Summary
Rail transport in Australia is undergoing a step change revolution in driving out cost. We have lagged behind the innovations in road, air and sea technologies. The experience of operating rail in remote areas has driven change in Australian rail operations, which will move into more main stream rail operations for the benefit of the industry as a whole.

Rail operations in Australia are some of the most diverse in the world. This paper is intended not to individually explore each innovation, but rather to step back and look at the direction of innovation into the future. In general rail is most economic over long distances, or moving high volumes of freight compared to alternative modes of land transport. From the experience in remote area operation, existing enabling innovations are considered, which have opened up new opportunities;

- Relay Running
- In-Line-Fuelling

The paper then considers subsequent innovations.

- Warehousing, high capacity purpose built rollingstock,
- AC Locomotives,
- Track Condition Monitoring – In Running,

Finally the paper addresses new innovations under development;

- Live Bearing Condition Monitoring
- Automatic Train Management System – “moving block”
- Driver Decision Support Software
- Second Generation Crew Van Facilities

It is argued that these innovations need to be supported by appropriate infrastructure investment, infrastructure charging and holistic transport regulation.

We in rail must move from a defensive stance in preserving redundant technologies and infrastructure to embrace the future and invest in where rail delivers the best outcomes; new infrastructure and smarter trains.

The future is an exciting mixture of opportunity, growth, safety and cleaner land transport. So what conclusions can we draw and where do we go from here?
1. Introduction
Rail operations in Australia are some of the most diverse in the world. We operate in some of the most challenging environments. Both the diversity and remoteness of rail operations have driven some unique and innovative solutions to rail operations in an endeavour to drive down cost and maintain safety.

This paper is intended not to individually explore each innovation, but rather to step back and look at the direction of innovation into the future, how the Australian experience has shown the need for “on train” or intelligent train and track management, over the traditional model of static, periodic or in situ monitoring that has occurred in the past.

We all remember VHS and Beta video, eight track music cartridges, cassettes, records, floppy disks, hard disks and hard drives? Each ones of these innovations represented a technology stream which limited the future innovation. Some represent, choices, which excluded other innovations. However all ran out of demand as new technologies overtook their space in the market.

Rail technologies have long been wedded to off train technologies for train management, track measurement and inspection and in situ train condition monitoring. Today the technologies have moved on. The future is, I believe smarter and safer trains.

In many parts of the world, fully automatic trains are the norm, Paris metro, for example. They are safer, more reliable and very efficient, with minimal human intervention. This type of technology has been announced for the Pilbara.

However, I believe that the remoteness and distances of Australia may limit automation, but smarter trains will become the norm.

2. The Australian Rail Industry
In Australia, we operate the largest trains in the world in the Pilbara at 32,000 tonnes. We have some of the largest metropolitan rail networks. We have the largest tram network, the steepest railway, longest railway straight line and some of the remotest operations in the world. Perth is the remotest city in the world. If you travel from the East Coast of Australia to Perth, you have travelled half way to Madagascar!

SCT and its sister company SBR (Specialised Bulk Rail) operate trains in some of the remotest and harshest environments in the world. Our primary operations go into the outback, between Perth and the East coast of Australia. Additionally, SBR operates between Coober Pedy (in the far northern deserts of South Australia) and Port Adelaide.

SCT locomotives have high utilisation given the long distances travelled. Our fleet of state of the art 4500hp AC locomotives and are in weekly operation between Parkes, Melbourne and Perth. This is a return trip of nearly 7000km. Our sister service between Coober Pedy and Port Adelaide operate a 3 day return services of nearly 1800km. Both services operate in semi arid sparsely populated desert country.

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These challenges have led SCT to adopt new technologies to ensure safe operation in these environments.

3. Why is rail important?
Rail and road operations are distinguished by quite different competitive advantages driven by their respective technologies. Rail, is capital intensive and requires economies of scale to remain viable. Road is less capital intensive and has a lower threshold economies of scale, but higher variable operating costs.

