Container Terminal Productivity in Port Botany: CTAL Terminal

Occasional Paper

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Container Terminal Productivity in Port Botany:

CTAL Terminal, 1983

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FOREWORD

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This Paper contains an analysis of the productivity of the Container Terminals Australia Limited (CTAL) operations in Port Botany in 1983 and includes comparisons with the operations of the older Seatainer and Glebe Island terminals in Port Jackson. The results of the work give valuable insight into the changes that have occurred in container terminal operations and productivity.

The Paper is based on a consultant report prepared by Dr R. Robinson of the University of Wollongong, who arranged access to CTAL operational records. The consultancy was managed by Operations Analysis Section staff.

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SUMMARY

The study reported in this Paper examined some aspects of the productivity of the second-generation container terminal operated by Container Terminals Australia Limited (CTAL) in Port Botany. Much of the work was concerned with the results of an analysis of the operational records of the CTAL terminal in 1983, its first full year of operation. It provided an informative comparison with an earlier study into the productivity of the first-generation Glebe Island and Seatainer (STL) terminals in Port Jackson in the period 1977 to 1981 and gave valuable insight into the changes that have occurred in container terminal operations and productivity.

In December 1979, the Brotherson dock container complex in Port Botany was commissioned. In March 1980 the Australian National Line terminal on the northern side of the dock became operational, followed by the CTAL terminal on the southern side in February 1982. Together, the facilities provide six berths, nearly 2000 metres of wharf face and more than 80 hectares of berth and backup space. This Paper includes a brief description of the background and some aspects of the decision-making process which led to the development of container terminals in Port Botany.

The CTAL terminal has almost twice the combined area of the two Port Jackson terminals, with an operating area three times that at Glebe Island and twice the berth length. It has a non-central city location with good road and rail links into adjacent and dependent industrial areas and, therefore, none of the site and access constraints which were a fact of life for the Port Jackson terminals. In 1983, the CTAL terminal was operating well below its design capacity, with a throughput of only 91 000 twenty foot equivalent units (TEUs) and berth occupancy below 40 per cent for 10 of the 12 months, a result of the depressed economic conditions in the liner shipping industry.

In terms of shipping and container traffic, and not surprisingly since CTAL took over STL functions, the CTAL terminal was quite similar to the STL terminal. The average size of vessels calling at CTAL in 1983 was 28 000 deadweight tonnes (DWT), with more than 80 per cent of

vessels over 20 000 DWT. Container exchanges averaged 786 TEUs, with the largest exchange being 1587 TEUs. For 30 per cent of vessel calls, more than 1000 TEUs were exchanged.

A major part of the study was an analysis of how the time spent by a vessel at berth was used. Alongside time refers to the time between the arrival of the vessel at berth and its departure from it and, in this study, was disaggregated into three components. These were net work time, the actual time spent working the vessel, operational delay time, the time lost due to such factors as equipment breakdown and handling hatch covers, and non-operational delay time, the time lost due to factors such as industrial disputes and inclement weather. These and other parameters were analysed for the CTAL terminal in 1983. The data were then used in conjunction with the numbers of containers loaded and unloaded during each vessel call to derive various container handling rates.

Average vessel alongside time at the CTAL terminal in 1983 was 51 hours. This was a marked improvement over the average of 94 hours spent alongside by vessels using the STL terminal during the three years 1977, 1979 and 1981. Of the time spent at berth at the CTAL terminal, 36 per cent was net work time, 49 per cent was non-operational delay time and 15 per cent was operational delay time.

Three measures of container handling rates were defined for vessels using the CTAL terminal in 1983, although only two of them were directly comparable with handling rates calculated for the STL terminal. These were alongside handling rate, the total number of containers (TEUs) handled per hour of alongside time, and net container handling rate, the total number of containers (TEUs) handled per hour of net work time. The average alongside handling rate for CTAL was 16.2 TEUs per hour, compared with 9.4 TEUs per hour at STL. The average net container handling rate was 45.5 TEUs per hour at CTAL, as against 21.5 TEUs per hour at STL. Despite the time interval between this and the earlier study, it is clear that there has been a considerable improvement in handling rates at the new CTAL terminal over those achieved at the older STL terminal.

Because of a lack of published data for overseas container terminals, it has not been possible to determine whether the productivity at the CTAL terminal is comparable with world standards. However, it appears that, with the help of lessons learnt from the first-generation Port Jackson terminals, in particular with regard to site area and terminal access, productivity is considerably higher at the second-generation CTAL terminal.

CHAPTER 1-INTRODUCTION

In December 1979, the new Brotherson dock container complex in Port Botany, with its six berths, nearly 2000 metres of wharf face and more than 80 hectares of berth and backup space, was commissioned. At the same time, the new Australian National Line (ANL) terminal on the northern side of the new dock was opened, although it was not until March 1980 that the terminal serviced its first ship. Almost exactly two years later, in February 1982, the second new terminal operated by Container Terminals Australia Limited (CTAL), a consortium of shipping companies including major British, European and Japanese companies, became operational.

The older inner city Port Jackson terminals, Glebe Island and Seatainer (STL) terminals, were developed in a context of considerable urgency and uncertainty about the nature of the innovative changes in shipping and cargo handling. They were hasty responses to a need to provide adequate facilities for the new container vessels introduced to handle Australia's trade with the United Kingdom (UK) and, somewhat later, Japan and the United States of America (USA). Rapid growth rates in containerised cargo, not unusual in the early stages of development, boosted by changes in exchange rates and in tariff regulations, led to all cargo handling facilities in the Port of Sydney being inundated with imports in the later months of 1973. The congestion which resulted underlined severe problems in the port and prompted the decision-makers to move quickly for new terminal facilities within the Port Botany development. By early 1974, the decision to go ahead with container terminals had been made.

The development process was long, tedious and complicated, not only because it was part of a major infrastructural development project involving the dredging of large areas and deep channels in a shallow bay and the reclamation and consolidation of an extensive site area, but also because it was marked by public concern and political action and reaction in a period of heightened social awareness of environmental issues. The development of the whole new port, as well as that of the container terminals, became, and to some extent remains, highly politicised.

When the ANL terminal in Port Botany became operational in March 1980, the various services of ANL were transferred from Mort Bay and the Port Jackson terminals. In 1980-81, it handled over 111 000 TEUs, more than any other single facility in Port Jackson, and accounted for 29 per cent of the total container traffic through the Port of Sydney. In the next financial year, with CTAL operational for part of the year, the concentration of container traffic through Port Botany increased to 37 per cent and, a year later, accounted for more than half of the total Sydney container trade. In the last six months of 1983, the Port Botany terminals handled 58 per cent of the total traffic (see Table 1.1) but, despite their increasing share of the total traffic, the declining total trade tonnages through the Port of Sydney since 1982-83, as a result of the recession, have ensured that the new terminals are operating at levels significantly below their design capacity. The new Port Botany terminals have four times the combined area of the two original terminals in Port Jackson, a non-central city location with road and rail links into adjacent and dependent industrial areas (albeit, in some sections through environmentally sensitive residential areas) and new generation handling equipment and effective computing systems. They therefore offer the potential for significantly higher throughputs and greater productivity than was the case for the older generation, inner city terminals.

