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Freight Tunnel for Melbourne passes first economic test

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Abstract

The proposal is to move half a million per annum international shipping containers slowly under Melbourne on level tunnels of minimal cross-section using the *Pamela Process (IPAustralia 2015903568).*

The Rapid Economic Appraisal test for economic cost benefit analysis does not cull this project. Benefits (including road vehicles saved and congestion benefits) are comparable to Costs (including tunnelling and ICT) at about $2.3 billion. This first economic test can be refined cheaply.

Parties can proceed to the second economic test: a pre-feasibility study costing about $10m.

Introduction

The author's idea is to move freight slowly and cheaply in tunnels below Melbourne.

Testing innovative ideas for their economics can be expensive. Professional practice and official guidance suggest, in orders of magnitude, for a multi-billion dollar project, the following tests

- A 'Rapid Economic Appraisal" is the first screening step – my costing is between $0.1m and $1m
- A pre-feasibility study - could cost $10m
- A feasibility study leading to a business case - could cost say $100m.

Details of the freight proposal are given in section 1.

Principles of Rapid Economic Appraisal are shown in section 2.

Applying the Rapid Economic Appraisal test to the freight proposal is illustrated in section 3.

Possible next steps are portrayed in section 4.

The history of economic thinking behind the freight innovation is given in Appendix 1.

Wise advice remembered from the late Dr Alf Smith on cost contingencies is in Appendix 2.

1. The Freight Tunnel Proposal – using the *Pamela Process* (patent pending)

There is growing recognition that pipelines may be used for many engineering applications – for example the large hadron colliders at CERN (Laughton, 2011). Sewers and slurry pipelines move much freight economically: slowly with minimal impact on their pipes and tunnels. The proposed tunnel moves 500,000 containers per year or 1736 per working day, allowing for bad weather, maintenance and possible industrial issues. Figures 1 to 3 illustrate the *Pamela Process*[1].

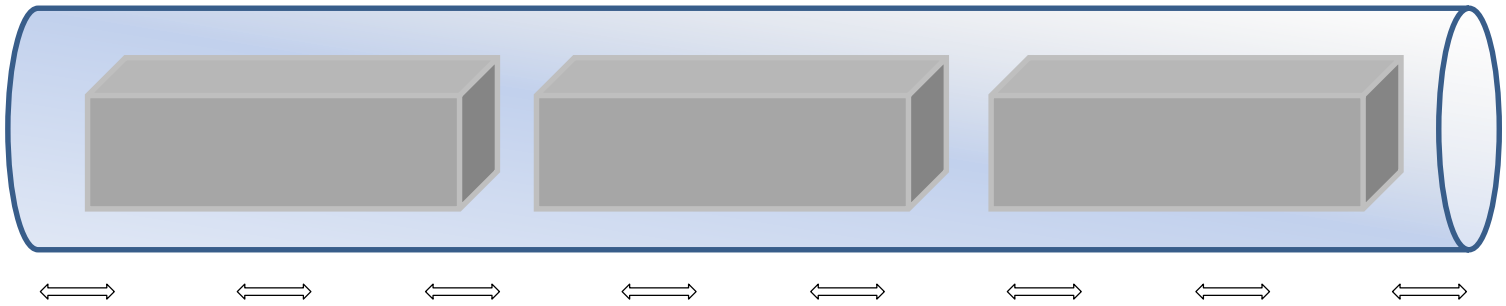
Figure 1 shows one 40 foot laden international shipping container snugly supported in four places by a tunnel of minimal cross-section.

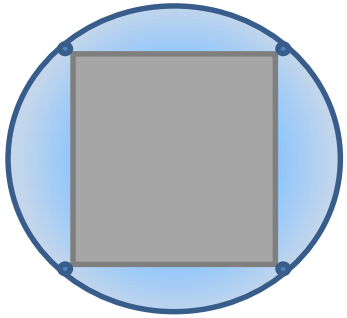
Figure 2 shows the container moving slowly (20 kph maximum) on a level gradient. The round journey from the Port of Melbourne to six inland road or rail terminals has an indicative length of 20 km.

Figure 3 indicates synchronised hoists move containers to and from the freight tunnel to surface depots without impeding the steady movement of containers within the tunnel.

