Monitoring the Australian Waterfront: Port Performance and Reliability

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Abstract:

The movement of international sea containers is a complicated system that involves both land and sea components, with the port as the interface between the two. As trade is crucial to economic growth, ports have been the focus of reform programs in a number of countries. Typically, the success of these programs have been measured by partial performance indicators of individual port enterprises. For example, crane handling rates and vessel turnaround times. However, these indicators do not provide a measure of how well a port is operating as a complete system. This paper provides a new approach to monitoring the impact of waterfront reform upon port performance by investigating changes in the reliability of liner shipping schedules within Australia.

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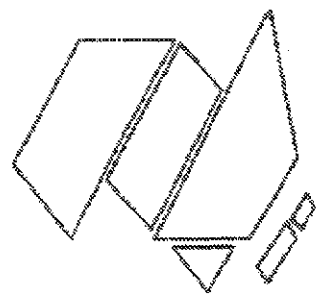


MONITORING THE AUSTRALIAN WATERFRONT: PORT PERFORMANCE AND RELIABILITY

A. THE DEVELOPMENT OF PORT PERFORMANCE AND RELIABILITY MEASURES

1. INTRODUCTION

The movement of international sea containers is a complicated system that involves both land and sea components, with the port as the interface between the two. Ports operate as the link between many enterprises, some with competing commercial interests. Given that trade is crucial to a healthy national economy, ports have been the focus of a number of national micro-economic reform programs.

Initially, the Australian Government's waterfront reform program concentrated on the stevedoring industry. However, in recent years the emphasis of waterfront reform has shifted to include the total transport chain; from the warehouse to the wharf. The purpose of this shift is to ensure that the benefits of improved port operations flow to the ultimate users of the container system - the shippers or cargo owners. This change of emphasis was highlighted by the House of Representatives Standing Committee on Transport, Communications and Infrastructure (HORSCOTCI) in the report on its inquiry into the *Efficiency of the Interface Between Seaports and Land Transport* (HORSCOTCI 1992).

The Committee's report recommended that the Bureau of Transport and Communications Economics (BTCE) "produce a six monthly Port Interface Indicator on sea/land transport interface efficiency" (HORSCOTCI 1992, p.101). Subsequently, the Bureau has published a waterfront cost index covering the period July to December 1992, in *Transport and Communications Indicators* (BTCE 1993, 21). The cost index provides a holistic indicator of the costs of shipping cargo to or from a warehouse through a port.

However, changes in costs alone cannot represent accurately the effects of the Government's reform program. For example, increases in the cost index may be the result of improved quality of port services or it could reflect a more inefficient transport chain. Since the quality of port services offered may be equally important in the decision to import or export, particularly for time sensitive or fragile cargo, an indicator of overall service quality is required to complement the cost index.

2. WATERFRONT PERFORMANCE INDICATORS

It is generally recognised that there are limitations in using port indicators for comparison purposes. Dowd and Leschine (1990, 110), reporting on US container terminal productivity, concluded that:

> "...the measurement of container productivity has more in common with a commercial art form than with science! The lack of uniformity in the data

> used for productivity measurement is enormous.... This lack of uniformity renders difficult valid comparison of the measurements of two terminals and the formulation of uniform standards for international, national, regional or portwide application."

The Bureau of Industry Economics (BIE 1993, xiv) also highlighted the difficulty of drawing reliable international comparisons using existing waterfront indicators:

> "While there have been considerable improvements in ship and cargo turnaround times by reference to historical performance on the Australian waterfront, the BIE was unable to obtain reliable data to indicate how Australia's performance on these and other quality of service measures compares with our international competitors."

Examples of Australian waterfront performance measures reported by the Waterfront Industry Reform Authority (WIRA 1992) and the Australian Transport Advisory Council (ATAC 1992) are shown in table 1. The uniformity of the WIRA and ATAC indicators has been important in comparing the effect of the waterfront reform program throughout Australia. These indicators complement each other, reflecting the emphasis of the Government's waterfront reform program, but they do not measure the total port performance. They indicate the level of service provided by individual operations, but they do not adequately reflect the interaction between service providers and the overall port performance.