This study has been designed to examine some aspects of the productivity of the new CTAL terminal during its first full year of operation in 1983. It is a companion to the earlier study of the productivity of the two Port Jackson terminals and is usefully read in conjunction with it (Bureau of Transport Economics (BTE) 1984a). Again, as with the earlier study, this is essentially a background study. It has not been cast within a problem-solving or operations research framework but is concerned with establishing some of the basic operating and productivity characteristics of the new terminal. Comparisons are made with productivity at the older terminals although differences in definition and data availability have meant that this is not always possible.

The study draws on a large range of statistical and other information contained in company records, but two computer-prepared documents have been especially important. First, detailed information about vessel times, delays, containers handled and handling rates were abstracted and computed from the Ship Working Summary. From this, 41 variables were coded for computer processing. Second, some aspects of the landside handling operations were able to be examined in some detail

TABLE 1.1-CONTAINERS (TEUs) HANDLED AT FACILITIES IN PORT JACKSON AND PORT BOTANY, 1977-78 TO 1983-84

(TEUs)

	Port Jackson					*Port Botany*			*Sydney*
Year	*White Bay (STL)*	*Glebe Island*	*Mort Bay (ANL)*	*Other*	*Total*	*ANL*	*CTAL*	*Total*	*Total*
1977-78	107 476	73 766	39 332	77 658	298 232	na	na	na	298 232
1978-79	111 505	99 796	47 391	90 645	349 337	na	na	na	349 337
1979-80	111 818	99 157	35 172[a]	103 748	349 895	17 452[a]	na	17 452	367 347
1980-81	87 023	80 462	na	104 823	272 308	111 272	na	111 272	383 580
1981-82	51 772[b]	84 836	na	122 338	258 946	125 141	24 707[b]	149 848	408 794
1982-83	na	59 771	na	111 119	170 890	108 626	92 251	200 877	371 767
1983 (July-Dec)	na	23 645	na	62 003	85 648	67 297	48 860	116 157	201 805

a. ANL left Mort Bay in April 1980 but began operations in Port Botany in March 1980.
b. CTAL terminal began operations in Port Botany in February 1982.

na not applicable

Source: For 1977-78 and 1978-79, MSB (1981) and for 1979-80 to 1983-84, personal communication from the Maritime Services Board.

from the Road Receivals/Deliveries Summary Reports prepared as an in-house document to monitor road handling operations of containers. From these reports, it was possible to code 20 variables summarising aspects of handling perfomance.

The discussion and analysis of the findings of the study are presented in six chapters in this Paper. After this introductory chapter, Chapter 2 examines the conditions and events and some aspects of the decision-making process which led to the development of the Port Botany terminals. It discusses the factors which prompted the development of additional new container handling facilities in Port Botany, the reasons for the later development of the CTAL terminal in relation to the ANL terminal, the nature of the various delays experienced in the development of the terminals, the findings of the Simblist and Kirby Inquiries and, specifically, some of the concerns about the development of the CTAL terminal.

Chapter 3 focusses on the layout and operational organisation of the CTAL terminal. It discusses, in some detail, the shipping operators which used the terminal, the nature of the trades and the ships which serviced the trades, as well as the container traffic through the terminal.

The first full year of operation of the new terminal was 1983. Although it had operated since February 1982, the early period of operation, as with all container terminals and most complex operating systems, was essentially a 'shake down' or 'phasing in' period. Chapter 4 explores aspects of vessel time and container handling rates throughout 1983. It presents the results of disaggregating 'vessel alongside time' into its various components and examines some of the 'delays' which were incurred by vessels calling at the terminal. A number of measures of container handling performance and the rates achieved over varying time periods are also described in this chapter.

The CTAL terminal operator pays special attention to the landside handling of containers received from and delivered to trucks in an attempt to minimise truck delay time. Chapter 5 looks closely at the volumes handled and the rates of handling achieved at the terminal-road interface. Some comments are also made about rail movements to and from the terminal.

Chapter 6 is a concluding chapter and summarises the findings of the study.

CHAPTER 2-THE DEVELOPMENT OF CONTAINER FACILITIES AND CTAL OPERATIONS IN PORT BOTANY

INITIAL DEVELOPMENT PLANS

Speculation about the development of container terminals in Port Botany ended in March 1974 when the Maritime Services Board (MSB) called for applications for the lease of two terminal sites. The MSB's plan was for the development of a three-berth terminal of 36.4 hectares and a two-berth terminal of 24.3 hectares (MSB 1976). There were only two applications, one from STL and the other from ANL. Both companies sought the larger northern terminal area arguing that in the longer term a two-berth terminal would prove inadequate. After considerable discussion the original terminal plan was modified to create two three-berth terminals, a northern terminal of 42.2 hectares with a quay face of 1000 metres and a southern terminal of 38.6 hectares with a quay face of 936 metres (MSB 1976).

Negotiations between the MSB, ANL and STL continued and an Agreement for Lease of the northern terminal was signed with ANL in December 1975. ANL's intentions to establish a terminal at Port Botany were motivated partly by the congestion experienced at its Mort Bay terminal. This was accompanied by progressively more vocal and well-organised resident opposition to the environmental degradation and safety problems being created by the invasion of residential areas by increasing numbers of container-carrying trucks moving to and from the Port Jackson terminals, especially those at Mort Bay and White Bay on the Balmain peninsula. By 1975, this opposition had become even more serious and politicised (NSW Government Commission of Inquiry into the Kyeemagh-Chullora Road 1981).

At the same time, ANL's operations were also changing as it expanded its role as an Australian carrier, particularly in the international trades, and it was evident to ANL and to the MSB that new facilities were needed. The company policy of using not only vehicle deck vessels but also hybrid carriers and fully cellular vessels meant that it required both roll-on roll-off (ro-ro) and lift-on lift-off facilities. It also meant that its operations were spread over the Mort Bay ro-ro facility as well as the two terminals at Glebe Island

and White Bay. There was, therefore, a good case for the consolidation of operations at a single terminal and ANL was most anxious to transfer its operations to a possible site in Port Botany.

It took longer to conclude the negotiations for the southern terminal and it was not until February 1978 that an Agreement to Lease was signed, not with the original applicant STL, but with a newly-formed company, Container Terminals Australia Limited (CTAL).

The extended timetable for the development of the southern terminal was partly due to changes in the corporate structure of STL and subsequent discussions and negotiations between Overseas Containers Australia Proprietary Limited (OCAL), a previous shareholder in STL, and the new partners for the Port Botany terminal. There were, however, other more practical reasons for the delay.