[1] The intention is to apply to IPAustralia to upgrade the provisional application for the *Pamela Process* to a standard patent and to request an examination. IPAustralia publishes details of successful patents.

Figure 1. Pamela Process – Conceptual drawing – Steel rollers electrically controlled, bi-directional, fits standard cargo container 8’ wide x 9.5’ high





Cross section view – standardised cargo container transported by rollers on a rail, fits standard 8’ x 9.5’ containers

Figure 2. Transport from container port to strategic distribution centres

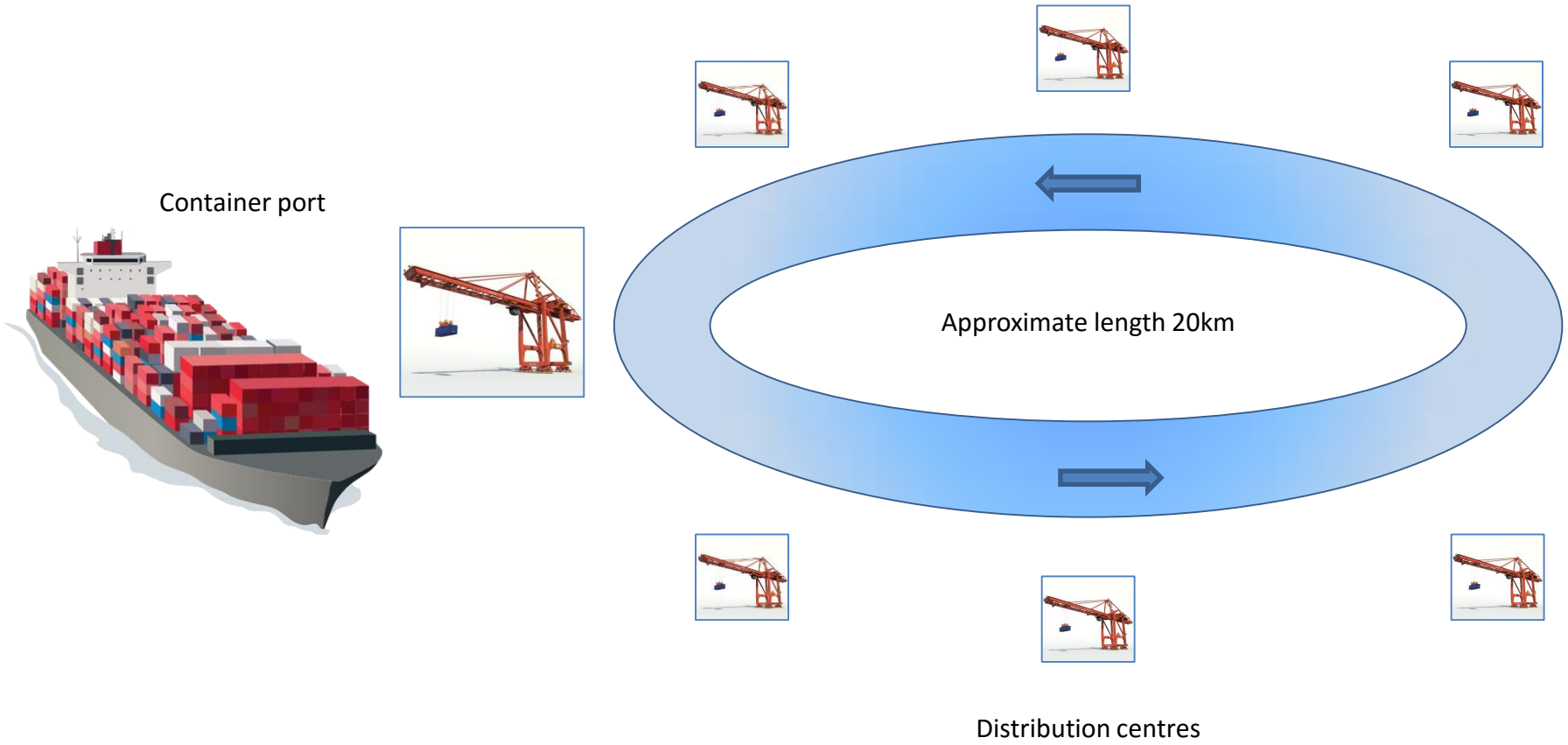
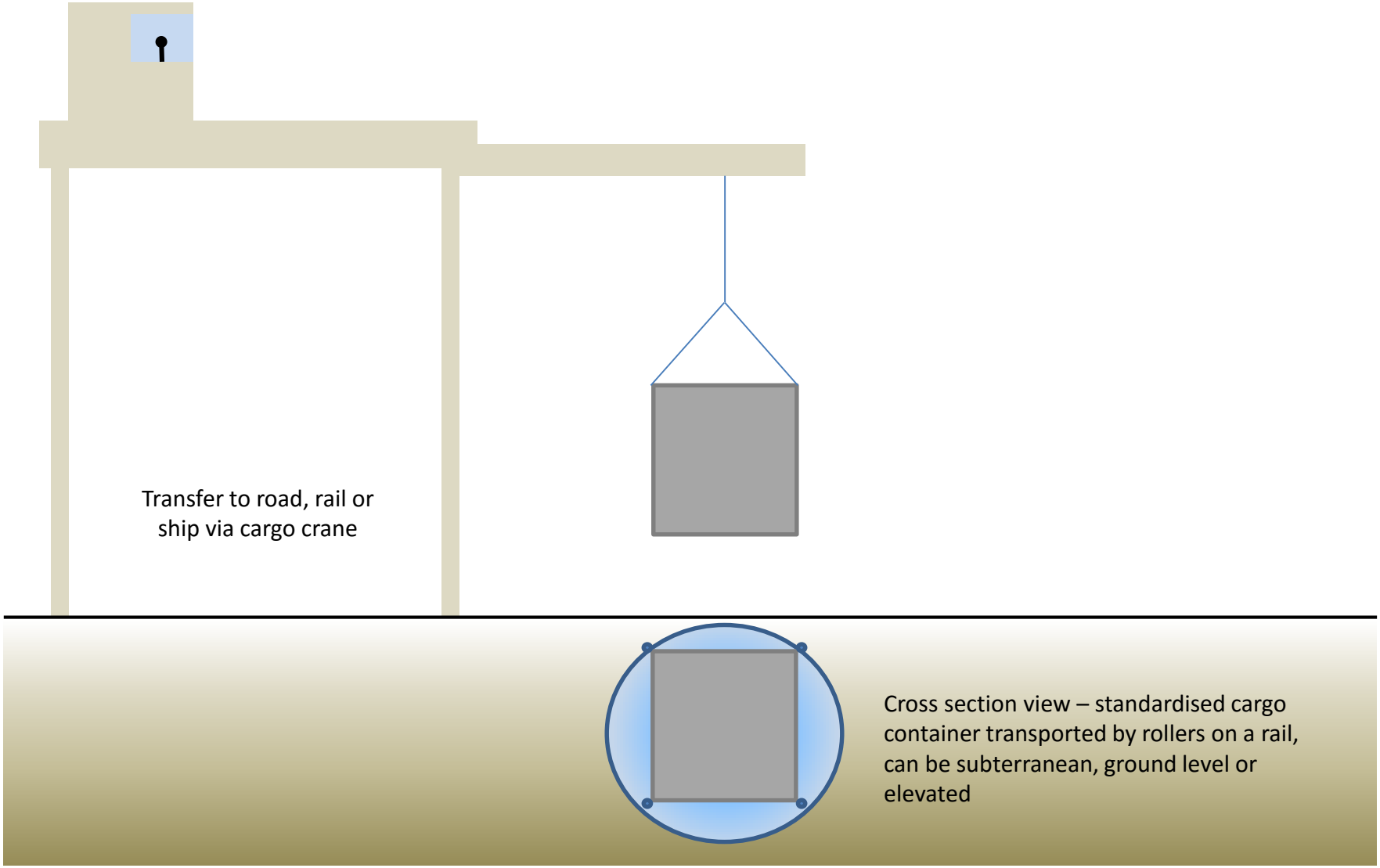


Figure 3. Multi-modal connectivity via road, rail or cargo ship



2. 'Rapid Economic Appraisal'

The aim of this technique is to be a low-cost screening tool. Practitioners do it quickly to keep costs down in terms of professional hours. If there are 50 bright ideas, the technique may be able to cull many quickly, focussing scarce professional time on a worthy few.