In general rail is most economic over long distances, or moving high volumes of freight compared to alternative modes of land transport (road and air). Road with its much higher reliance of fossil fuel (rail uses 10% of the fuel road does per tonne moved\(^1\)) cannot compete with rail over long line haul distances, however rail has much higher consolidation costs to generate the volume of freight in one location, to make a train of sufficient size to operate economically. As a rough rule of thumb, the consolidation and deconsolidation cost for rail in the market place where road can be contestable for freight, currently requires approximately 500km\(^2\) line haul, to achieve the fuel savings necessary to overcome the consolidation costs.

Where high volumes of freight are available in a single location, minimising consolidation costs, rail can be significantly more economic than a road operation. This can be seen in metropolitan commuter networks with dense populations and in the mineral industry where large volumes of freight move from a single origin point like a mine to a port.

Rail can never provide full coverage of the land based transport market. Rail where it is economically efficient to do so, can significantly reduce harmful environmental emissions, the use of non renewable environmental fuels and safety to the community.

Rail now moves more gross tonnes per kilometre than road, but I believe rail can and will into the future, be able to contest a greater share of the land transport market. However, we must be mindful that rail will never efficiently service small communities with low volume freight needs. I do believe that rail can achieve economically efficient shorter haul operations and justify infrastructure investments in shorter line haul rail lines, at lower costs if we innovate and exploit current experience learned in remote rail operations.

4. Lead innovations in rail operations
There are two innovations that have had enormous implications for the changing

\(^{\text{1}}\) ARA
\(^{\text{2}}\) Ibid

\(^{3}\) Australian Infrastructure Statistics—Yearbook 2012; Commonwealth Department of Infrastructure, Transport & Regional Economics.

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landscape of the Australian Rail Industry than any other. Relay Running and In-Line-Fuelling. These two innovations have formed the springboard to invigorating the rail industry.

4.1. Relay Running

Relay running, which is operating trains with two crews, operating in relay; one in a crew resting car, while one operates the train, in continuous rotation for the length of the journey. Relay running has not been regarded as a significant change in rail operations and viewed with suspicion in some quarters, but it has profoundly altered the landscape. Rail in Australia has long been the preserve of monolithic vertically integrated rail companies, which survived by having achieved economies of scale to overcome some of the inherent challenges in rail technology, particularly in remote area operation.

Generally rail operators had to have sufficient critical mass; operating frequent trains, to support large depots where crews were strategically placed to relieve and drive trains. A typical operation would involve a crew departing on a train, driving a reasonable distance for a half shift and returning on a train timetabled to return at the destination. Progressively this was extended to rest shifts, where crews would drive for a full shift, finish at a remote location and return after a reasonable period of rest. Either option required dedicated crew facilities, spare staff to manage out of course running and infrastructure, such as accommodation houses. This formulation favoured incumbents and created significant barriers to market entry and competition.

The introduction of relay running enabled smaller operators to enter the market, who could not sustain the critical mass to support the infrastructure on the ground, or simply the frequency of trains necessary to economically accommodate resting crews return home within a reasonable period of time.

Other benefits accrued, better on time running, with the flexibility to change crews any time or location. Most profoundly, the very high cost of accommodation facilities in the remote Australian outback was overcome. Previously the accommodation facilities at Cook, 845km from the nearest town, was the only feasible crew resting location in the Nullarbor.

4.2. In-Line-Fuelling

In-line-fuelling was another important innovation to improve rail competition in Australia, learned in the harsh reality of the Outback. Trains travelling between the East and West coasts of Australia were required to refuel several times on the 3,500 km journey. In particular, it was necessary to have large fuel storages between Kalgoorlie and Port Augusta in sensitive, pristine environments. In particular fuel at such remote locations, was expensive and provided by a monopoly provider.

In-line-fuelling opened up competition by removing dependence on single fuel infrastructure providers, where duplication would have been both uneconomic, without a significant critical mass. Also fuel could be purchased in capital cities at rates substantially lower than prices, necessarily high enough to support the cost of transport and very high maintenance costs associated with the remoteness of the East West railway locations. This and relay running, lowered
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barriers to entry into the rail market, and enabled significant price reductions, together with vastly improved transit times.