First, it was apparent that in the construction of the two terminal areas there would be a necessary phasing of the reclamation programme and only one terminal would be completed at a time. Since it was perceived that ANL had a pressing environmental need to transfer its trade from Mort Bay (CTAL 1975), the three parties involved, the MSB, ANL and OCAL, agreed that the development of the ANL terminal should take precedence over that of the southern terminal. It was seen that this would effectively delay the proposed CTAL terminal for one or two years.

Second, OCAL and its partners were quite uncertain that the volume of trade was sufficient to warrant a precipitate move from White Bay. They were concerned that any early move, in the light of the decline in trade through the White Bay terminal in 1975-76 and following the boom conditions of the previous year, would require unacceptably high container handling charges to make the terminal cost-effective. Because of this, OCAL began negotiations with the MSB to defer the full development of a three-berth terminal and proposed an initial two-berth development, with an option to develop the third berth at a later stage. In due course, this proposal was accepted and implemented.

There was a third reason for delay in the development of the proposed CTAL terminal, imposed exogenously on the corporate interests and others involved directly in the discussions. It was related to both the formal and informal actions that were linked to environmental issues. The progressive interest in environmental issues generally, and in those associated with the development of Port Botany particularly, created uncertainty for OCAL and its partners and led to some hesitancy to commit resources to the project. The more formal moves, and specifically the Simblist Inquiry (or more accurately the Botany Bay Port and Environment Inquiry) effectively stopped development not only of the container terminals, but also of virtually the whole Port Botany project.

THE SIMBLIST INQUIRY

There had been, as noted earlier, a strong reaction by inner city residents to the environmental problems created by container-carrying trucks passing through residential areas. There was, therefore, understandable concern that the development of two large container complexes in Port Botany and the associated truck traffic flows would result in similar environmental problems in suburbs adjacent to Botany Bay and its access roads. It was, however, the proposal to establish a coal loader in Port Botany that caused most concern to residents in the area and that effectively politicised the port development proposals.

By early 1976, however, public opposition was considerable and, in the progress towards the May 1976 New South Wales (NSW) State election, it became apparent that the environmental aspects of the whole Port Botany project were an important election issue. It was the view of the Australian Labor Party that a moratorium was needed to allow time to evaluate the feasibility of the whole of the port development project and an undertaking was given that, on election to Government, an inquiry would be established to examine the whole question. The sitting Liberal Government was defeated and all works on the Port Botany project were immediately halted. In June 1976, the Premier of NSW announced the appointment of a Commissioner (S.H. Simblist, Q.C.) to carry out an inquiry into the role of Port Botany in terms of the needs of the State and the environmental impact including social and economic aspects of the existing and planned projects. It was also to make recommendations on the future of the planned port development and, if necessary, make alternative proposals (Botany Bay Port and Environment Inquiry 1977).

There was no real concern among the container shipping interests that the Inquiry would propose a discontinuation of the container terminals' development, but there was some apprehension about the nature of environmental controls which might be imposed and misgivings about the intermodal split required on container traffic to and from the terminals. It was not surprising then that the report of the Commissioner, sent to the Premier in November 1976 and published in December of that year, concluded that the construction of the two container terminals should proceed, but subject to the condition that certain propositions be carefully considered with a view to minimising the impact on the environment (Botany Bay Port and Environment Inquiry 1977). The propositions included recommendations for the construction of a number of additional roadworks in the suburbs adjacent to Botany Bay, as well as for the development of possible new arterial routes, a Kyeemagh-Chullora county road and a road link leading to the west and northwest of the port and across the city to Port Jackson.

They also included a recommendation for the greatest possible use of rail for the carriage of containers and argued that the terminal operators be compelled to accept a much higher rail usage than the 20/80 per cent rail/road split suggested by ANL. Further, the report suggested that, in order to minimise road haulage of containers through city streets, existing and possibly new container depots should be used particularly for full-container-load (FCL) collection and distribution in the western suburbs and for the transfer of import and export less-than-container-loads (LCLs) to and from the terminals. It was also suggested that rail transfer points be established at marshalling yards at Enfield, Clyde and other locations (Botany Bay Port and Environment Inquiry 1977).

In January 1977, the NSW Government approved the recommendation that the construction of the container terminals should proceed, but left unresolved the rather difficult issues of intermodal split and the mechanics and logistics of container collection and distribution. After seven months delay, the programme for the development of the terminals in Port Botany continued.

CTAL COMMITMENT AND PLANS

During 1977, CTAL carried out a major review of the viability and feasibility of the new container terminal project. There were questions to be answered about the comparative advantages of using four single-lift or three twin-lift portainer cranes, manning levels on the terminal and details of, among other things, funding arrangements. There were two other particularly important and related questions which were of special concern to the consortium members. The first was what action was required in respect of the White Bay terminal vis-a-vis a new terminal in Port Botany and the second was whether or not the terminal would be financially viable if competitive box rates were charged. By September 1977, it had been agreed among the partners that the MSB be requested to terminate the STL lease on White Bay and that no new competing facilities be allowed in Port Jackson until trade volumes were such as to require new capacity.

Levels of throughput were seen to be a critical aspect of the development of the CTAL terminal and since, in the early years of development, the terminal would be operating well below its capacity, the cost of providing such capacity must result in higher box rates. It was apparent, too, that variations in the operational performance levels, which required varying manning levels and resulted in variable proportions of fixed, or non-inflating, costs through time, could significantly influence box rates. They could therefore be competitive with rates prevailing on the White Bay terminal, for example, even at relatively small differences in throughput levels. Certainly, there was concern that the new terminal should be competitive and, although it appeared to the CTAL partners that in the early stages of development the price differential would favour the established terminals, in the longer term this would be less so and, in any case, a small differential would be acceptable, given the expected improved performance.

There was also some concern in the later months of 1977, in the aftermath of the Simblist Inquiry and with continuing discussion of environmental issues, that unused land, even within or adjacent to the proposed terminals, would be allocated to public use. This would make it impossible at a later date to revive the original terminal project with its third berth.

After CTAL signed the Agreements to Lease in February 1978, there were important questions of operational design, planning and financial structure to be decided, development approvals to be sought and environmental impact statements to be prepared.

Alternative methods of financing were also discussed at some length. The first method was based on the use of debentures and shareholder loans to finance payment of civil works, assuming either lease or supplier finance for cranes and the lease of mobile equipment. The second alternative was to lease all civil works, requiring no loan finance, and the equity subscription could be used to finance the purchase of some or all the mobile equipment.

Numerous development approvals were required before any site works could commence on the new terminal. These included approvals from the MSB, the Federal Department of Environment, Housing and Community Development, the Planning and Environment Commission of NSW, the State Pollution Control Commission (SPCC) and Randwick Council. In addition, the State Government's Botany Bay Sub-regional Community Advisory Committee could examine proposed developments and make recommendations to the Minister for Planning and Environment.

