Introduction

This report discusses rail freight movement in Australia. Total freight movement is forecasted to triple by 2050 from 2006 levels (ARA, 2010). In 2014, an estimated 14.5% GDP contribution coming from transport and logistics sector is very crucial to Australian economy (Ernst and Young, 2014). Section-1 discusses reasons for desirability of intermodal approach for non-bulk freight movement, Section-2 discusses why rail use is more justified at Sydney port than Melbourne port and Section-3 discusses why rail freight share is less than might be expected for each sub-system considered by Ghaderi et al., (2016).

Section-1

Container movement is strongly concentrated in Australia, in 2009-10, 97% of the container movement was handled by 6 ports (Melbourne, Sydney, Brisbane, Fremantle, Adelaide and Burrnie) (Lubulwa et al., 2011). In 2011-12, approximately 8% of Australia's non-bulk freight was carried by rail on three main corridors (Eastern states-Perth, Melbourne-Brisbane, and Brisbane-Northern Queensland) with estimated growth rate averaging at 3.5% per annum (BITRE, 2014).

Fig-1 shows population density and rail network with majority of the population concentrated in coastal cities. Dispersed location of industrial activities/international ports and consumer market, non-bulk freight travels vast interstate distances to reach point of consumption (Ghaderi et al., 2013). Fig-2 shows major freight flows in Australia for year 2010-11.

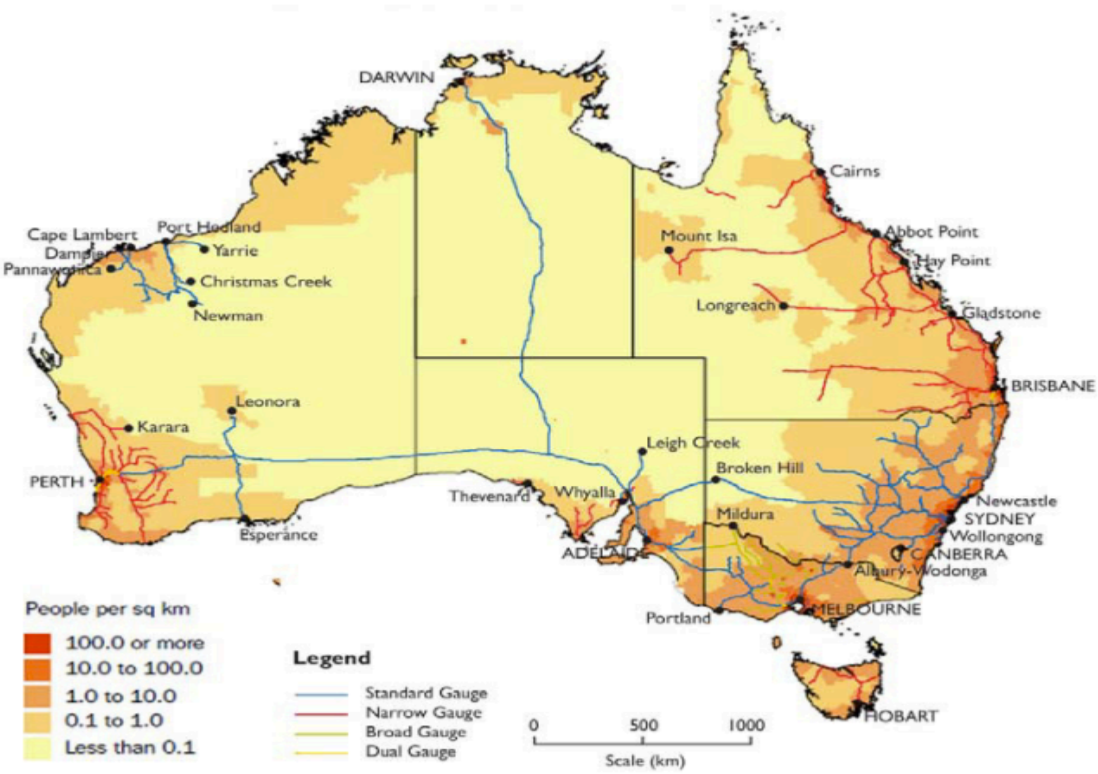

Fig-1 Railway network by gauge and distribution of population across Australia (Ghaderi et al., 2015)