This fundamental thinking has continued to drive further investment in rail, supporting further improvement efficiencies. Launched from these innovations and new infrastructure like the Darwin Alice Springs rail line, we have seen the mineral market open up to rail, where previously these freights were more cost effective by road.

5. Current improvements spawned by improved operational efficiencies.
The introduction of the aforementioned innovations started a journey if improved competition, better and more diversified offerings to the marketplace and INVESTMENT. Which was something lacking in rail since the ‘60’s.

5.1. Warehousing, high capacity purpose built rollingstock.
SCT for example has become the largest property developer in Australia of rail related warehousing facilities. Improved rail economies have enabled investment in purpose built warehousing facilities. Most operators are now moving to the model of collocating freight forwarders, warehouses and rail terminals together. Kewdale, Forrestfield, Parkes, Keswick, Altona and Penfield are some of the recent multimodal facilities that have been built, with a number of other facilities on the drawing board, or development phase.

Co-location obviously is a further improvement in managing the all important consolidation costs so critical to enabling rail to reduce the length of journey required to achieve the fuel efficiencies necessary to overcome roads advantages.

5.2. AC Locomotives
New technologies like AC locomotives are further reducing fuel costs. As rail has become more reliable and transit times have reduced, renewed investment in the industry has become more typical. When I first entered the rail industry nearly 30 years ago, rail cars were still operating that were introduced in 1904. Even today, locomotives are operating that were first introduced in the 1950’s. Imagine trucking companies with old Leyland trucks today!

Intermodal long haul rail operations were the first in Australia to introduce AC traction locomotives. AC locomotives have enabled significant fuel savings with the better performance achieved by this type of technology. AC (alternating current) Drive, also known as Variable Frequency Drive is rapidly becoming the norm. AC traction adhesion levels are up to 100% greater than DC. Much higher reliability and reduced maintenance requirements are also reported for AC traction motors.

AC Locomotives have better adhesion and lighter weight; they are more fuel efficient and environmentally sustainable. These locomotives also allow full braking down to zero speed, unlike DC dynamic braking. With AC traction the braking can be much higher because the drive system in braking acts just like the drive does in traction thus eliminating wheel slip. An AC locomotive can control to a specific motor torque level allowing the tractive effort to be essentially constant at the higher range of available adhesion.

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AC traction provides improved adhesion through weight transfer compensation. A locomotive under load, weight tends to transfer from the front axle to the rear axle. The lead axle load may be reduced by about 20%, thus tractive effort reduced by about 20%. When the lead axle goes light, the AC drive system will reduce power to that axle and apply more power to the rear axle without incurring wheel spin.

The introduction of this technology has had some further profound impacts. The efficiencies achieved by this technology have changed the economics of locomotive operating life. It’s now cheaper to buy new locomotives than undertaking major overhauls and rebuilds. I think we will see the operating life of locomotives shorten. Newer higher speed diesel engines are much lighter allowing more human comfort and operating flexibility in the design of locomotives. More modern locomotives have allowed greater technologies to be built into a locomotive, increasing the rate of innovation!

### 5.3. Track Condition Monitoring – In Running

Along with improving locomotive technologies, track condition monitoring and rail infrastructure management is being assisted by smaller and smarter technologies. Track condition monitoring equipment is now small enough to install on operating rollingstock.

Most networks across Australia tracks are monitored by, recording cars every three months or so, cab track inspections, and weekly hi rail inspections and some track walking. These methods are costly and labour intensive in areas where there are skills shortages, but more critically, infrequent.

Most maintenance is driven by the results of three monthly track recording car’s identifying defects over the preceding three months. Almost everywhere in Australia, low traffic volumes mean that track maintenance is more often driven by environmental factors, than by usage or “wearing out”. However as we all know, the environment can affect the track conditions significantly in the allowed three month window. This is partially offset by manual track inspections. However, increasingly the weather itself is becoming more extreme.

Reliable, frequent and low cost track condition monitoring; by installing this equipment on selected commercial rollingstock has enabled operators to reduce the inspection window to weekly recordings. It’s possible to conceive of this technology, reducing the window to daily or even more frequently. Obviously, the advantage is earlier maintenance interventions. Frequent monitoring provides more informed observations of the rate of deterioration of track condition and ultimately more predictability as to when maintenance interventions are required. It may even be possible to predict track buckles or broken rails, probably the most common contributor to rail accidents.