An Environmental Impact Statement (CTAL 1979) was completed in March 1979 and the programme of capital expenditure reviewed. In 1978-79 values, it was expected that the programme would involve $26.7 million for civil works, $17.7 million for cranes (including three twin-lift quay cranes and two rubber-tyred gantries) and $8.0 million for mobile equipment, for a total expenditure of $52.4 million. Methods of financing remained under discussion, but, by the end of the year, it was expected that the civil works would be financed by means of a leaseback arrangement, the quay cranes would be financed through a leverage lease and all of the mobile equipment would also be leased, perhaps partly by means of a leverage lease.

THE KIRBY INQUIRY

While the construction phase of the terminal proceeded there was continued debate about the provision of adequate road capacity to handle port-generated container traffic and road versus rail haulage of containers. The primary focus for this debate was the Kirby Inquiry (Commission of Inquiry into the Kyeemagh-Chullora Road). Although general recommendations on these issues had been made in the Simblist Inquiry, it was apparent that more specific directions were needed if there was to be any real amelioration of the traffic problems.

The Kirby Inquiry was first announced in September 1978: its major objective was to assess the need for a regional road link in the planned county road corridor reservation known as the Kyeemagh-Chullora Road or any alternative regional road link or combination of road links between the central industrial area and the western and south-western sub-regions of the Sydney metropolitan area. The Inquiry began in June 1979 and public hearings began in September 1979. Soon afterwards, in November 1979, the NSW Minister for Transport specifically requested from Commissioner Kirby a comprehensive report on containers, including an examination of the issues of road-rail breakdown of Port Botany container traffic and recommendations to the Government to ensure the least possible disruption to Port Botany residents (MSB 1979b). The final report on the container movements issue was submitted to the Minister in October 1980.

In this report Commissioner Kirby recommended the direct railing of most FCL containers destined for the western suburbs from Port Botany to the existing depots at Villawood and Chullora. LCL containers would not be involved in these movements. The Inquiry conceded that the scheme would involve an additional cost but concluded that the costs were not disproportionate to the environmental damage which would otherwise occur. There were other problems which the Inquiry conceded would arise but suggested a series of safeguards and a system of policing the scheme. Another of its recommendations was the suggestion that the Government permit the establishment of a 6000 TEU depot at Port Botany, essentially as suggested in a joint ANL/CTAL submission to the MSB in September 1979 (MSB 1979a).

Despite the apparent simplicity of the Kirby recommendations to rail FCL containers to Villawood and Chullora the recommendations were difficult to implement. Even from the time of the initial hearings, there was significant opposition to the rail option from powerful shipping, transport, labour, commercial interests and policy-making bodies, including the MSB, shipping lines and the Australian Chamber of Shipping, the terminal operators (ANL, CTAL and Glebe Island Terminals), the NSW Road Transport Association, the Waterside Workers Federation and the Transport Workers Union.

The severity, too, of depressed trading levels created an economic environment which was certainly not conducive to the absorption of additional costs in container shipping and handling. The decision by STL in May 1983 to close the Chullora depot in July of that year has, of course, made the Kirby recommendation very difficult to implement.

As the Kirby Inquiry proceeded, and then through 1981, the CTAL site gradually assumed the appearance of a large and modern container terminal. By late 1981, it was ready to begin operations. On 27 February 1982, the Overseas Containers Limited (OCL) vessel *Jervis Bay* berthed alongside to be the first vessel to use the new terminal.

CHAPTER 3-THE CTAL TERMINAL: OPERATIONAL ORGANISATION, SHIP AND CONTAINER TRAFFIC

The CTAL terminal, with a total site area of 38.56 hectares, is almost twice the combined area of the two original Port Jackson terminals, Glebe Island and the former STL terminal at White Bay. Even the present operating area of 30.46 hectares is three times the area of the Glebe Island terminal with twice its berth length. CTAL is a modern terminal and extensive by most standards. For example, Modern Terminals Limited on the Kwai Chung terminal in Hong Kong has two berths, seven quay cranes and covers 28 hectares.

TERMINAL LAYOUT AND ORGANISATION

Some of the basic terminal characteristics are set out in Table 3.1 and the layout is shown in Figure 3.1. Three berths are available on the terminal with 3.9 hectares of wharf apron and another hectare of stack space within backreach of the cranes, although only two berths have back-up stacking areas. Three twin-lift quay cranes handle the ship exchange and all three cranes may be allocated to any one ship. The cranes are serviced by tractor/chassis combinations, with a specially designed 'bathtub' chassis capable of holding two 20 foot or one 40 foot container, operating to and from cranes and stacks. Lift trucks with sideframes for 20 foot containers and toplift spreaders for 40 foot containers transfer containers from chassis to stacks and vice versa. Lift trucks are also used to lift containers to and from trucks and rail waggons for receival and delivery.

Export stacking areas are computer-designed and allocated and export stacking plans for each ship allow for varying discharge ports, different container sizes and weights and different commodity types. Ship loading is also computer-sequenced from export stacking areas on the seaward side of the terminal. These are laid out in rows from two to seven containers deep and up to three high.

Yard stacking areas for import containers are allocated to the ship by computer and are segregated to ensure efficient in-terminal handling or onward movement. Stack plans include areas for 20 foot or 40 foot FCL road deliveries, 20 foot refrigerated containers (reefers), LCLs

TABLE 3.1-TERMINAL CHARACTERISTICS, CTAL TERMINAL, PORT BOTANY, 1983

Date operations commenced	27 February 1982
Site area	38.56 hectares
Stage I	30.46 hectares
Wharf apron and area within backreach of cranes	4.9 hectares
Yard stack area (including roadways)	17.1 hectares
Empties yard	1.1 hectares
Stage II (future development)	8.1 hectares
Length of berth face	936 metres
Number of berths	3
Depth alongside	15.3 metres
Wharf cranes	3 twin-lift
Crane capacity	
with 20 foot spreaders	25 tonnes
with 40 foot spreaders	35 tonnes
heavy lift	84 tonnes
Yard equipment	18 lift trucks (4x35 tonnes, 14x25 tonnes)
	35 fifth wheel drop-off type of chassis ('bathtub')
	14 yard tugs
Yard stack capacity	2 600 ground slots
	7 800 TEU capacity stacked three high
Reefer capacity	108 non-integrated units 144 integral units

Source: CTAL records (1983).