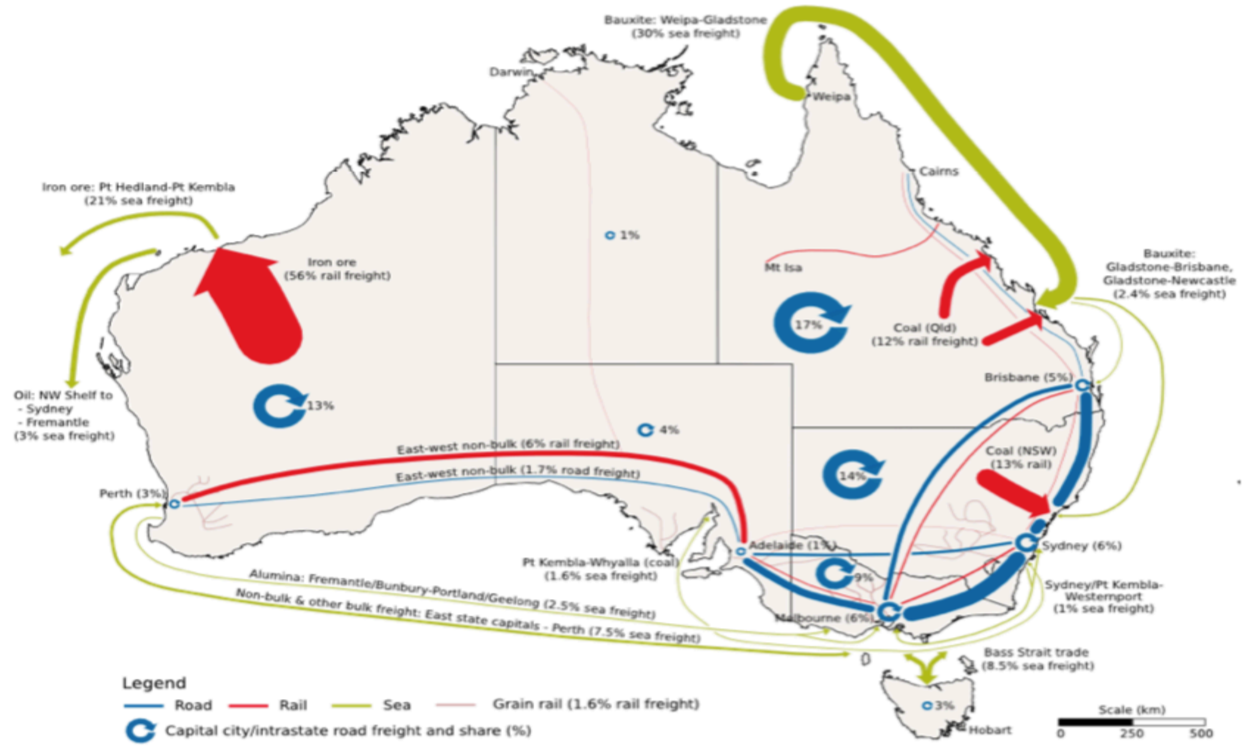

Fig-2 Major freight flows in 2011-12 (BITRE, 2014)

Movement of freight has external costs of emissions, congestion and noise (Braekers and Janssens, 2009;Demir et al., 2015). External costs in capital cities in 2005 was estimated to be $9.5 billion, including $3.5 billion private time cost, $3.6 billion in business time cost and $1.2 billion in extra vehicle operating cost with Sydney metropolitan area at highest cost of congestion of $3.5 billion warranting the need to address these externalities (Ernst and Young, 2014). Intermodal transport is one of the approach which can reduce these externalities (Mostert et al., 2017).

Intermodal transport is defined as “The movement of goods in one and the same loading unit or vehicle which uses successively several modes of transport without handling of the goods themselves in changing modes.” (OECD, 2002).