This innovation may not totally supersede current management practices, but may complement these processes. Either by extending the frequency of full track condition monitoring cycles, increased network capacity, or by reducing track maintenance occupations. With timely and predictive maintenance interventions, costs will be...

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6. **Innovations in development**

Today further innovations are actively under development. These innovations are likely to come into operation within the next few years, helping to further manage costs and improve asset utilisation and network capacity. Some examples follow;

6.1. **Live Bearing Condition Monitoring**

Although bearing failures have dramatically declined in the last ten years, they still present a significant risk and loss event. W.I.L.D and RailBAM, static trackside equipment has had a significant contribution to this improvement.

RailBAM and WILD train monitoring systems are the primary systems used by network managers to monitor rolling stock wheel and bearings.

RailBAM stands for “Rail Bearing Acoustic Monitoring” and is a predictive tool to identify wheel sets with bearing faults, which left unchecked could result in catastrophic failure and is a leading cause of derailments.

WILD technology (Wheel Impact Load Detectors) monitors force exerted on railway tracks as a wheel passes over the monitoring equipment. Its primary focus is to identify wheels that are not round and therefore “hammering” the rail head and distorting the track. However WILD is also a diagnostic tool for rail operators to identify wheels with damage and enables earlier maintenance intervention to re-lathe the wheel, thus extending wheel life.

WILD monitoring will not identify faulty wheel bearings, but assists in identifying wheel faults that contributes to wheel bearing faults.

Both these technologies in Australia date back to the early 1990’s and have been in use in Australia since the early 2000’s. Obviously, the effectiveness of this technology is dependent on the number of installations and the frequency a vehicle passes one of these installations. There can be thousands of kilometers between each vehicle cycling past the installation. This is enough time for something to go seriously wrong.

Now it is possible to individually monitor each wheel bearing. Developments in the aerospace industry have been applied to rail in remote areas. We now have computer chips monitoring a wheel bearing. Information is recorded and downloaded at the end of a trip for analysis. In addition, if the wheel bearing exceeds certain parameters, a message is sent to a central transmitter, which forwards an alarm signal to the train driver and our company’s central monitoring system, thus preventing a major failure.

More importantly, this recording technology allows predictive maintenance. “Outliers” can be identified. Outliers are bearings which may be well within defined parameters, but may have an acoustic footprint, or run at a hotter temperature than the typical unit. Static equipment is influenced by the ambient weather conditions, i.e. in cold conditions, bearings will be cooler. However, it has been demonstrated that outliers will fail sooner than normal units. On this basis, it’s possible to identify and replace units that will fail, well before any risk can occur, virtually eliminating this risk.
ARTC is well progressed in developing a “moving block” or Automatic Train Management System, (ATMS) train mounted safeworking system. Eliminating ground installed signalling equipment. This system has major advantages in increased network capacity, without having to build additional rail track infrastructure. I’m sure that the literature on this initiative is well publicised, but there is a less obvious, but significant advancement in this in improving the economics of train operations.

Trains with ATMS are going to be able to obtain up to the minute track condition information, including speed restrictions, delays and the like. The currency of this information will be integrated with existing driver decision support systems that aid driving. This opens potential for improved train handling, lower operating costs and fuel savings. Not only will there be better network utilisation, but improved train operations.

6.3. Driver Decision Support Software
The need for train drivers to be skilled operators and be familiar with the track, on which they operate, “Route Knowledge”, is recognised. However, a driver’s competence in route knowledge has limitations. Not only can the usual human factors intervene, such as distraction, health and fatigue, but there are also limits to human processing capacity. In situations where track conditions change, it can be difficult for a driver to calculate how best to drive to the new track condition, such as a speed restriction. Indeed, it is not always possible to communicate new changes in track conditions in a timely way, or in a manner that draws the appropriate attention from the intended recipient of the advice, in a world where there can be human “information overload”.