TABLE 1 ATAC AND WIRA PORT PERFORMANCE INDICATORS

Primary indicator	*Subsidiary indicator*
ATAC Indicators	
Ship turnaround time	Time awaiting berth
	Time at berth
	Time at berth working
	Time awaiting departure
	Total port time[a]
Cargo dwell time	
Port throughput	TEU per working hour[b]
	TEU per gross hour[b]
WIRA Indicators	
Shipping performance	Delays whilst along side
	Delays due to industrial disputes
Port	Average berth occupancy
	Arrival entry delays

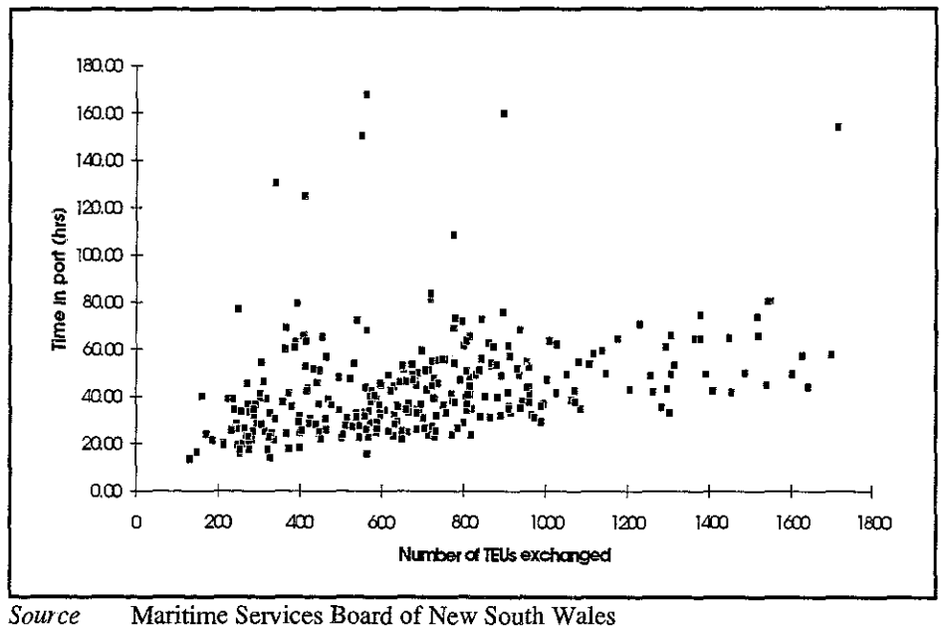
a Median and 95th percentile
b Median and 5th percentile
Source ATAC (1992), WIRA (1992)

To provide an indication of total port performance two alternatives are possible. Additional partial indicators could be obtained to form a bundle of measures that in total indicate changes in the quality of service being provided along the transport chain (see BTCE 1992, Garvin 1984). However, such a method would require significant resources and the cooperation of the enterprises being measured.

An alternative approach is to establish one holistic measure of port performance. Although unable to indicate the performance of individual components of the transport chain, such an indicator would be comparatively simple to compile and would be a good complement to the port interface cost index.

The Need for a Reliability Indicator

The BIE (1993, 45) and the BTCE (1992, 38) argue that any measure of performance should be accompanied by a measure of the variation in performance. That is, some measure of the reliability of the system. The BTCE has obtained information from some port authorities that indicates that there is considerable variation in the relationship between the number of containers exchanged and the time the vessel is at berth. Figure 1 indicates that any single measure of port performance will not provide a realistic indication of the true port performance. There is a need to measure such significant variations in performance.