RECORDIT (REal COst Reduction and Door-to-door Intermodal Transport) study for three European corridors during period of 1992 to 2002 with complete analysis for almost all external costs for intermodal and unimodal transport modes showed intermodal transport at greater advantage (Braekers and Janssens, 2009; Kreutzberger et al., 2003). Table-1 shows marginal average external cost for road and rail of which rail is approximately 50% lower in comparison to road.

Cost element	**Road** [1]	**Rail**[2]	**Inland waterway**	**Short sea shipping**
Accident	5.44	1.46	0	0
Noise	2.138	3.45	0	0
Pollutants	7.85	3.8	3.0	2.0
Climate Costs	0.79	0.5	Negligible	Negligible
Infrastructure	2.45	2.9	1.0	Less than 1.0
Congestion	5.45	0.235	Negligible	Negligible
Total	**24.12**	**12.35**	**Maximum 5.0**	**Maximum 4.0**

Table-1 Marginal external cost per transport mode (Euro per 1000t/km) (European Commission, 2002)

Iannone, (2012) based on modelling data in Campania, Italy for ports Naples and Sarleno and intermodal ports Nola and Marcianise that transporting containers by train would produce 6 times less total external cost per TEU-km than truck transport will deliver annual saving of 12,600 tonnes of CO_2 and in terms of air pollution (CO, NO_X, PM, SO_2, VOC) from transport is approximately 220 tonnes per year. Similarly, modelling studies for port Gothenburg in Scandinavia showed implementation of intermodal terminal will result in 25% lower CO_2 emissions (Roso, 2007).

Further, movement of freight trucks impacts residents (who are not customers of freight) with issues of congestion and noise resulting in local councils put restrictions permitting movement during specific time periods and allowing certain type of vehicle which can affect businesses (Lubulwa et al., 2011). Adopting the intermodal approach can reduce the number of trucks moving between port and customers and eliminating externalities of road transport (Lubulwa et al., 2011). For example, to transport 300,000 TEU throughput per year through Enfield intermodal centre running seven 600m train shuttles at 60% load can result in reduction of 329 truck trips per day (Shipping Australia, 2011). Also, valuable land in Australian cities can be used for other important purposes by diverting industrial and warehouse usage sites to hinterland intermodal facility (BITRE, 2016).

Thus, there is a strong business case for movement of current and future non-bulk freight market via intermodal approach reducing externalities.

<u>Section-2</u>

Using the concept of 'break-even distance' that is briefly explained below, rail is more likely to be the choice for freight movement at Sydney port in comparison to Melbourne port.

Macharis et al., (2010) have shown in Belgium intermodal transport beyond a certain break-even distance becomes more desirable when cost of transhipment and terminal cartage are offset. Further including fuel price variable in the cost of unimodal and intermodal transport and using the LAMBIT model break-even distance reduces from 99km to 88km for reference scenario as shown in figure-3 and figure-4.

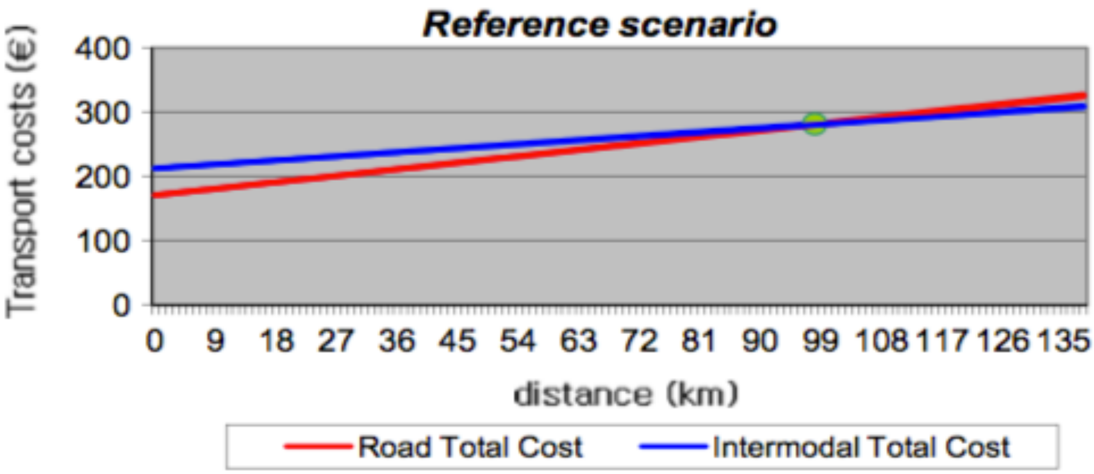

Fig-3 Reference scenario for break-even cost distance (Macharis et al., 2010)