It has long been practiced in both the road and airline industry to provide decision support for pilots and drivers. In rail the decision support software is already available and can be used to identify optimal driving of a train under various loads and conditions. This happens now, but the detailed data required to ensure optimal driving in all conditions is not always available, particularly the information necessary to enable a driver to drive appropriately under current traffic conditions. For example, the conditions for “ideal” powering and braking positions can be established for a train in certain geography, under various train lengths and loads, but this “ideal” may not be optimal when speed restrictions are imposed and trains cross or overtake. Optimal driving may be different is the train has to stop at the end of the section, as opposed to continuing at speed. Additionally, a driver’s advanced knowledge of traffic can be incomplete. Therefore for example, knowing that a train may be slowed in several sections time for a cross, may make the optimal drive a slower trip, conserving fuel, at the expense of achieving line speed and quicker travel time.

Once ATMS has been implemented, the same computer that manages the traffic of the network and its database can be interfaced with the on train decision support system, allowing real time up to the minute optimal driving conditions for the train.

The consequences of this technology may not be immediately obvious. There are clear economic advantages in fuel savings, through

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Driving efficiency. I believe it’s also possible to assist in reducing network congestion and higher infrastructure utilisation, by ensuring trains are driven exactly to the current network demands.

Safety will be improved, through reduced fatigue, better task load and more directly, ensuring train separations are better managed with timely driver interventions, before the ATMS system becomes engaged.

Integration of the driver decision support with ATMS creates synergies that will deliver a greater outcome that each system individually.

6.4. Advanced Second Generation Crew Van Facilities
Finally, I’ve touched on the competition benefits and economic benefits of relay running, which I believe are far more profound, than most would realise. There is however, continuing concern about the fatigue implications and some safety aspects arising from relay running. Firstly, concern surrounds the quality of rest achieved in a relay van. Secondly there are concerns arising from rostering practices that have evolved through industrial instruments. Finally, there is a marginal, but increased risk of slips, trips and falls in travelling between crew vans and locomotives, often is less than ideal circumstances.

For the Australian rail industry, I firmly believe that relay running is a critical and crucial operational requirement to extend and improve rail’s economy, utilisation and competition. Large barriers to entry and accessibility for “on ground” crewing facilities have inhibited rail in competing with road operations to remote mining locations. Relay running has now opened up new possibilities, but we need to go further to address the concerns outlined above.

Crew Vans, to provide crew resting facilities have all been designed around passenger rollingstock. To my knowledge there are no custom built crew vans in operation. These “rebuilt” crew vans from passenger rollingstock have one essential design flaw. They have been built for small trains with low loads. Modified draw gear, vehicle frames and bogies, suitable for heavy freight trains have never produced an ideal outcome for ride quality that a custom vehicle could produce. Most are very old original vehicles that have not incorporated current technologies or design practices. Finally, the crew facilities have been limited in design to the outline of a passenger carriage and cannot produce a reliable platform for connecting the advanced electronics used in a modern locomotive driving system. These crew vans, I’ll label first generation.

Today the availability of passenger rollingstock that can couple to a freight train is very scarce. More and more self propelled light passenger vehicle in operation ensuring less availability going forward into the future. So plans are now on the drawing board for development of what I’ll call second generation crew vans, these are purpose built crew vans.

These vans will deliver a number of benefits. Improved ride quality resulting in improved rest and sleep opportunities for crews. Crews will also experience quieter rides, thus improving restorative sleep opportunities as well. It is also expected that these purpose built vans will reduce the risk of slips, trips and falls from transferring crews to and from rail rollingstock.
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Locomotives, with on board transfer facilities. This is also expected to reduce transit times on train schedules by also reducing crew changeover time.

7. Conclusions
The innovations described above will undoubtedly drive costs in rail operations by;

- Enabling more competition in the market place,
- Reduced infrastructure and maintenance costs,
- Reducing incidents and losses, and
- Improving operational efficiencies and consequent cost savings.

I believe that rail in Australia is indeed at a crossroad. The structural reforms of the 1990’s and 2000’s are now coming into fruition. There has been significant growth in rail usage. Efficiency gains and environmental considerations are likely to continue to drive demand for rail services into the future.