'Rapid appraisal' is defined in volume 1 of the *National Guidelines for Transport System Management in Australia* (2006) page 9 as:

> "Rapid appraisal is intended to be a cost-effective way of gauging whether an initiative is likely to pass a detailed appraisal. The methodology for a rapid appraisal is the same as for a detailed appraisal but with lower expectations about comprehensiveness and accuracy."

These *Guidelines* are currently being updated. Current professional best practice is ahead of the 2006 *Guidelines*, so this author does not follow every requirement.

Dr Robert Noakes taught the author the following principles for rapid appraisal:

- Partial analysis. Focus on one project. Assume DO NOTHING for other projects.
- First guess is best guess – the midpoint of any range.
- Use published unit values where possible – e.g. *National Guidelines, ABS.*
- No time for risk analyses – if one treats both benefits and costs the same it is a fair quick test
- So no need for contingencies or probability distributions.

Contingencies also troubled the late Dr Alf Smith, economist. Leaving contingencies out of both costs and benefits avoids problems at this first crude economic test. Appendix 2 gives more details of the author's memories of Dr Smith's insights

3. The Rapid Economic Appraisal of the Freight Tunnel proposal

ECONOMIC COSTS

Table 1 ECONOMIC COSTS	
$M Net Present Value at 4% over 2015 to 2039 in 2015 prices. Detailed spread-sheet available on request.	
River Crossing	185
Tunnel	1039
Mechanical - Tunnel	178
Hoists	247
Information and Communications ICT	523
Operating Costs	125
TOTAL COSTS	**2297**

The largest cost item is the tunnel with ICT second.

The River Crossing cost recognises the need for reinforcements for the tunnel under the Maribyrnong River.

Tunnel costs are based on the Australian Rail Track Corporation estimates of their Toowomba Range tunnel, Queensland, boring through 5 km of basalt under the Great Dividing Range (ARTC, 2010).

- The ARTC tunnel boring machine is budgeted to progress half a metre per hour.
- The ARTC costs per km were divided by half for this paper, as the Freight tunnel will have a smaller cross-section, and less mass and movement to support.
- The ATRC tunnel carries a long interstate container train at speed compared to one slow-moving laden container proposed here.
- The proposed ARTC tunnel concrete lining is over a metre thick, which is far greater than that which Melbourne Water needed in 1989 to line a tunnel of tighter radius.
- Tunnel costs are typically under-estimated (Spackova 2013).

Mechanical – tunnel is an estimate of the services needed to support each container and any rails or rollers.

Hoists will need to be precision instruments to be able to synchronise with the non-stop flow of containers within the tunnel.

ICT (Information and Communications Technology) costs are always underestimated. This estimate is three times the first assessment by the author.

- Innovations can help place a ceiling on ICT cost estimates.
- For example, a trial in Californian ports tracks the location and identification of cargo containers using Radio Frequency Identification (RFID) (Hulme 2016).

Operating costs are recognised at $10m per annum and include energy and maintenance.

ECONOMIC BENEFITS

Economic benefits are shown in Table 2.

The surest foundation for benefits is ABS data. However, the ABS did not progress Transport Satellite Accounts to their System of National Accounts as we suggested at ACE 2012 conference (Norman 2013).

Large benefits arise directly from the bleak outlook from the DO NOTHING rule of rapid appraisal. Each project is reviewed in isolation, assuming that nothing else happens on the infrastructure side.

- In this case, DO NOTHING means no Western Distributor, no East-Link and no second river crossing. Traffic crawls to almost a stop around Australia's largest container port by about 2025. We use an indicative 5 kph for traffic speed.

Table 2 ECONOMIC BENEFITS

$M Net Present Value at 4% over 2015 to 2039 in 2015 prices. Detailed spread-sheet available on request.