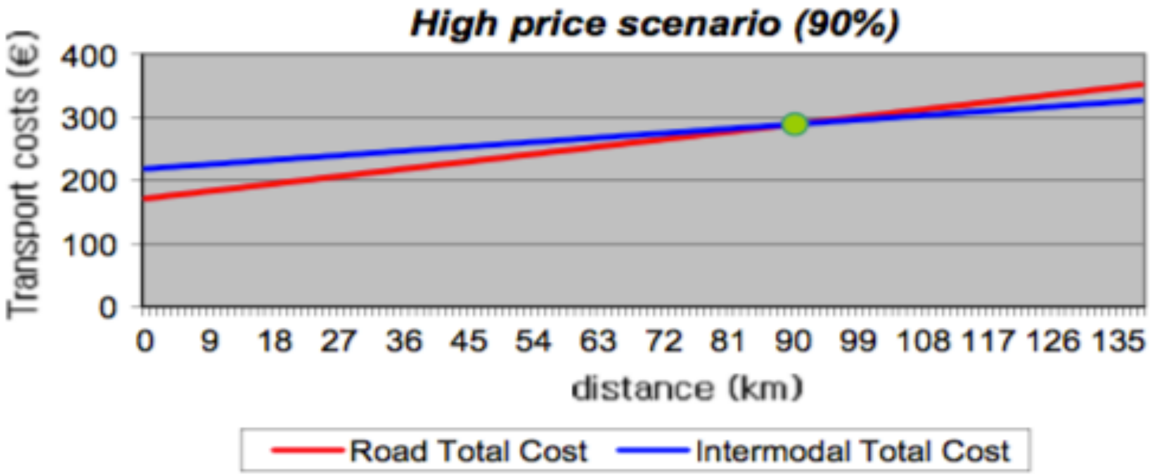

Fig-4 Higher price scenario and break-even cost distance (Macharis et al., 2010)

Melbourne port

Docks do not have rail access but freight trains are handled outside stevedore's port terminals and requires container to be transferred via trucks to rail terminal. In case of road, there is a direct access available to docks. Thus, movement of containers via rail requires them to travel by road outside the terminal for transfer to rail while such transfer is not needed for road haulage (Ghaderi et al., 2016).

