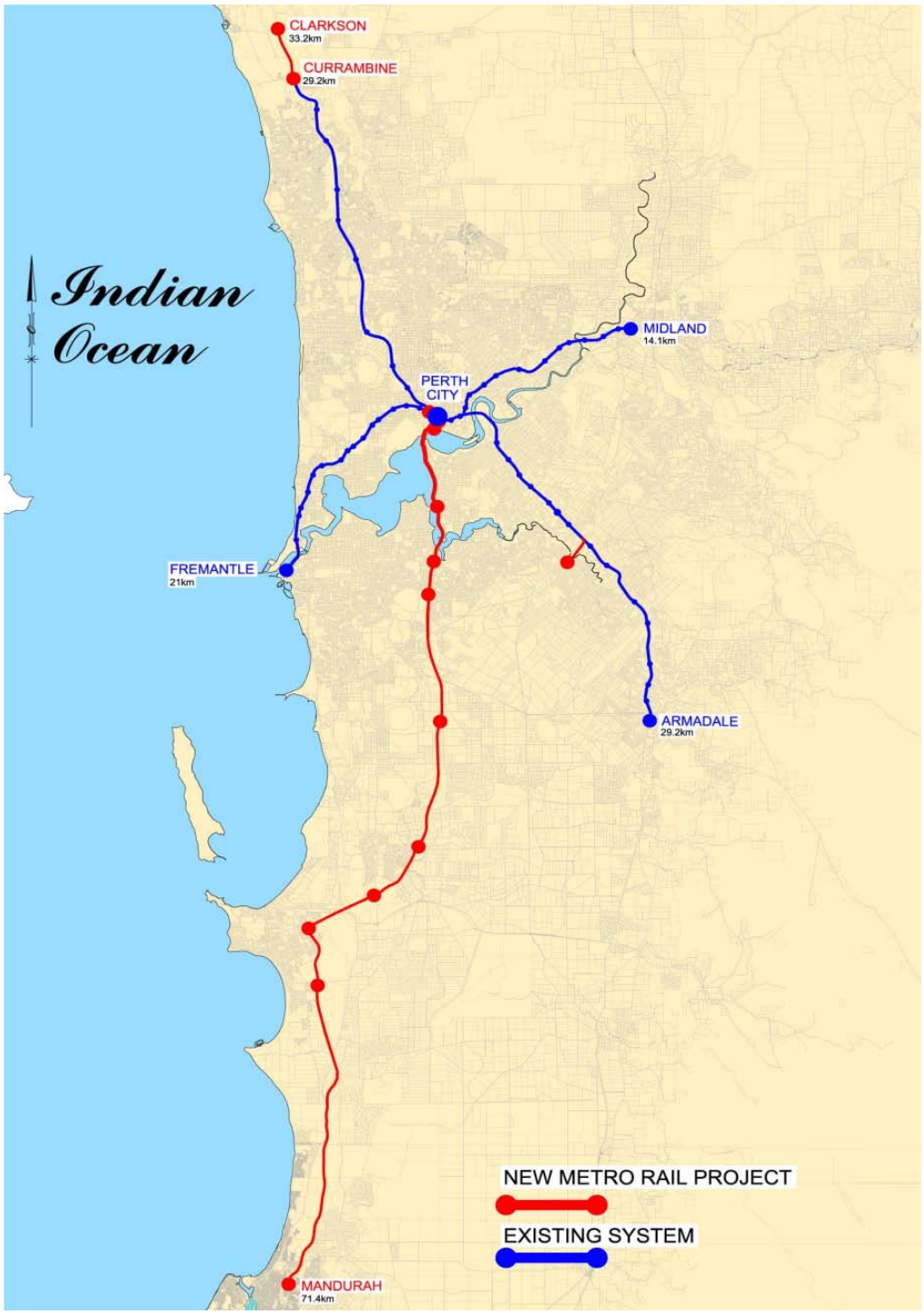
I hope the information above and the summary that follows is of value to the committee.

M Peter Martinovich
03 October, 2011

Addendum One
Summary of the New MetroRail Project

Scope
The NMR project was responsible for:

1. Extending the Northern Suburbs Railway approximately 3 kilometres to a new transit Interchange station at Clarkson.
2. Works on the existing Armadale Line between Perth and Kenwick.
3. A five kilometre spur off the Perth Armadale Railway at Kenwick from Kenwick to a new station at Thornlie.
4. Building a new line from Perth to Mandurah.



A quick snapshot of the new the New Mandurah Line

- Two major city underground.
- Nine suburban stations.
- Route of 71 kilometres.
- The first 28km of the route is in the median of the Kwinana Freeway.
- Commissioned in late December 2007.