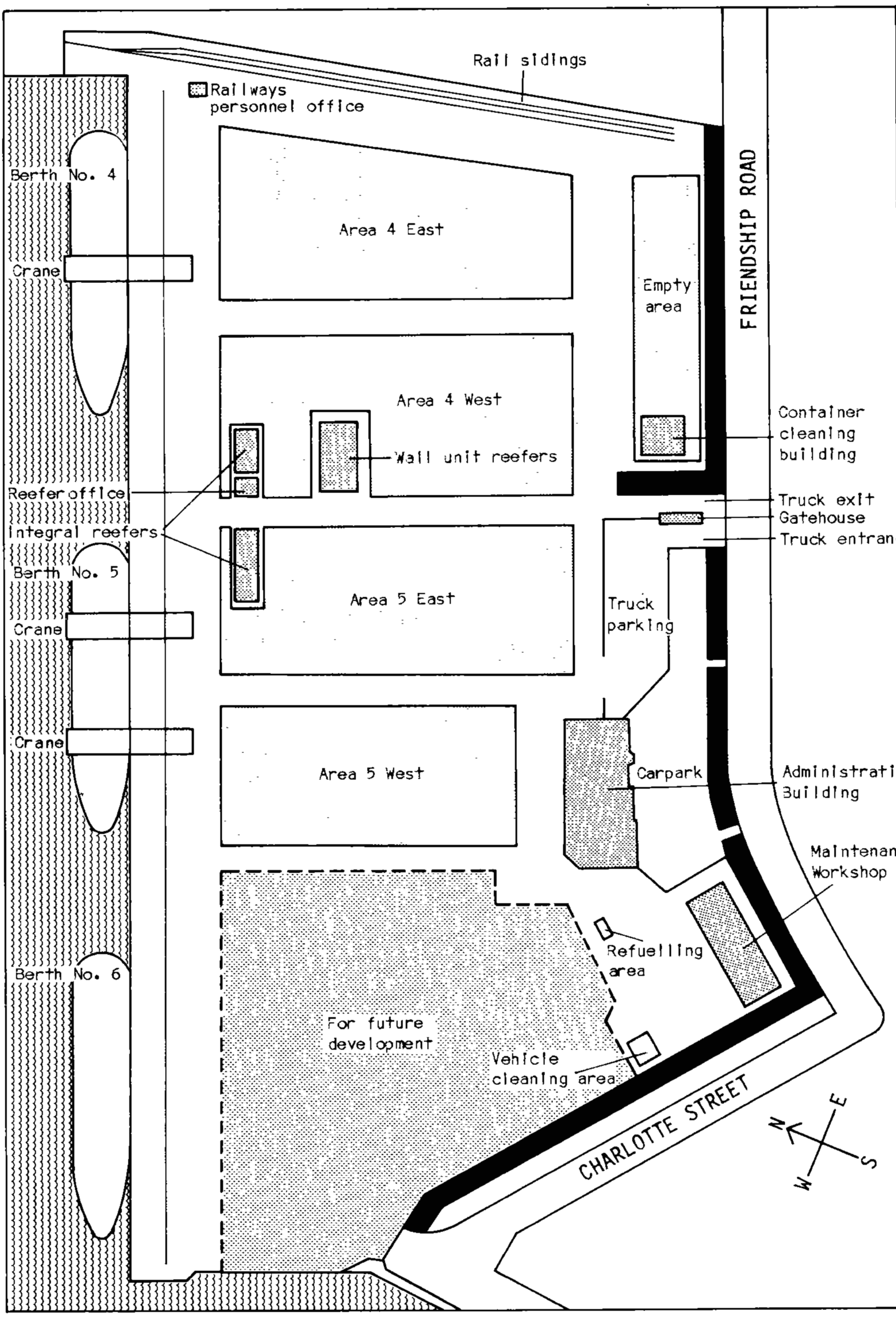

Figure 3.1–CTAL terminal layout, 1983

for transfer to the container freight station by either road or rail and containers to be railed to Brisbane. Import stacking areas are on the landward side of the terminal and container rows are two deep with one-over-one, or two high, stack configuration (Anon 1982).

The terminal is served by a rail link and siding with three standard gauge tracks able to accommodate 15 rail waggons and 45 containers. Normally one of four operational methods is used. These comprise moving containers by lift truck between rail waggons and stacks adjacent to the rail siding, by lift truck between nearby stacking areas, from rail waggons to chassis for direct transfer to stacks, or from rail waggons to chassis for later transfer to stacks.

The terminal operates on a two shift basis, with the day shift from 7.30 am to 3.30 pm and evening shift from 3.30 pm to 11.00 pm. Normally, two cranes are allocated per vessel and the operation of each crane requires two gangs of eight men. Each gang consists of the crane driver, two 'chasers' (one on the vessel and the other on the wharf), three drivers for the internal transfer vehicles (ITVs, tractor/chassis) and two lift truck drivers. In addition, one foreman supervises ship work and another the stack area. Where two cranes are operating, it is usual to work through meal breaks and 'smokos', although when three cranes are operating the third crane does not work through meal breaks. Meal breaks are worked through when a single crane is operating.

SHIP CHARACTERISTICS

In 1983, 25 vessels used the CTAL terminal on a regular basis and operated largely within three major consortia (see Table 3.2). Fourteen of the 25 vessels plied the Australia, New Zealand and Europe trades with 10 of the 14 belonging to the OCL group. The Australia Japan Container Line and three Japanese shipping lines operated five vessels in the Australia/Japan trade. Only two vessels, the *Asian Jade* and the *Asian Pearl* served the Australia/Far East route with its Australian (ANL), Asian and Hong Kong/Taiwan interests. Four vessels operated between Australia and the Persian Gulf, three of which belonged to the Nippon Yusen Kaisha (NYK) and the fourth in a joint service between OCL and the Blue Star Line.

The largest vessels using the terminal were on the long-haul European routes, namely the *Tolaga Bay* and *Portland Bay* of over 40 000 DWT and up to about 2500 TEUs. For vessels on the Australia/Japan trade, DWT varied between 23 000 tonnes, for the *Arafura* with a TEU capacity of 1148, and 34 000 tonnes for the *Ariake* with a TEU capacity of 2000.

TABLE 3.2-CHARACTERISTICS OF VESSELS USING THE CTAL TERMINAL, 1983

Vessel	*TEUs*	*DWT*	*Operator*	*Consortium*	*Trade*
Jervis Bay	1 572	29 262	OCL	ANZECS	
Moreton Bay	1 572	29 262	OCL	ANZECS	
Encounter Bay	1 572	29 262	OCL	ANZECS	
Botany Bay	1 572	29 262	OCL	ANZECS	
Flinders Bay	1 572	29 262	OCL	ANZECS	
Remuera Bay	1 655	32 753	OCL	ANZECS	Australia/ New Zealand/ Europe
Resolution Bay	1 823	38 757	OCL	ANZECS	
Mairangi Bay	1 823	38 757	OCL	ANZECS	
Tolaga Bay	2 436	47 197	OCL	ANZECS	
Portland Bay	2 436	47 209	OCL	ANZECS	
New Zealand Pacific	1 822	38 642	SCNZ	ANZECS	
Kangourou	1 490	29 810	CGM	ANZECS	
Lloydiana	1 590	32 502	Lloyd Triestino	ANZECS	
Sydney Express	1 589	33 350	Hapag-Lloyd	ANZECS	
Muscat Bay	422	15 789	OCL	OCL/Blue Star	
Haruna Maru	650	19 310	NYK	na	Australia/ India/ Persian Gulf
Plata	450	14 035	NYK	na	
Planeta	450	14 040	NYK	na	
Arafura	1 148	23 009	AJCL	na	
Ariake	2 000	34 346	AJCL	na	Australia/Japan

TABLE 3.2 (Cont)-CHARACTERISTICS OF VESSELS USING THE CTAL TERMINAL, 1983

Vessel	*TEUs*	*DWT*	*Operator*	*Consortium*	*Trade*
Canberra Maru	1 570	29 888	MOL	na	Australia/Japan
Hakuba Maru	1 584	29 232	NYK	na	Australia/Japan
Nichigoh Maru	1 576	31 517	YSL	na	Australia/Japan
Asian Jade	1 176	24 383	AAE	AAO	Australia/Philippines/ Taiwan/Korea/Hong Kong
Asian Pearl	1 176	24 355	AAE	AAO	Australia/Philippines/ Taiwan/Korea/Hong Kong

na not applicable

Note: OCL = Overseas Containers Limited (comprising Dolphin Line Ltd., Ocean Transport and Trading Ltd., Shaw Savill and Albion Co. Ltd., The Clan Line Steamers Ltd., The Peninsula and Oriental Steam Navigation Co., The Scottish Shire Line Ltd.)