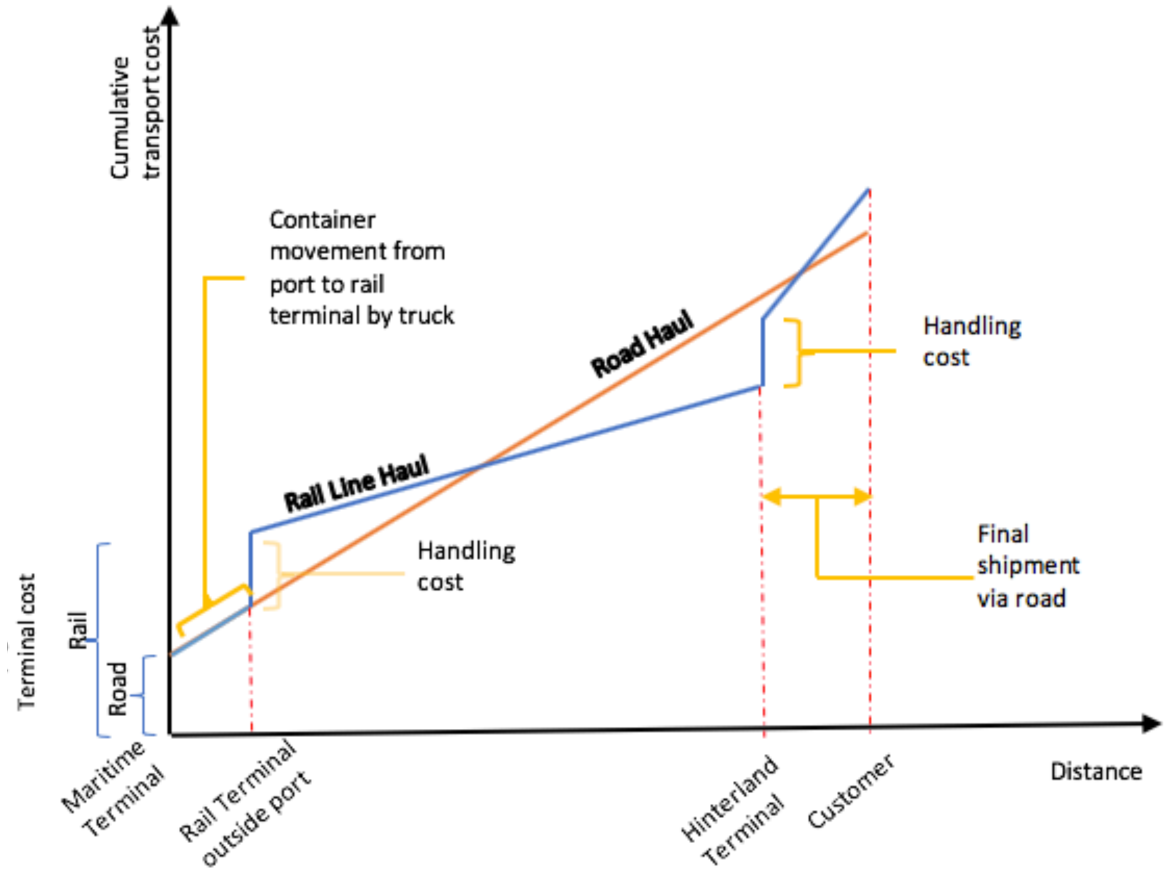

Fig-6 Cumulative cost vs distance comparison between road haul and rail haul (via intermodal terminal) [Adapted from (Regmi and Hanaoka, 2012)]

Figure-6 shows that cost of moving container via road is cheaper with higher per km cost in comparison to rail which has lower per km cost. Primary reason being the requirement of extra handling cost which does not offset the lower per km shipping cost for the distance considered.

Sydney Port

Docks have direct rail and road access. In case of rail, the haulage of freight to customer takes place via rail through intermodal terminal while for road haulage travels directly to customer without the need of going through intermodal terminal (Ghaderi et al., 2016).