Source Maritime Services Board of New South Wales

FIGURE 1 PORT TIME AS A FUNCTION OF TEUS EXCHANGED FOR BOTANY BAY, JULY - DECEMBER 1992

The need for a reliability indicator is important since it is generally recognised that waterfront reliability is a major influence on the costs incurred by users. For example, the BTCE estimated the costs of waterfront unreliability to be in the range $890 to $1000 million in 1988 (BTCE 1990). These costs included inventory costs incurred by importers who found it necessary to hold additional stocks to allow for unreliable delivery times, lost trade for exporters, ship delay costs and truck queuing costs. However, in that report, the Bureau was more concerned with the impact of delays rather than variations in the "performance spectrum" (BTCE 1992, 38). Subsequently, the terms unreliability and delays were used interchangeably

The BIE (1993, 44) also noted the problems of conceptualising reliability indicators on the waterfront;

> "Given the nature of the waterfront as a transport interface, different organisations have different views about indicators of reliability. Ship operators are concerned with ship delays and ability to keep to schedules, some port authorities monitor variations in ship turnaround times while terminal operators look at the consistency of equipment performance and cargo processing and clearance procedures."

The Bureau (BTCE 1990) identified unreliable ship schedules as a major source of costs to port users. The ability of liner vessels to deliver cargo on time, both here and overseas, is crucial to the competitiveness of Australian industry. Since the efficient and effective turnaround of vessels can be regarded as the most obvious output of port operations, and as all port activities can play a part in the ability of ship operators to maintain their schedules, port performance and reliability indicators can be derived from the reliability of shipping schedules. That is, by comparing the time a vessel is expected to be in port and the actual time that vessel spent in port.

3. LINER SHIPPING SCHEDULES

Liner shipping schedules are based upon the characteristics of the port and sea components of the container system, but the factors influencing the performance of these two components are numerous and often inter-related (Frankel 1990, 1993).

Naturally, the liner operator has most influence upon the sea component. The factors that affect liner operations may be found in most maritime management textbooks. Also, there have been numerous models developed for effective fleet allocation and management (Perakis & Jaramillo 1991, Lane et al. 1987).

The liner operator has less influence on port performance, but based upon such factors as past experience, the volume of cargo to be discharged, vessel size and choice of stevedore, an estimate can be made on the expected time a vessel would require to be in port. That is, the planned port time is an implicit indicator of port performance.

There is a commercial incentive for the liner operator to accurately plan vessel schedules to efficiently allocate resources. However, in an imperfect world there will be a degree of variation in the ability of individual liner operators to accurately predict

future events, reflecting to an extent attitudes towards risk. Subsequently, it is assumed that changes in the mean planned or expected time in port, per vessel, will represent a change in the expected performance of that port.

Assuming that there has been no significant change in the number of containers exchanged at Australian ports and if the benefits of the waterfront reform process in Australia have flowed on to the liner shipping lines, then it is expected that liner operators would now be allowing less time for Australian port calls.

4. THE PORT PERFORMANCE RATIO

A measure of port performance can be obtained by comparing the difference between the actual time vessels spent in port (a) and the time those vessels were expected to be in port (e), weighted by the number of port calls for that period (n). This difference is the schedule variation (S). That is;

$$S = (\sum a - \sum e)/n$$

Negative schedule variations will occur when vessels take less time in port than expected, that is, port performance was better than anticipated. Alternatively, positive schedule variations will represent a worse than expected port performance.

However, the size and direction of the schedule variation will be dependent upon the time allowed for the port calls. That is, port performance can appear to be adversely affecting shipping schedules (a positive schedule variation) when liner operators expectations are too optimistic. Or a port could be perceived as performing very well when liner operators were overly pessimistic of that port's performance. Therefore, a better indicator of port performance is the schedule variation as a proportion of the total expected port time (e). That is, the *Port Performance Ratio* (P Ratio) is;

$$P\ Ratio = (\sum a - \sum e)/\sum e$$

The characteristics of the P Ratio are;

- as the port performs closer to expectations, the P Ratio approaches zero,
- optimistic expectations of port performance (fewer days in port) will tend to result in positive ratios, with the more optimistic the expectations the larger the ratio, and
- pessimistic expectations of port performance (more planned days in port) will tend to result in negative ratios, with the more pessimistic the expectations the smaller the ratio.