ANZECS = Australia New Zealand Europe Container Service (comprising Compagnie Generale Maritime (CGM), Hapag-Lloyd Aktiengesellschaft, Lloyd Triestino di Navigazione Societa per Azioni, Nedlloyd Lijnen BV, OCL)

SCNZ = Shipping Corporation of New Zealand

NYK = Nippon Yusen Kaisha

AJCL = Australia Japan Container Line

MOL = Mitsui OSK Lines Ltd.

YSL = Yamashita-Shinnihon Steamship Co. Ltd.

AAE = Asia Australia Express Ltd.

AAO = AAE, Australian National Line and Orient Overseas Container Line

Source: CTAL records (1983).

The *Asian Jade* and *Asian Pearl* were, by comparison with the European trade ships, considerably smaller with a TEU capacity of only 1176 and a DWT of about 24 000 tonnes. The smallest vessels operated on the Australia/Persian Gulf routes.

Table 3.3 defines the distribution of vessel DWT for all vessel calls at the terminal. About one-sixth of all vessels were 20 000 DWT or less and about one-third exceeded 30 000 DWT. The table also indicates a strong concentration of vessels in the modal class of 26 000 to 30 000 DWT (29.2 per cent).

TABLE 3.3-DISTRIBUTION OF VESSEL SIZE FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Vessel size (thousand DWT)	*Vessel calls*	*per cent*	*Cumulative per cent*
< 16	14	12.4	12.4
16 - 20	6	5.3	17.7
21 - 25	23	20.4	38.1
26 - 30	33	29.2	67.3
31 - 35	22	19.5	86.7
36 - 40	8	7.1	93.8
> 40	7	6.2	100.0
Total	113	100.0	

Notes: 1. Mean = 28 309 DWT
Standard deviation = 8 264 DWT
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TRADE AND CONTAINER TRAFFIC CHARACTERISTICS

In 1983, four major trades were focussed on the CTAL terminal:

- the Australia/New Zealand/Europe trade organised within the ANZECS consortium;
- the Australia/Japan trades served by five vessels;
- the Australia/Far East trades covering the Philippines, Taiwan, Korea and Hong Kong which ANL, the Orient Overseas Container Line (OOCL) and the AAE served jointly in the AAO consortium; and

- the Australia/Asia/Persian Gulf trades in which OCL and the Blue Star Line operated a joint service and which was also served by NYK (see Table 3.2).

Of these four trades, European origins and destinations accounted for virtually half the total number of containers handled at the terminal (see Table 3.4) and the Japanese trade for about one-third. The Middle East trade was considerably smaller and accounted for less than 5 per cent of containers handled. Interestingly, however, the trade was served by relatively small ships of less than 20 000 DWT but which made up nearly 17 per cent of all ship calls at the terminal. The proportions of ship calls in the Far East and Japan trades closely mirrored the container volumes, but, in the Europe trade, 50 per cent of the total terminal throughput was handled by 36 per cent of the vessel calls (Table 3.5). The larger size of these vessels on this long-haul trade is apparent from Table 3.2.

Some of the relationships between the number of ships in the four trades and their container loads are apparent from Table 3.6, although care needs to be taken in interpreting average and standard deviation values. On average, 786 containers were handled per vessel call at the terminal in 1983, although one ship handled more than twice that many. There was some imbalance in the average number (TEUs) of import and export containers, 429 compared with 339, and an overwhelming dominance of 20 foot boxes, with only about 7 and 9 per cent of import and export containers respectively being 40 foot. The average number of 40 foot export containers per vessel, 31, was somewhat unrepresentative, given the large standard deviation, and one vessel handled 228. Restows (TEUs) were not uncommon. Only 19 per cent of vessel calls had no restows, for example, but 83 per cent had less than 25 and only 7 per cent had more than 50.

Interestingly, most ships handled a considerable deck load of containers (TEUs), the average being 274, although one vessel handled 710 containers on deck. Table 3.7, which shows the distribution of deck loads on vessels which used the terminal in 1983, indicates that about 40 per cent of vessels had deck loads of more than 300 containers, although only 11 per cent had more than 500. The large deck loads are not particularly surprising given the stowage configuration of the earlier generation OCL vessels such as *Encounter Bay* and *Botany Bay*, with six high stacking under deck and four high on deck. Larger vessels, like the *Resolution Bay* and *Tolaga Bay*, however, have an eight high configuration under deck and only two high above deck, which improves shipworking productivity due to a reduction in lashing and unlashing work.

TABLE 3.4—CONTAINER THROUGHPUTS (TEUs) AND NUMBER OF VESSEL CALLS BY TRADE, CTAL TERMINAL, 1983

	All services		*Europe*		*Japan*		*Far East*		*Middle East*	
Month	*(TEUs)*	*Vessel calls*	*(TEUs)*	*Vessel calls*	*(TEUs)*	*Vessel calls*	*(TEUs)*	*Vessel calls*	*(TEUs)*	*Vessel calls*
January	7 193[a]	12[a]	3 597	4	2 780	5	451	1	365	2
February	6 539	10	3 083	3	1 755	3	1 361	2	340	2
March	6 835[b]	10[b]	2 701	2	2 619	4	761	1	346	2
April	5 572	9	2 365	2	1 974	3	565	1	668	3
May	7 604	9	3 439	3	2 513	3	1 383	2	269	1
June	7 343	8	3 809	3	2 567	3	653	1	314	1
July	7 015	10	4 041	4	1 875	3	590	1	509	2
August	8 950	9	4 218	4	3 226	3	1 506	2	0	0
September	9 763	11	5 627	4	2 799	3	696	1	641	3
October	6 774	8	2 967	3	2 781	3	762	1	264	1
November	8 322	10	4 090	4	3 029	3	817	1	386	2
December	8 924	9	4 986	5	3 082	3	856	1	0	0
Total	90 834[ab]	115[ab]	44 923	41	31 000	39	10 401	15	4 102	19

a. Includes vessel which berthed in late December 1982; trade not known.
b. Includes 408 TEUs to West Coast North America (one vessel call) and restows.