Congestion Benefits to remaining users	675
Producer Surplus	-11
Social (crash costs)	345
Environmental (health costs)	86
Vehicle Operating costs saved	540
Road Vehicles saved	690
TOTAL BENEFITS	**2325**

Congestion Benefits to remaining users are estimated at $62.5m per annum. This can be thought of as a saving in vehicle operating costs and travel time of $6.25 per trip of ten million vehicles remaining on the roads, as a result of taking half a million truck trips off the road. These are illustrative numbers – any estimates with precision will require expensive transport modelling and data collection.

The negative producer surplus item recognises that competitors may be adversely impacted by this tunnel proposal. Detailed economics is required for any meaningful estimate.

Social benefits are illustrated by avoided deaths from increasing road freight congestion as nothing is done. The value of life lost is taken on the high side at $8m per person, representing growing community anger under the DO NOTHING rule. Each year we assume four extra deaths, being a pedestrian, cyclist, driver and logistics worker. Extra social benefits not yet valued include the improved amenity of the suburbs, a reduction in the bifurcation of communities by truck-filled roads, and better vistas.

Environmental estimate is the avoided extra asthma death per annum, as the heavy particulates from the diesel fumes of the port stalled traffic enters the lungs of residents and workers. Again, precise environmental estimates require expensive modelling – a task for the pre-feasibility stage. Not yet valued are benefits to greenhouse gas emissions, groundwater and noise pollution.

Vehicle operating costs saved are taken as $200 per round trip for the 578 trucks taken off the road travelling at the inefficient engine speed producing 5 kph stop-starts. This includes labour, diesel, and tyres.

Road vehicles saved are the cost of replacing the fleet of 578 container trucks every five years at $0.5m per prime mover and trailer.

4. Possible Next Steps

The indicative Benefit Cost Ratio (BCR) of about 1 suggests this idea cannot be culled immediately.

Our costs to date have been modest, under half of the bottom of the $0.1m to $1m range for Rapid Appraisal on page 1.

The unpaid column is voluntary time given by friendly colleagues (thanks) and the author.

Table 3 suggests more could be done even at this Rapid Appraisal stage.

TABLE 3: COSTS OF THIS PAPER ($)

	PAID	UNPAID	TOTAL
Actuary	200	1000	1200
Economists	1000	40000	41000
Geophysical engineers	200	1000	1200
IPAustralia	190	500	690
Legal		2000	2000
Other professionals	1000	1000	2000
Patent Attorney		500	500
Printing	30		30
TOTAL	**2620**	**46000**	**48620**

Even from our modest efforts and a BCR of about 1, this paper may encourage other parties to fund the next step – the pre-feasibility study to cost about $10m.

Potential funders could include

- Major customers of the Port of Melbourne, including the dairy exporters
- Private sector entrepreneurs who may be attracted by the chance of making a profit.
- Large land-owners and freight-forwarders who may be able to value capture some benefits
- The Commonwealth Government – either through grants or tax concessions or subsidies for innovative infrastructure projects
- The Victorian Government – faced with increasing congestion and unsettled inner urban residents
- Local Government
- The new owner of the Port of Melbourne
- Competitors in freight infrastructure.
- RACV

The tasks would be standard for any pre-feasibility study, with a special focus on geology.

The basalt of the Western Plains of Melbourne requires careful professional study as the following quotation from an experienced geophysical engineer shows (Macgregor, 2016).

> "Frankly, I hate the basalt plains! It is very difficult to excavate, either by open trenching or by tunnelling. Clay overburden is from 0 to 2m or 3m. There are many boulders (a boulder under every thistle we reckon). Basalt weathering is variable. If the basalt is hard (fresh - slightly - moderately weathered) it likely needs drilling/blasting, depending on jointing. But it is far from homogeneous, quite the opposite. Often multiple basalt flows are of varying ages and thicknesses. Groundwater is usually not an issue."

It may be worth spending $1m on the relationship between this and any competing or complementary projects. Competing projects could include a new port or surface transport of containers. Estimates of producer surplus could be done within this allocation.

Experience from the Netherlands suggests it is essential that the private sector takes the lead. An ex-post evaluation of their underground logistics systems found a major factor for failure:

"The political support of the important political decision-makers was lacking and also support from the private sector in the field of logistics (transport companies and the large shipping companies) was missing (Visser, 2008).