One of the major benefits of the P Ratio is that the actual port performance can be interpreted as either;

- for every day it is expected that port Y will take to turn a vessel around, port Y takes X actual days to turn a vessel around, or

- port Y is working vessels X percent better than expected

As long as the planned and actual times in port are measured in the same way for individual ports, the P Ratio of one port can be compared to any other port, nationally or internationally

5. THE PORT RELIABILITY INDICATOR

Although the P Ratio provides the average port performance for all port calls in a given period, each vessel calling at that port may be considered as having its own port performance ratio (P_i), where;

$$P_i = (a_i - e_i)/e_i$$

If the individual P_i ratios for port calls were plotted together, a normal distribution can be expected with the mean P_i being approximately equal to the port P Ratio. The *Port Reliability Indicator* (R Indicator) measures the variation of this curve and represents the difference between the upper decile of the P_i distribution (P^U) and the lower decile of the P_i distribution (P^L). That is;

$$\text{R Indicator} = P^U - P^L$$

and represents the variation in port performance for 80 per cent of port calls in a given period. Obviously, the smaller the R Indicator the smaller variation in port performance and the more representative the P Index is of total port performance.

B. THE PORT PERFORMANCE RATIO AND RELIABILITY INDICATOR APPLIED TO THE AUSTRALIAN WATERFRONT

1. SAMPLE DATA

This analysis considers only fully cellular container vessels that exchange international containers at the Australian mainland capital city ports of Fremantle, Adelaide, Melbourne, Sydney (Port Jackson and Botany Bay) and Brisbane. A fully cellular container vessel is a vessel built to carry cargo in containers only and excludes roll on/roll off vessels.

The analysis investigates two periods in order to compare changes in port performance over the course of the waterfront reform program. The implementation of waterfront enterprise based agreements (EBAs) at the container terminals is generally regarded as the bench mark of the reform program. Although WIRA gave approval to all major container terminal EBAs throughout 1991, the major benefits did not generally flow on until 1992. Consequently, the first period, 1 July to 31 December 1990 is referred to as the pre-EBA case while the second period, 1 July to 31 December 1992 is referred to as the post-EBA case.

Both the pre-EBA and post-EBA cases consist of five samples, each of two weeks duration, with vessels included on the basis of the following criteria;

- the vessel was listed as a container vessel in the Department of Transport and Communications' *Liner Service Sheets* (DTC 1992);
- the vessel was employed on the Asian, North American, European and Mediterranean services; and
- the vessel made a port call to at least one of the five Australian mainland capital city ports within the sample period. Vessels that were sitting off port were not regarded as having arrived at that port.

The data were obtained from the *Daily Commercial News* published sailing information. Expected arrival times will tend to be more accurate than expected departure times. This is because arrival times are updated daily by the *Daily Commercial News* Services Department to take into account recent developments, while departure times are based on advertised data which are not compiled every day.

The selected services were chosen because they represent the most significant proportion of Australia's international liner trade, by value and volume. The samples enabled a significant database to be established of approximately half the fully cellular container vessels arriving in Australia during the periods covered.

The analysis considered only those vessels making port calls within two weeks of the advertised schedule to ensure consistency between samples since schedules tend to be more accurate the closer the event. Unpublished work by the Bureau on the trans-Tasman service suggests that the degree of schedule reliability tends to vary considerably between service operators but were usually consistent within two weeks prior to the first port of call in Australia.

Where either an arrival or departure time was not published, rather than exclude that port call for the sake of one date, it was assumed that the shipper could make a reasonable assessment from the information provided. For Melbourne and Sydney, if the arrival (or departure) day was provided, the departure (or arrival) was assumed to be one day later (or earlier). For Fremantle, Adelaide and Brisbane, arrivals and departures were assumed to be on the same day.

The database was established on an *ex-post* basis. That is, the information recorded reflects actual rather than scheduled events. In cases where a vessel was advertised as being expected in a port but never arrived, the port call rather than the vessel was excluded. Similarly, if a vessel made a port call to a port other than one of the mainland capital city ports, the port call rather than the vessel was excluded.