Railways in General

- Not just infrastructure projects.
- Rather complex systems comprised of disciplines that must be integrated successfully to ultimately make the trains run safely and efficiently.
- Fundamentally different to the procurement of road infrastructure with which comparisons are sometimes made
- In the Planning Phase, need to identify and expose interfaces between disciplines and how they will be addressed.
- Treatment of Interfaces is a critical in determining options and selection of final contract models.

The Role of Government in the Planning & Provision of Public Works

- Develop and own the Vision for its citizen.
- Articulate the requirements - the more defined the requirements, the more certainty that can be expected from the cost estimates produced, the less risk of scope creep – the more certain the outcomes – **this is essential.**
- Seek bids from the Private Sector Response.
- Adjudicate between competing responses received.
- Award contracts.
- **Manage to ensure expectations are delivered in conformance with the planned scope of works and cost estimate** – (Plan the flight, then fly the plan).
- Be an informed client.

The Critical Role of Master Planning Perth's Urban Rail Expansion

Good and thorough planning is essential – spend time and spend the money in this critical phase.
The recently completed rail expansion in Perth was based on three Master Plans.

- South West Metropolitan Master Plan (1999 / 2000).
- Northern Suburbs Extension Master Plan (2000).
- Perth Urban rail Development Supplementary Master Plan (2002).

The Strategy behind the Master Plans was to produce:

- A comprehensive, rigorous, credible and persuasive case to undertake the project.
- The more rigour, the greater the confidence in outcomes – especially scope and cost.
- To integrate the project into the community and stakeholder base.
- To be sufficiently convincing to be allocated funding.

Who carried out the Master Planning Perth's Rail Extensions

The plans were prepared by dedicated, interdisciplinary team of railway and project expertise across a broad spectrum of railway engineering, operations and public consultation. An honest culture was adapted to not pre-script; or second guess; or control by first anticipating every likely scenario and outcome. Second guessing limits outcomes to its proponent's view and constrains initiative.

- It is essential that planning is not constrained by existing practices.
- Standards and operating procedures must always be open to challenge and review

The Master Planning Objectives were as follows:

- Determine patronage demand.
- Define services to meet the patronage demand.
- Quantify the Infrastructure and Rollingstock to provide the services.
- Involve the stakeholders and engender their ownership – it is their project.
- Integrate with land use, planning and policy objectives to the extent possible.
- Through iteration of the above steps, prepare final concept plans.
- Finally, and only then – Estimate costs.

Demand Analysis is the cornerstone of Master planning

- The Demand Analysis is the start of the Business Case.
- It defines what the market is and forces an understanding of it.
- Demand Modelling requires an informed knowledge of existing and future land use and trip patterns.
- The teaming of land use planners with demand modellers in Perth gave the critical outcomes on which all else was based.
- **The outcome sought was to determine the capacity needed to satisfy the demand in the morning peak period of travel to work** – services, rollingstock, and infrastructure were designed and sized on that need.

Master Planning involved the creation and implementation of a Stakeholder Consultation Strategy. The steps were to:

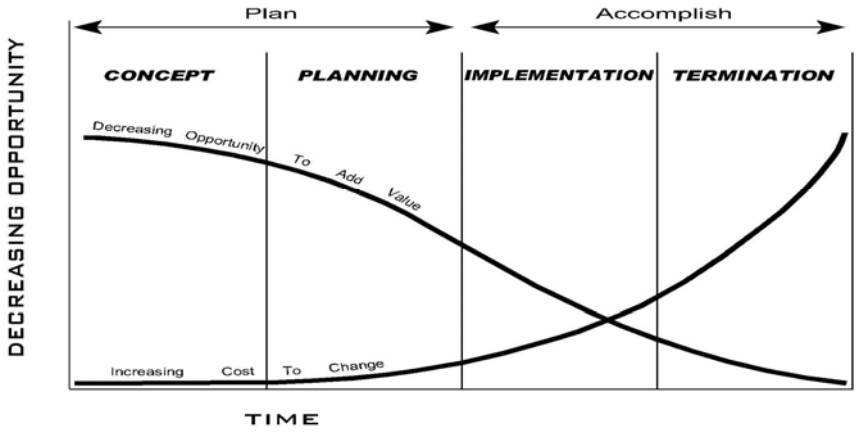
- Establish Stakeholder Reference Groups.
- Inform stakeholders of requirements and objectives.
- Make clear what is, and what is not negotiable.
- Be genuine – maximise information exchange.
- Give feedback.
- **Engender their ownership of the project you initiated but need to pass onto the stakeholders.**
- **Develop unity of purpose.**
- Keep in mind that if THEY cannot understand or grasp your proposal, then YOU have failed.
- YOU must make take risks and make the first move in establishing the RELATIONSHIP.