Rail demand in the bulk export commodities markets will always fluctuate with the demand for commodities, but all forecasts\(^4\) are for transport demand in Australia to continue to grow, both road and rail, but I believe that rail demand in its core markets will remain high. There is also potential for rail demand to replace road transport in the intermodal market, where road and rail is largely substitutable. I predict that as rail costs will reduce at a greater rate than those on road. Intermodal rail operations currently dictated by consolidation and deconsolidation cost being lower than the line haul fuel savings compared with road.

Innovations already in the pipeline will drive down that breakeven line haul cost for intermodal rail operations and reduce the size of a viable train.

7.1. Where will rail innovation go from here?
I believe there will be a step change in reduction in rail costs, into the near future, but dependant on the rate of investment in the technologies described above. Rail is capital intensive and has a long investment cycle. Demand will drive new investment and replacement infrastructure. This will be driven by a movement away from traditional static, on ground installations and into smarter train technologies. Already points and signals are increasingly operated by in cab technologies, and it seems a long time ago since we were predominated by signallers at crossing locations. Centralised Traffic Control systems and automatic train braking systems operated from ground based static control systems are enormously costly, maintenance intensive and need large volumes of traffic to justify their costs.

Technologies derived in the outback built into “smart trains” are lower cost and require less maintenance. The reach of these technologies will evolve into more densely trafficked areas of operation. Signalling and infrastructure maintenance inspections will increasingly be undertaken by “smart trains”. Closer integration of infrastructure software with on train computing will reduce operating costs and fuel efficiency. Both infrastructure and operational costs will come down.

\(^{4}\) The Outlook for the Transport Sector, November 2012, Australian Industry Group
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Those continuing to invest in off train technologies will I believe find an ever shrinking market.

7.2. Will the rules of land transport competition remain the same?
Emphatically no! As we have seen in the steel industry in the last twenty to thirty years, large capital intensive mills have given way to small furnace technology, enabling a multitude of small scale steel making factories and the decline of large scale manufacturing of steel.

A similar revolution is occurring in Australia, in commercial freight operations. The technologies described above have enabled smaller operators to compete with the large organisations. The value of economy of scale is diminishing as a competitive advantage. Smaller operators are able to compete more effectively because of the innovations described. There are now more rail operators in the commercial and profitable rail freight sector than ever before.

Product lifecycle theory, confirms this. Rail in Australia has grown through the Initiation and Growth phase. Now as a mature market, product differentiation and multiple operators have already shown costs are being driven down. When SCT entered the East / West rail market, price reductions of 30% were observed. There is no reason to think that similar opportunities don’t exist in the bulk ore or East Coast intermodal markets.

7.3. Rail infrastructure investment and charging
The rate of change will be inhibited or advanced by appropriate infrastructure investment. Unfortunately, infrastructure investment is largely seen from a pure competition perspective, without the strategic perspective, beneficial to the country and its taxpayer investors. By way of example, investment in the Hume freeway to complete the dual carriageway occurred concurrently with investment in upgrading the rail corridor. Similarly, the Princess Freeway between Melbourne and Geelong occurred at the same time as the fast rail project to improve rail transit times. And the net result? The road and rail competitive position remained unaltered. On the face of it, this is a perfectly reasonable outcome. However, is this best for the community? The Melbourne – Brisbane inland rail corridor languishes, a distance where rail can be more competitive than road, while the shorter haul Melbourne to Sydney and Sydney to Brisbane corridors attracts investment, with the backdrop of the freeway systems between these capitals also being improved concurrently.

If one looks at rail’s natural competitive advantages, long haul and high volume, infrastructure investment in the Melbourne / Brisbane corridor makes more sense, than regional rail, or Sydney to either Brisbane or Melbourne. Road will always have a natural competitive advantage in short haul, or low volume transport. Yet, short haul low volume loss making rail infrastructure still continues to attract investment.

7.3.1. Complementary transport investment
Each of rail, road, air and sea transport operates in distinct market segments. Air, with its speed will win for high value, short shelf life products. Shipping will always be competitive in the long shelf life, low value

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products. Road and rail will never compete in the international market from our island.