Melbourne Water may be the best public sector agency to coordinate the pre-feasibility study. It may be able to contribute several $m of valuable inputs simply from corporate memory / records of geology and tunnelling experience.

APPENDIX 1 History of Economic Thinking for this paper

This paper has many parents, including ideas and suggestions from The Australian Treasury, IPAustralia, The Melbourne Habitat Trust, Melbourne Water and a port user.

- The Treasury. At the formal luncheon for the *Australian Conference of Economists* in Brisbane 2015, the Secretary, The Treasury, Mr John Fraser, explained there was not a shortage of good funding for projects, rather a shortage of good projects. Funding was not the problem. He asked anyone with a good project to send him the details. He promised to find the funding. This paper responds to Mr Fraser's challenge.

- IPAustralia. Also at the conference last year, economists from IP Australia explained to the author in conversation how cheap and easy it is to register a patent, at least provisionally. They said Australians were backward and under-confident in applying for patents to their own detriment. So the author applied for the provisional patent for the Pamela Process (IPAustralia application number 2015903568) paying the $190 fee.

- The Habitat Melbourne Trust developed a concept of a freight tram on the surface between the Port and the container-road terminals. (The Habitat Melbourne Trust 2015). The author felt that:

    - Relocating the freight tram underground may not be that expensive, given the cheap cost of tunnelling for sewers, and may yield benefits through grade separation; and

    - Carrying only one container per freight tram would save double-handling

    - Removing the freight tram through a patented innovation would cut costs further

    - Keeping tunnel cross-section to a minimum was essential for the economics

    - A for-profit approach may be more influential than the Habitat not-for-profit genre.

- Melbourne Water has over a century of understanding the geology and tunnelling-knowledge of the basalt plains of Western Melbourne. In 1989 Melbourne Water showed the author down their tunnel towards their Werribee treatment plant. It bored through basalt to relocate the outfall sewer under the ground. They explained their record-breaking tunnelling achievements and their economical cost per cubic metre.[2]

- A port user is represented by Mr Maxwell Jelbart OAM, a notable dairy farmer and company director. Mr Jelbart is passionate about keeping transport costs internationally competitive for Australia's dairy exports, using innovation wherever possible.

The *Pamela Process* is named after Mrs Pamela Margaret Norman (1942-2015), Mrs Graham Bainbridge, nee Pearce.

[2] The inspection arose from the economics work on water and sewage pricing for Melbourne Sydney and Perth (Dixon and Norman 1989).

APPENDIX 2: Insights into Contingencies remembered from the late Dr Alf Smith

Dr Alf Smith, economist, was Deputy Secretary of the Department of Business and Innovation at the time of his sudden death in January 2012. Some years earlier he had quiet asides with the author during breaks in meetings whose contents remain confidential.

1. Bidders for large infrastructure projects in Australia are few in number, leading to the possibility of misuse of market power.

Locally, there are only four to five large banks. Of our domestic engineering firms, only a few have sufficiently strong balance sheets or parent firms to join with the banks and other parties to bid for very large projects.

Overseas bidders have the strength but may lack the willingness to put a huge effort into bidding for an unsuccessful tender; even if the non-winners are compensated to some extent. They may feel that locals will have advantages or otherwise be favoured.

The net result could be a reduction in competition between bidding consortia; raising the possibility of cartel behaviour.

2. Contingencies may be converted into monopoly profits by a cartel.
(The following arithmetic example is by the author.)

A cartel can take the cost estimate including contingency as the floor price below which members should not bid.

- For example, engineering cost estimators and quantity surveyors estimate their best guess at A$1.0 billion.
- Engineering firms add say a 20% contingency of $200m to take the total project cost to $1.2 billion.
- Financiers add a further 20% for risks no-one has considered. A further $240m to take the total to $1.44 billion.
- The bidders then add their profit margin on top of the $1.44 billion.
    - Bidder A may submit $100m profit component in an overall bid of $1.54b
    - Bidder B may submit $97m profit in an overall bid of $1.537b

In the 'normal' event that not all the contingencies are required, bidder B pockets much of the $440m as a super-normal profit.

3. There is some economic respectability for secrecy.

Keeping detailed costs and especially contingencies out of the public domain may prevent bidders signalling to each other.

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