Source: CTAL records (1983).

TABLE 3.5-PROPORTION OF CONTAINERS (TEUs) AND VESSEL CALLS IN SERVICES WHICH USED THE CTAL TERMINAL, 1983

(per cent of total[a])

Service	*TEUs*	*Vessel calls*
Europe	49.7	35.9
Japan	34.3	34.2
Far East	11.5	13.2
Middle East	4.5	16.7
Total	100.0	100.0

a. Calls by West Coast North America vessel and vessel which berthed in late 1982 not included.

Note: Figures may not add to totals due to rounding.

Source: Calculated from data in Table 3.4.

TABLE 3.6-PARAMETERS OF CONTAINER TRAFFIC FLOWS FOR VESSEL CALLS, CTAL TERMINAL, 1983

Container traffic	*Mean*	*Standard deviation*	*Maximum number*
Imports			
20 foot containers	367	178	821
40 foot containers	31	23	91
Total (TEUs)	429	211	949
Exports			
20 foot containers	277	174	803
40 foot containers	31	36	228
Total (TEUs)	339	200	895
Restows (TEUs)	18	33	292
Total (including restows)			
20 foot containers	660	325	1 457
40 foot containers	63	52	267
All containers (TEUs)	786	383	1 587
Deck containers (TEUs)	274	170	710

Note: Number of vessel calls = 113

Source: CTAL records (1983).

TABLE 3.7-DISTRIBUTION OF CONTAINER DECKLOADS FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

TEUs on deck	*Vessel calls*	*per cent*	*Cumulative per cent*
1 - 100	20	17.7	17.7
101 - 200	24	21.2	38.9
201 - 300	23	20.4	59.3
301 - 400	23	20.4	79.6
401 - 500	11	9.7	89.4
501 - 600	5	4.4	93.8
601 - 700	6	5.3	99.1
701 - 800	1	0.9	100.0
Total	113	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

Table 3.8 indicates the considerable variation between the 'average' pattern for the different services. The larger number of containers carried in the long-haul Europe trade is apparent, with an average load of 1086 containers (TEUs), but the average loads for the Japan and Far East trades were not greatly dissimilar to each other. Forty foot containers were considerably more important in the Australia/Japan trade than in the other three trades, because Japanese shippers readily moved to using this size of container. Import/export imbalances are apparent too, with the notable exception of the Far East trade where the margin is much closer than in the other trades.

Essentially, most of the CTAL operations in 1983 were oriented towards ships with medium to large loads, with less than one ship in four, for example, handling a total of 500 or fewer containers (TEUs) (see Table 3.9). For 30 per cent of ship calls, more than 1000 TEUs were exchanged at the terminal and 70 per cent of vessel calls involved more than 600 TEUs. That load sizes have remained relatively static since the late 1970s and early 1980s is reasonably well indicated by comparison with the average loads for vessels using the STL terminal in 1977, 1979 and 1981, which were 755, 733 and 825 TEUs respectively. However, the average total number of TEUs handled per vessel call at CTAL in 1983 was considerably greater than that for the common-user Glebe Island terminal over the same three years, with averages of 338, 439 and 464 respectively (see BTE (1984a)).

TABLE 3.8-PARAMETERS OF CONTAINER TRAFFIC FLOWS FOR VESSEL CALLS IN FOUR TRADES, CTAL TERMINAL, 1983

Container traffic	*Australia/Asia/ India/Persian Gulf*		*Australia/Japan*		*Australia/Europe*		*Australia/ Philippines/Taiwain/ Hong Kong*	
	Mean	*Standard deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*
Imports								
20 foot containers	112	32	365	105	510	153	355	93
40 foot containers	4	2	49	20	38	16	9	5
Total (TEUs)	120	31	463	136	586	192	373	96
Exports								
20 foot containers	84	30	229	83	411	180	329	131
40 foot containers	2	1	59	38	34	41	14	13
Total (TEUs)	87	31	347	139	479	197	357	145
Restows (TEUs)	9	11	14	13	21	27	1	2
Total (including restows)								
20 foot containers	205	52	606	166	940	266	685	194
40 foot containers	6	2	109	49	73	48	23	13
All containers (TEUs)	217	51	824	247	1 086	332	732	208
Deck containers (TEUs)	83	33	264	152	397	153	215	124

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 3.9-DISTRIBUTION OF IMPORT, EXPORT AND ALL CONTAINERS (TEUs) HANDLED DURING VESSEL CALLS AT THE CTAL TERMINAL, 1983

	Import			*Export*			*Total containers*		
TEUs	*Vessel calls*	*per cent*	*Cumulative per cent*	*Vessel calls*	*per cent*	*Cumulative per cent*	*Vessel calls*	*per cent*	*Cumulative per cent*
0	1	0.9	0.9	1	0.9	0.9	0	0	0
1 - 100	5	4.4	5.3	14	12.4	13.3	0	0	0
101 - 200	17	15.0	20.4	13	11.5	24.8	10	8.8	8.8
201 - 300	11	9.7	30.1	27	23.9	48.7	10	8.8	17.7
301 - 400	16	14.2	44.2	18	15.9	64.6	2	1.8	19.5
401 - 500	19	16.8	61.1	16	14.2	78.8	5	4.4	23.9
501 - 600	15	13.3	74.3	12	10.6	89.4	8	7.1	31.0
601 - 700	22	19.5	93.8	7	6.2	95.6	15	13.3	44.2
701 - 800	4	3.5	97.3	2	1.8	97.3	9	8.0	52.2
801 - 900	2	1.8	99.1	3	2.7	100.0	11	9.7	61.9
901 - 1 000	1	0.9	100.0	0	0.0	100.0	11	9.7	71.7
1 000 - 1 100	0	0.0	100.0	0	0.0	100.0	7	6.2	77.9
1 101 - 1 200	0	0.0	100.0	0	0.0	100.0	7	6.2	84.1
> 1 200	0	0.0	100.0	0	0.0	100.0	18	15.9	100.0
Total	113	100.0		113	100.0		113	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

CHAPTER 4-VESSEL TIMES AND CONTAINER HANDLING RATES

The time which vessels spend in port and the ratio of port time to sea time is a critical element in vessel productivity and vessel costs. It also has important implications for the total delivered costs of commodities, for port productivity and pricing and for port investment and development programmes. Minimising ship turnaround time in port is an important general principle, although there are a number of reasons why ships remain longer than theoretically necessary in port. Under low levels of utilisation, for example, small amounts of cargo may be handled with time to spare in projected stay times in individual ports. On long-haul routes, cumulative time savings in other ports may allow longer times in particular ports, or port time may be traded off against steaming time to maintain schedules. Ship days saved, moreover, are only valuable if they can be productively used.

Terminal handling rates and productivity are influenced by these factors and are functions of both the number of vessels demanding service and the 'tightness' of vessel schedules, as well as the operational efficiency of the terminal itself.