Since planned port calls that did not take place are excluded, the analysis did not take into account those vessels that adopted an amended route and skipped a scheduled port. A master of a vessel may be instructed to do so in an effort to make up lost time or perhaps in anticipation of a major delay at the missed port.

2. RESULTS

The analysis considered two areas of interest:

- the performance of Australia, as a whole, to determine the impact Australia has upon the reliability of liner services;
- the relative performance and reliability of the Australian mainland capital city ports.

Australia As Part of The International Container System

The influence that all Australian container ports have on the reliability of international liner schedules can be determined by considering Australia as a port. That is, the arrival at the first Australian port of call and the departure from the last Australian port of call were compared. Feeder vessels (vessels that call at only one Australian port) were not included as it was assumed that these vessels were not representative of vessels calling at several Australian ports. By definition, these vessels are influenced by one port only and therefore were only included in the individual port analyses.

Although the number of planned and actual days in Australia will include some proportion of sailing time, the data obtained indicated that there has been little change in the nature of the sailing component. This is supported by the insignificant change in the average number of port calls per vessel (see tables 2 and 3).

Tables 2 and 3 indicate the results of the Australia as a system analyses. The general reduction in the number of planned days in Australia per vessel indicates that overall there was a perception that the performance of the Australian waterfront had improved. There was a reduction in the actual number of days spent in Australia for both conference and non-conference vessels. This indicates that there has been an improvement in the Australian waterfront. However, the small change in the P Ratio for all vessels suggests that the improved Australian waterfront performance was close to expectations. However, for every 100 days vessels are planned to be in Australia, they are here on average for 112 days.

Interestingly, the optimistic expectations of improved Australian waterfront performance was only shown by conference operators[1]. This may mean that either:

- the benefits of the reform process were uniform and non-conference operators had previously been planning too few days in port, or non-conference operators have been slow to adjust to the changes occurring on the waterfront. In either case, a noticeable improvement in the reliability of the non-conference schedules in the post-EBA period could be expected; or

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[1] Conferences consist of liner operators acting in cartels or consortiums. They are exempt from anti-competitive laws by Part X of the Trade Practices Act. This exemption is currently under review.

- the benefits of the reform process were not uniform, with conference operators benefiting more than non-conference operators. If this was the situation then there should be no change in the waterfront performance or reliability for non-conference vessels, but conference operators should enjoy improvements in both the performance and reliability of the Australian waterfront.

The poorer P Ratio for conferences suggests that conference operators may have been over optimistic in their expectations of improved waterfront performance. However, the improvement in the non-conference P Ratio is primarily due to those operators being pessimistic about waterfront performance. Although the reasons for the difference in conference and non-conference expectations have not been determined, it may be that conference operators were expecting to gain significant benefits from new workplace arrangements at their affiliated stevedores, whereas the non-conference operator did not expect to gain in a similar manner. While conferences did experience some benefits, the non-conference operators would seem to have either gained unexpectedly from either this area of reform or from other port reforms.

Although Australia has a negative affect upon international liner schedules, it is interesting to note that table 2 indicates that over 30 per cent of liner vessels, for both conferences and non-conferences, arrive late at their first Australian port of call. Also, these vessels experience levels of waterfront performance that are significantly above the average. It seems that vessels arriving late receive priority treatment, even if it is at the expense of vessels arriving early or on time. This situation is not unique to the post-EBA period.

Table 2 shows that the Australian waterfront has become equally reliable for conference and non-conference operations. The deterioration in reliability is primarily due to the deterioration in the upper percentile of vessels, where 10 per cent of vessels are now taking at least 60 per cent longer than anticipated in Australia.

Table 3 illustrates the results of comparing how the Australian waterfront performs for vessels on the major Australian trade routes. Caution should be taken with these results due to the relatively small number of observations for each route. Asia includes south east Asia and north Asia, while the European route includes trade for India, the Middle East and the Mediterranean.