The Importance of a highly defined Scope of Works

The development of the scope of works to a high level of definition was essential to:

- Properly represent the needs to satisfy the demand –this alone needs much consultation to avoid surprises.
- Reduce uncertainty which reduced the risk of scope creep during implementation.
- Provide a firm basis for cost estimation that reduced cost risk.
- Gain the trust of stakeholders.
- Provide confidence to decision makers.

The idea here is to eliminate scope creep before contracts are called. It is essential to spend the time and money "up front" to define the scope of works. It is in the planning stage that there is the maximum opportunity to accept change at least cost. But once contracts are awarded, the penalty of changing (e.g. scope creep) can be every high in cost and time. A good Master Plan minimises these risks.



The Master Plan as a Datum

The Master Plans became the datum for the implementation and a key responsibility of Project Management was to ensure conformance to the Master Plans.

Perth – Mandurah Railway; Scope of Contract Packages

There were three main infrastructure contracts and three station Packages

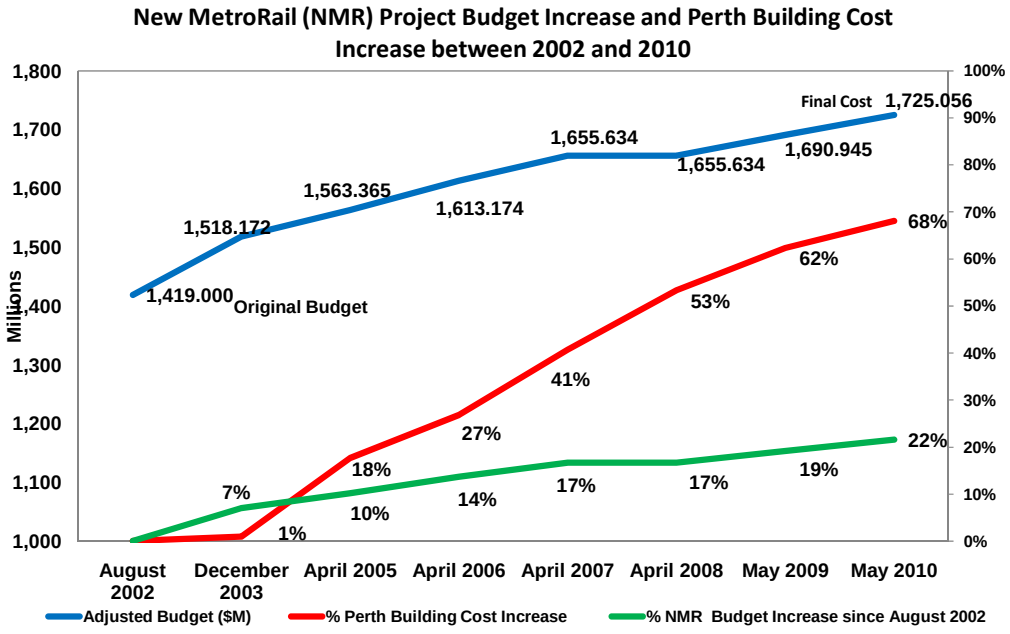
- Package A – Main Railway Infrastructure and civil
- Package E – Glen Iris to Perth; Freeway rearrangement over 16 kilometres plus major Bridges
- Package F – Underground Railway Through Perth
- Package D – Major transit stations at Canning Bridge, Bull Creek and Murdoch
- Package B – Major transit stations at Cockburn, Kwinana and Leda
- Package C – Major transit stations at Rockingham, Warnbro and Mandurah

Rolling stock was procured under a Design, Build & Maintain Package.

New MetroRail Project
Kwinana Freeway combined Transport Corridor
Railway in the Kwinana Freeway

- Subject of severe political and professional criticism during Planning
- Major Challenges were Overcome
- Risk Analysis was critical
- New Standards were developed, verified and validated

Outcomes of the Perth – Mandurah Railway
Actual v Projected Costs v Construction Index



ADDENDUM TWO (Reproduction of a previous paper)
THE CHALLENGE TO DESIGN AND BUILD A RAILWAY

Railways are inherently dangerous.
They comprise features such as:

- Overhead traction wiring, or a third rail, energised to high voltages
- Heavy vehicles travelling at high speeds generating high inertia
- Control of inertial forces through interaction of smooth wheels with rails and the track structure
- Interaction of all above with the natural and urban environment, commuters, other services and infrastructure such as the road vehicles at level crossings
- Limited options for evasive actions

Like the civil aviation network, rail systems are made safe by the application of rules, regulations, procedures, codes of practice, attention to maintenance and operator training. A necessary product of all this is the absolute need for adherence to repetitious, standardised and predictable performance by everyone involved. All this must conform to the Rail Safety Act.

But the application of the requirements to safely and competently run and manage a railway have made it the safest mode of land passenger transport and this record needs to be maintained if confidence in the system is to be retained and continued high levels of expenditure are to be justified.