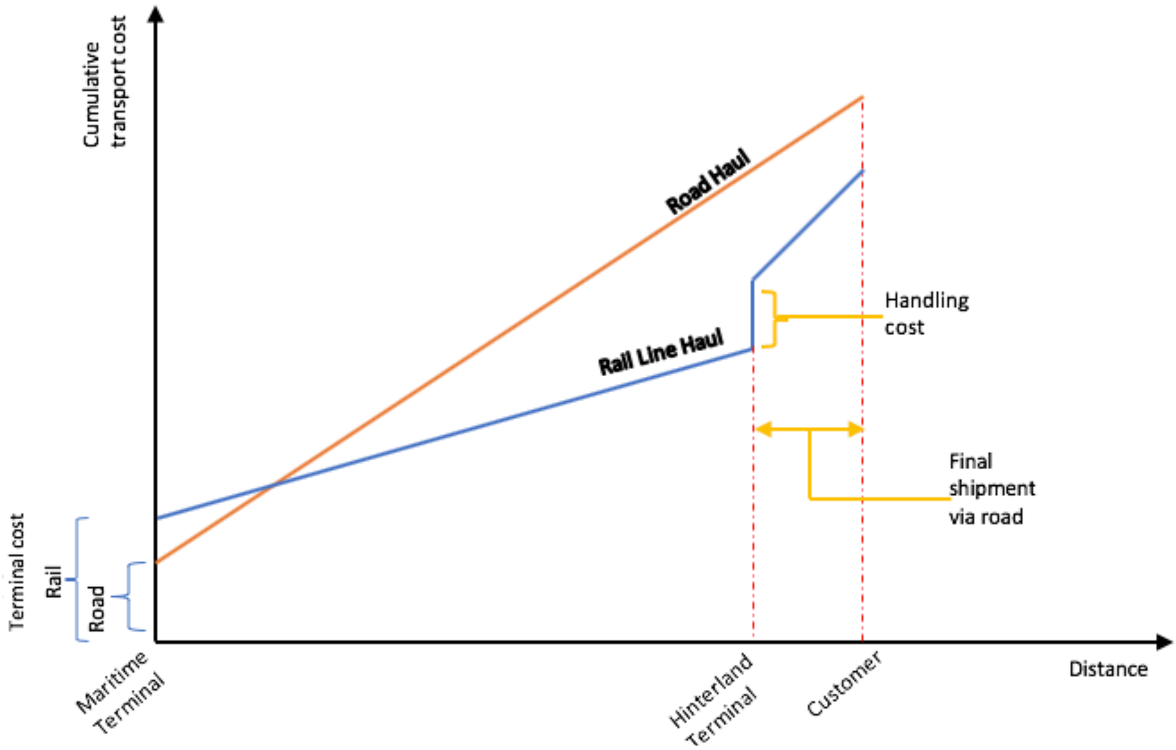

Fig-7 Cumulative cost vs distance comparison between road haul and rail haul (via intermodal terminal) [Adapted from Regmi and Hanaoka, (2012)]

Above figure shows that cost of moving container via rail is cheaper with lower per km cost and higher terminal drayage and costs in comparison to road which has higher per km cost and lower terminal Drayage and costs. Break even distance is less for movement via rail for Sydney in comparison to Melbourne. The primary reason being the availability of the access to rail at docks which removes the additional handling cost present in the case of Melbourne.

<u>Section-3</u>

In 2011, rail freight accounted only 9% for Melbourne and 14% for Sydney of the total freight share of 35% and 34% respectively (Shipping Australia, 2011).

<u>Interstate sub-system</u>

One of the primary reasons for less rail freight volume is three different gauge lines (narrow, standard and broad) across the continent as shown in figure-1. Each developed to support movement of freight within the state hinterland from the port, rather than taking broader view of integrating cities across the state (ARA, 2010). This results in additional handling cost and as shown in section-2 rail loses its cost advantage (Janic, 2007; Macharis et al., 2010). In Adelaide, freight line with standard gauge and passenger line with broad gauge results into conflict points across the network which supports movement of 30,000 containers via rail to/from port Adelaide to northern regions, overcoming physical barrier of gauge difference would benefit freight movements (Ernst and Young, 2014).

Along with physical barriers of gauge differences, railways being state monopolies there were jurisdictional and institutional barriers as well which hindered interstate movement; with deregulation of rail sector this barriers were to be removed but, access and control regimes defined by respective state government served state level market interest rather than intention of 'one stop shop' across the interstate network envisaged for ARTC (Australian Rail Track Corporation) (Everett, 2006).

Freight lines share track network with passenger train movements where priority is often given to passenger than trains often resulting in increased delivery times (ARA, 2010; Ghaderi et al., 2015). For example, at Port Botany in Sydney, with dedicated freight track, freight trains servicing hinterland intermodal terminals on shared passenger networks are not allowed on peak hours (6:00-9:00am and 3:00-6:00pm) during weekdays (Shipping Australia, 2011). Similarly at port Fermantle part of network is shared with passenger trains for roughly a kilometre where passenger rail takes priority and impacts freight services during peak hours (07:00-10:00 and 16:00-19:00) (Ernst and Young, 2014). Dablanc et al., (2013) have also highlighted this as one of the barriers within the existing rail strategies for freight.