Liner operators on the Asian route anticipated significant improvements in waterfront performance, while other operators expected only marginal improvements. In reality, there was virtually no improvement experienced by European operators and consequently there was a deterioration in the P Ratio for this route. However, the European route now reflects the general average for all vessels, while reliability remains above average.

There were significant improvements in the waterfront performance for liner operators on the Asian route, but these improvements fell short of expectations. There was also a deterioration in reliability, but both the P Ratio and R Indicator for Asian operators are consistent with the average for all vessels.

TABLE 2 THE PERFORMANCE AND RELIABILITY OF AUSTRALIA AS A PORT[a], BY SERVICE TYPE

	All vessels		*Conference vessels*		*Non-conference vessels*	
	Pre-EBA	*Post-EBA*	*Pre-EBA*	*Post-EBA*	*Pre-EBA*	*Post-EBA*
Number of vessels	95	101	56	52	39	49
Number of port calls	260	282	158	145	102	137
Number of port calls per vessel	2.7	2.8	2.8	2.8	2.6	2.8
Average number of planned days in Australia per vessel	9.43	8.45	9.91	7.87	8.74	9.06
Average number of actual days spent in Australia per vessel	10.45	9.50	10.57	8.96	10.28	10.06
P Ratio	**0.11**	**0.12**	**0.07**	**0.14**	**0.18**	**0.11**
P Ratio for vessels arriving in Australia						
Early	0.20 (14)	0.15 (14)	0.13 (7)	0.36 (5)	0.29 (7)	0.03 (9)
On time	0.13 (44)	0.17 (49)	0.08 (25)	0.16 (28)	0.20 (19)	0.18 (21)
Late	0.06 (37)	0.07 (38)	0.03 (24)	0.05 (19)	0.09 (13)	0.08 (19)
R Indicator	**0.58**	**0.73**	**0.55**	**0.73**	**0.63**	**0.73**
Lower decile P Ratio	-0.15	-0.13	-0.17	-0.13	-0.13	-0.10
Upper decile P Ratio	0.43	0.60	0.38	0.60	0.50	0.63

EBA Implementation of the waterfront enterprise based agreements. The periods examined were 1 July to 31 December 1990, and 1 July to 31 December, 1992.

a From the vessel's arrival at the first Australian port of call to its departure from its last Australian port call.

() Number of vessels.

Source: *Daily Commercial News*, various editions; BTCE estimates.

TABLE 3 THE PERFORMANCE AND RELIABILITY OF AUSTRALIA AS A PORT[a], BY TRADE ROUTE[b]

	North America		*Asia*		*Europe and other regions*	
	Pre-EBA	*Post-EBA*	*Pre-EBA*	*Post-EBA*	*Pre-EBA*	*Post-EBA*
Number of vessels	21	20	45	40	29	41
Number of port calls	53	52	131	118	76	112
Number of port calls per vessel	2.5	2.6	2.9	3.0	2.6	2.7
Average number of planned days in Australia per vessel	7.14	6.95	10.42	8.48	9.55	9.15
Average number of actual days spent in Australia per vessel	8.52	7.85	11.42	9.58	10.34	10.22
P Ratio	**0.19**	**0.13**	**0.10**	**0.13**	**0.08**	**0.12**
P Ratio for vessels arriving in Australia						
Early	0.22 (4)	na (0)	0.19 (7)	0.19 (8)	0.22 (3)	0.09 (6)
On time	0.27 (7)	0.15 (15)	0.10 (22)	0.14 (16)	0.11 (15)	0.21 (18)
Late	0.13 (10)	0.06 (5)	0.05 (16)	0.08 (16)	0.01 (11)	0.06 (17)
R Indicator	**0.83**	**1.00**	**0.53**	**0.73**	**0.61**	**0.68**
Lower decile P Ratio	-0.20	-0.29	-0.10	-0.13	-0.21	-0.11
Upper decile P Ratio	0.63	0.71	0.43	0.60	0.40	0.57

EBA Implementation of the waterfront enterprise based agreements. The periods examined were 1 July to 31 December 1990, and 1 July to 31 December, 1992.

a From the vessel's arrival at the first Australian port of call to its departure from its last Australian port call.

b Asia includes south east Asia and north Asia. Europe includes India, the Middle East and the Mediterranean.