But, as stated, road has its market advantages and so does rail. Neither will compete where the other’s natural competitive advantage is strongest! So investing in infrastructure to equalise road and rail competition adds little value to the community. There will always be segments of the market where all modes of transport are substitutable, but in the main, infrastructure investment, to complement the modal advantage will give a better result to the community.

It is my belief that infrastructure investment will inevitable flow to rail, but government investment to complement its modal advantage will accelerate the use of rail and increase rail substitution for marginal road markets.

7.3.2. Infrastructure access charging

Similarly, I think we need to look at infrastructure charging models that will accentuate rail’s competitive advantage, as well as recover its economic cost more efficiently. From my experience with the Victorian regional rail network, fixed costs are very high, around 90%. Most networks in Australia do not have enough volume to drive maintenance charges through usage. Generally, environmental degradation is the main driver of maintenance costs. However, access charging regimes are built around unrealistic variable charging regimes. Variable costs are usually around 40%. What occurs, is a cross subsidation from heavy freight operators to light rail operations.

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On a network, crossing loops and track speed is largely fixed. Train weight has little impact on cost drivers. So, why charge by Gross Tonne Kilometres? The product a network is offering is pathways, for a fixed train size. If a train is short, or below axle load, it still occupies the same network space. If rail is to progress, charging regimes need to move to Train Kilometres. In this scenario, a train of maximum weight and length is advantaged over less efficient trains. This encourages maximising network occupation and efficiency. In turn, efficient operators, compete more effectively with alternative modes of transport, where rail is most effective. The cost to the community at large is reduced.

7.3.3. Holistic transport regulation

Unfortunately, our community is acclimatised to road tragedy. Rail, statistically is about nine times safer that road transport. And yet, we often see trivial safety issues in rail cause modal shifts to road. Why for example would you shift a train load of passengers from a train, with a marginal increased exposure to risk on rail, to road, with a nine times increase of risk exposure?

All our regulation in transport is modally contained. Safety risk is defined by the inherent risk within the mode of transport. So a modal shift may be required if there is a shift of safety risk, within the mode. Often this results in a significantly greater risk occurring to the community.

It is my view that regulation and risk should be proportionate to the inherent risk, but also recognise the risk associated with the next best alternative. Let me give you an example.
In Melbourne recently, a computer failure in the under road city tunnel caused signage to fail. The failure of the driver warning systems was deemed sufficient to close the tunnel and force all traffic onto arterial roads, off the freeway. This was a good outcome for the tunnel operators, who avoided their increased risk, but increased road accidents and harm, with the alternative.

It is my thesis; regulation should not focus wholly within the mode of transport being regulated, but Must in all good conscience consider, the risk inherited, by modal substitution. It is my observation; high costs are incurred in rail for the sake of safety, to substitute road transports, which will never ever achieve the same level of inherent safety as can be achieved on rail. Safety solutions must be considered holistically. It makes no sense for rail to incur high substitution costs, environmental costs and reputational damaged, when in fact the alternative is much worse. Investment and cost reduction, without rail regulation adjustment, will inhibit rail’s full potential to deliver alternative safe, clean and environmentally sustainable land transport.

7.4. Driver less, automatic trains, remote controlled technologies or not?
One final observation; Driver only operation, Remotely Driven Trains and Driver Less Operation is often argued as the panacea to remove rail costs. Is it? Automatic or Driver Less train operations are extensively used across the world. The Paris metro for example is a great success, significant safety improvements have been made and costs lowered. However, these systems are “closed” systems. They are small area, single traffic networks, without interfaces with road or other networks.

Remote driver operations, such as those proposed in the Pilbara are also feasible, because of the limited traffics and localised area of operation, without many interfaces.

In “open” systems, such as the defined interstate rail network, crossing multiple networks, multiple operators, multiple technologies, road interfaces and large areas of remote environments. The applicability of driver less trains may be difficult to implement satisfactorily. In simple practical terms, a train failure of any sort can mean delays of many hours to obtain human intervention. This potentially could cause significant delays for minor issues. This is not to say such technologies should not be pursued, but there are still many opportunities to drive out cost, without having such a high cost significant capital investment.

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