Railways are highly Specialised
Rail is sufficiently different from other types of civil projects to demand intimate involvement by the Owner in the design process. The hands-off approach is unlikely to produce the desired result.

Rail is an area of uncommon specialisation. Whereas professional engineering courses cover most branches of specialisation, rail disciplines are generally not addressed or understood in the same way. Rail engineering is a complex discipline that as well as the challenges of civil engineering includes the intricacies of overhead power, communications, signalling and control systems all of which must conform to a rigorous regulatory requirement. There is an intimate interaction with the general public with high expectations of service reliability and safety. The breadth of all this is only fully appreciated by a dwindling number of practitioners. Therefore lack of a full understanding from within the general contracting and project management industry should not be surprising. With rail transport becoming an increasing priority for Australian cities, more attention needs to be paid to formal training of railway engineers.

The above highlight that a rail system is constituted of multiple interfaces. There is the potential that civil engineering contractors dealing with rail projects can find themselves in territory that is either unfamiliar or understood only theoretically.

It is the author's experience there is need for constant review and questioning of practises and standards with a view to ensuring not only the best outcome but so that not only the letter, but most importantly the spirit and intention of Rail Safety are met. To engage in this requires a comprehensive and sound knowledge of railway engineering and operations. Consequently, the ability to fully document the requirements for tendering – especially in a political, time constrained and cost constrained environment may be a big expectation. But it is the environment in which rail professionals must perform. There is no point complaining that others don't understand what is required.

The impacts of all these factors may not become obvious until well into construction. Whereas in purely civil engineering terms, changing the characteristics of a railway line is not a problem, the effect of a seemingly trivial change can create the conditions for potentially extensive consequences with respect to cost and time. For example, the alteration of a curve that might be required for whatever reason can have unforseen implications for the overhead power system and signalling.

When elements such as Automatic Train Protection and other electronic systems are involved, costs are compounded. Al these things are magnified greatly if a mixed freight / passenger service has to be accommodated.

Lessons

Lessons to be drawn from all this is that the continual close involvement of the Owner / Client – who most probably has immediate access to more rail expertise than the contractor is likely to command - at all points of the design and construct process would seem likely to produce the most satisfactory long term result.

On many engineering projects the handover to operation and maintenance is relatively straightforward in comparison with the difficulty and effort required for design and construction. Consequently, the focus of a design & construct project is likely to be getting the project to handover status. However, from the Owner's perspective even if a completed rail project is perfect in every detail, it is not functional until the operation and safety of the system has been verified, validated and tested and the Owner is in full possession of all information required to safely operate and maintain the system.

This requires that operations and maintenance manuals be produced well before construction is completed. Training of the Owners operational staff needs to be commenced in sufficient time for them to competently operate the system when it is completed.

Documentation and training can soak up significant Contractor resources, and as there are always difficulties during construction, something has to go onto the back burner. The most likely works to be deferred are those not critical to immediate priorities - such as documentation and training – aspects most critical for the Owner.

If the design and construct contract is extended to include some agreed period of maintenance, the delay in transfer of information can potentially become even worse because from the Contractor's point of view, the Owner doesn't have to do anything about maintenance anyway. This is almost never true.

The Way Ahead

It seems that if a railway procurement endeavour is to run smoothly, from the very outset of tendering there needs to be a clear, unambiguous understanding, by both the Owner and the Contractor of the following elements.

- The multiple interfaces that constitute a rail system
- The risk profile, operating procedures, maintenance, safety and public service obligations of the Client
- Integration of the outcome being procured into the broader system and the interdependencies that entails in delivery, handover, maintenance and operation
- The requirements of Rail Safety Regulation
- The need to resolve design and construction issues expeditiously and at least risk to both parties
- The associated necessity to maintain design (and possibly planning) capacity throughout execution of the contract
- Senior managers on both sides who have the necessary awareness and experience
- A commitment to production of the required outcomes, rather than execution based on a rigid format
- The need for a timely and proper commissioning plan produced and managed by competent people
- Timely production and delivery of training manuals and procedures
- **Facilities within contracts for the Owner to take corrective action on problems before control is eroded or even effectively lost**.

In other words, there is no easy option. The bottom line for the Owner is that attention to detail and proactive management of the entire project cannot be delegated. The degree of control required is

driven by the owner's risk exposure. The greater the control required by the owner, the less control should be outsourced to others.

Whether they realise it or not, the people involved in the rail industry are engaged in a major economic activity with a profound impact across the board of what makes up community economics. The final performance of a railway depends on a myriad number of decisions that must be taken over every kilometre. If trains cannot run, everyone involved is exposed to losses.

Relating all this to the New MetroRail Project, the effort expected of an endeavour to virtually double an existing network can then be put into proper perspective.