() Number of vessels.

Source: *Daily Commercial News*, various editions; BTCE estimates.

Liner operators on the North American trade appear to have gained most unexpectedly from improvements in waterfront performance. Although previously the Australian waterfront performance was significantly worse for North American operators with vessels taking 119 days in Australia for every 100 days planned, the performance experienced in the post-EBA period reflects the all vessels average. However, there has been a significant deterioration in reliability for these vessels, with the R Indicator being significantly worse than average.

The trade route analysis is interesting in that the operators on different routes experience vastly different movements in the performance of the waterfront yet the ability of the waterfront to meet expectations became consistent across all services, with vessels spending taking approximately 13 percent longer in Australia than expected

The Australian Mainland Capital City Ports Analyses

Tables 4A and 4B compare the performance and reliability of Australia's mainland capital city ports. The results for Australia in this analyses represent the aggregate for all port calls within Australia.

Liner operators expected an improved performance for all ports. In all ports there was an improvement in performance but the degree of the improvement varied considerably. The best performing port in the post-EBA period was Brisbane with the average vessel spending only an extra 10 per cent of time in port than expected. Although reliability for Brisbane deteriorated, this was mainly due to the lower decile of vessels spending even less time in port than expected (10 per cent of vessels visiting Brisbane took no more than half the time in port than expected). This was also a contributing factor to the very low P Ratio.

Fremantle and Melbourne both performed better than expected, however the performance of Fremantle is still significantly greater than the Australian average, with vessels on average taking 135 days in port per 100 days planned. But there is some compensation. Fremantle has one of smallest variations in performance recorded, with a R Indicator of 1. This may indicate that liner operators are being overly optimistic by significantly understating the amount of time required at Fremantle

For Adelaide and Melbourne the improved performance was not as good as anticipated. For Adelaide this was primarily due to an exaggerated correction in the expectations of liner operators. It is notable that unlike other ports in the pre-EBA period, the planned days in Adelaide exceeded the actual days in port, resulting in a negative P Ratio. However, like Fremantle, the reliability of Adelaide remained above average regardless of the deterioration in performance.

The relative poor performance of Sydney would seem to be directly attributable to how Sydney performed for vessels that arrived late. This may indicate that an increase in congestion as throughput volumes increase or congestion due to an industrial dispute by pilots. Unfortunately, the poorer performance of Sydney has not been compensated by an improvement in reliability.

Source: *Daily Commercial News*, various editions, BTCE estimates.

TABLE 4A THE PERFORMANCE AND RELIABILITY OF THE AUSTRALIAN MAINLAND CAPITAL CITY PORTS

	Fremantle		*Adelaide*		*Melbourne*	
	Pre-EBA	*Post-EBA*	*Pre-EBA*	*Post-EBA*	*Pre-EBA*	*Post-EBA*
Number of port calls	22	38	15	13	88	99
Average number of planned days in port per port call	2.00	1.76	2.47	1.62	2.68	2.20
Average number of actual days spent in port per port call	2.77	2.37	2.20	2.15	3.06	2.46
P Ratio	**0.39**	**0.35**	**-0.11**	**0.33**	**0.14**	**0.12**
P Ratio for vessels arriving in port						
Early	0.73 (5)	1.00 (3)	0.00 (2)	0.33 (2)	0.15 (15)	0.10 (13)
On time	0.47 (10)	0.43 (17)	-0.13 (7)	0.80 (4)	0.22 (37)	0.18 (41)
Late	0.00 (7)	0.21 (18)	-0.11 (6)	0.15 (7)	0.07 (36)	0.08 (45)
R Indicator	**2.20**	**1.00**	**0.60**	**1.00**	**1.33**	**2.33**
Lower decile P Ratio	-0.20	0.00	-0.60	0.00	-0.33	-0.33
Upper decile P Ratio	2.00	1.00	0.00	1.00	1.00	2.00

EBA Implementation of the waterfront enterprise based agreements. The periods examined were 1 July to 31 December 1990, and 1 July to 31 December, 1992.