Ernst and Young, (2014) and BITRE and ARA, (2014) have indicated long transit times and punctuality being the key issues influencing decisions of consumers and shippers on using rail for interstate intermodal freight movement. Dearth of funds has degraded rail infrastructure to sub-optimal quality of track and signalling resulting in average speed of 45 km/hr on some tracks that increases transit time in comparison to heavy road vehicles reaching average speed of 70 km/hr (Ghaderi et al., 2015;Ferreira, 1997). Table-1 indicates rail delivery times to be higher in comparison to road has resulted being not viable option for 65-75% of north-south freight task and fails to achieve modal share (ARA, 2010).

Mode	Syd-Melb	Syd_Bne	Mel-Bne	Mel-Adl	Mel-Per
Road	11	15	23	9	43
Rail	17	21.5-26	36.5-45	14.5-16.5	58-68

Table-2 Door to door freight transit times between Australian cities (hours) (ARA, 2010)

<u>Port Based Sub-system</u>

Stevedore booking is required for movement of container and there is a significant cost differential between rail and road which puts rail at disadvantage for comparable container movement (Shipping Australia, 2011). For example, in 2011 at Port Botany in Sydney, cost for minimum 36 lifts/hr at \$15/lift for a given rail window and if window was cancelled within 48hrs \$540/hr is charged regardless it was used or unused; for road transport a fixed \$10 monthly fee and \$5.5 per timeslot provided, which is significantly lower (Shipping Australia, 2011). Also, in terms of stevedore productivity, with two operators is expected to be at 1728 lifts per day without considering shunting operation. However, total lifts performed by both operators are lower than 864 lifts per day (Shipping Australia, 2011).

Insufficient rail capacity and inadequate rail infrastructure hinder modal shift to rail (ARA, 2010). Woodburn, (2006) showed similar case for at Felixstove and Southhampton in UK where infrastructure issues were identified as one of the constraints. Sydney port with one dedicated freight line comprise of two 600m, three 340m and two 475m siding but, trains operating vary in length with regional New South Wales (NSW) trains greater than 600m requiring splitting and shunting to access different terminals due to mismatch between train and siding lengths from lack of standardisation (Shipping Australia, 2011). In case of Melbourne, in past before train operations were ceased, limitation of rail sidings only one train can be loaded/unloaded (Shipping Australia, 2011).

<u>Intrastate Sub-system</u>

Good share of fright movements take place within Australian cities, In 2009, 87% of international and mainland containers imported through Melbourne port were destined to Melbourne metropolitan area while 54% of container exports from Melbourne port originate from metropolitan Melbourne (Lubulwa et al., 2011). Similar constraints (gauge difference, priority to passenger trains) identified in above sub-system deter the modal shift to rail despite freight volume availability.

In general, diversity of rail network with different load handling capacity restricts the use of heavier wagons and if they are permitted with trade-off of lower speed leads to uncompetitive transit times (BTRE, 2006). Trailing load allowed for any given section of track determines max trailing load capacity for route and when factored in with gradient of route impacts the train economics due to limit on trailing load or additional locomotive required (BTRE, 2006).

Fragmentation and segmentation of different actors and governments including failure to coordinate involved in freight movement results in inefficiencies (Termeer et al., 2010). For example, Western Australia has $43 per TEU subsidy for short haul operations to Kewdale intermodal terminal which is not the case in other states and restricting interstate movement which is higher than intrastate movement (Ernst and Young, 2014). In addition, dedicated and priority freight infrastructure servicing mining industry is funded by private industry to serve its interest rather than planning infrastructure for wider benefits (Ernst and Young, 2014).

Not accounting negative externalities in road freight pricing results in distorted use of infrastructure distortion and investment decisions (Ernst and Young, 2014). Rail also suffers competition from shipping industry where international shipping carry coastal trade across the wharfs without mandatory requirement of meeting Australian industrial and OH&S regulations countering the outcome of competitive neutrality (ARA, 2010). One corridor such freight corridor is Perth-Adelaide as shown in figure-2 where private and government operators compete with each other (Owens, 2003).

Conclusion

As discussed above, there is a strong case for increasing the modal share of rail for freight movement and identified gaps needs to be addressed for sustainable growth.

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