() Number of vessels.

Source: *Daily Commercial News*, various editions; BTCE estimates.

TABLE 4B THE PERFORMANCE AND RELIABILITY OF THE AUSTRALIAN MAINLAND CAPITAL CITY PORTS

	Sydney		*Brisbane*		*Australia*[a]	
	Pre-EBA	*Post-EBA*	*Pre-EBA*	*Post-EBA*	*Pre-EBA*	*Post-EBA*
Number of port calls	90	96	49	48	264	294
Average number of planned days in port per port call	2.59	2.18	2.29	2.04	2.51	2.09
Average number of actual days spent in port per port call	3.28	3.03	2.67	2.06	2.99	2.56
P Ratio	**0.27**	**0.39**	**0.17**	**0.01**	**0.19**	**0.22**
P Ratio for vessels arriving in port						
Early	0.68 (21)	0.34 (17)	0.29 (7)	-0.25 (7)	0.43 (50)	0.17 (42)
On time	0.35 (29)	0.38 (35)	0.48 (16)	0.15 (12)	0.29 (99)	0.30 (109)
Late	0.07 (40)	0.42 (44)	0.01 (26)	0.05 (29)	0.04 (115)	0.20 (143)
R Indicator	**2.33**	**2.33**	**2.33**	**2.50**	**1.83**	**2.33**
Lower decile P Ratio	-0.33	-0.33	-0.33	-0.50	-0.33	-0.33
Upper decile P Ratio	2.00	2.00	2.00	2.00	1.50	2.00

EBA Implementation of the waterfront enterprise based agreements. The periods examined were 1 July to 31 December 1990, and 1 July to 31 December, 1992.

a Aggregate of all mainland capital city port calls.

() Number of vessels.

Source: *Daily Commercial News*, various editions; BTCE estimates.

One of the disturbing results of the reliability analyses is that the ports of Brisbane, Sydney and Melbourne all have upper decile P Ratios of 2. That is, 10 per cent of vessels visiting these ports spend at least twice as long in port than planned.

5. CONCLUSIONS

The port performance ratio and port reliability indicator provide holistic measures of changes in the quality of service provided by port enterprises. However, more work is required to determine the reasons for persistent schedule variations. This could be due to liner operators consistently planning optimistic schedules with the expectation of some normal variation beyond that already incorporated in the schedules. For example, had liner operator expectations remained unchanged most liner vessels would now be spending less time in Australia than expected.

There does appear to be a trade off between the number of planned days in port and reliability. However, the relationship seems to be inconsistent, with some ports maintaining reliability regardless of any particular change in performance.

Both the P Ratio and R Indicator rely heavily upon the assumption that the liner schedules are themselves reasonably accurate. However, with more than 30 per cent of all liner vessels arriving late in Australia, this assumption may require further work.

Because the P Ratio and R Indicator are based on liner operator expectations which incorporate an allowance for particular port characteristics that may influence port performance they can be used to compare ports. However, the indicators themselves do not provide an indication of the effectiveness of port operations. For example, the same vessel may exchange the same amount of cargo at two similar ports. The two ports may perform consistently to liner operator expectations, yet one port may take half the time required to turn a vessel around than the second port. The average time planned per port call may provide an indication of this and should, therefore, be reported with both measures. To determine why one port is more effective than another, partial indicators would have to be used.

The Australian study shows that the measures established in this paper can be applied. The results indicate that there have been significant improvements in port performance in Australia, although these improvements have not necessarily resulted in improved reliability. But it is interesting that some liner operators, particularly those in conferences or operating in the Asian trade, expected better improvements in performance than were realised. Unforeseen events such as industrial action may have contributed to this.

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