This chapter examines not only the amount of time vessels spent alongside at the CTAL terminal in 1983, but also the amount of time which vessels spent working and the extent and structure of operational and non-operational delay times. The container handling rates achieved at the terminal are also examined.

Different ports and terminals use different variables to measure operational and non-operational delays, work times and handling rates and it is important to clarify the meaning of particular measures. The measures used in this study are defined in Table 4.1 and their inter-relationships are described in Figure 4.1.

Alongside time refers to the time between the arrival of the vessel at berth and its departure from it and, in this study, comprises two components, non-operational delay time and gross work time (see Figure 4.1). Gross work time, in turn, comprises two time segments, operational delay time and net work time. It is this last measure, net work time, which indicates the actual time taken to unload and load a vessel at the berth. Figure 4.1 also indicates the variables included in the non-operational and operational delay times.

TABLE 4.1-DEFINITIONS OF VESSEL TIMES AND CONTAINER HANDLING RATES

Measure	*Definition*
Vessel times	
Alongside time	Time between vessel arrival and departure from berth.
Gross working time (GWT)	Alongside time less non-operational delay time.
Net working time (NWT)	Gross working time less operational delays.
Non-operational delay time (NODT)	Delay time due to factors such as industrial disputes, bad weather, 'smokos' and breaks, waiting for the vesssel to sail, no work on the midnight shift.
Operational delay time (ODT)	Delay time due to such factors as equipment breakdown, lashing and unlashing and handling hatch covers.
Total delay time (TDT)	The sum of all non-operational and operational delay times.
Container handling rates	
Alongside handling rate	Number of TEUs handled per ship per hour of alongside time.
Gross container handling rate	Number of TEUs handled per ship per hour of gross working time.
Net container handling rate	Number of TEUs handled per ship per hour of net working time.

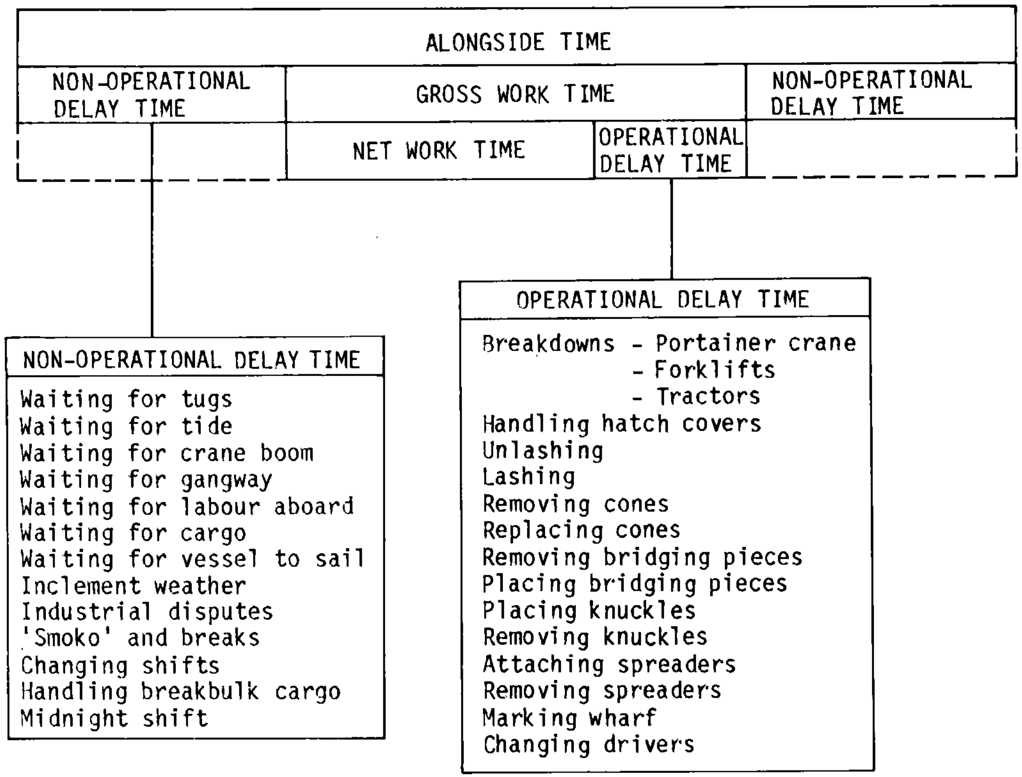

Figure 4.1-Vessel time profiles for vessels using the CTAL terminal, 1983

VESSEL TIMES

Alongside time

Alongside time refers to the total time which a ship spends at bérth. Its value should be regarded more as a measure of 'what happened' at the terminal rather than as a measure of terminal productivity because alongside time may be greatly influenced by vessel operating policies and factors exogenous to the technical capability of the terminal operating system. Nonetheless, it is a gross indicator of how a terminal is used over a period of time.

For the CTAL terminal in 1983, average vessel alongside time was 50.6 hours (see Table 4.2) although there was considerable variation in average alongside times for the four major services which used the terminal. The time varied from 60.7 hours for the Europe service to 20.4 hours for the Asia/Persian Gulf service (see Table 4.3). For more than half the vessel calls, less than two days were spent at the terminal and for about 20 per cent of calls more than three days.

TABLE 4.2-DISTRIBUTION OF ALONGSIDE TIME PER VESSEL CALL FOR THE CTAL TERMINAL, 1983

Alongside time (hours)	*Vessel calls*	*per cent*	*Cumulative per cent*
9 - 16	12	10.6	10.6
17 - 24	2	1.8	12.4
25 - 32	10	8.8	21.2
33 - 40	24	21.2	42.5
41 - 48	14	12.4	54.9
49 - 56	15	13.3	68.1
57 - 64	8	7.1	75.2
65 - 72	4	3.5	78.8
73 - 80	12	10.6	89.4
81 - 88	3	2.7	92.0
89 - 96	4	3.5	95.6
> 96	5	4.4	100.0
Total	113	100.0	

Notes: 1. Mean = 50.6 hours
Standard deviation = 24.7 hours
Median = 47.7 hours
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 4.3-PARAMETERS OF VESSEL ALONGSIDE TIME FOR A SAMPLE OF VESSEL CALLS IN FOUR SERVICES, CTAL TERMINAL, 1983

Service	*Number of vessel calls in sample*	*Average number of TEUs per vessel call*	*Mean (hours)*	*Standard deviation (hours)*	*Median (hours)*
All services	113	786	50.6	24.7	47.7
Australia/Asia/ India/Persian Gulf	12	217	20.4	10.4	14.9
Australia/Japan	22	824	56.9	22.7	51.5
Australia/Europe	40	1 086	60.7	22.7	58.1
Australia/Philippines/ Taiwan/Korea/Hong Kong	15	732	54.1	21.5	47.8

Source: CTAL records (1983).

Table 4.4 compares the averages and the statistical distributions for the CTAL, Glebe Island and STL terminals and, although the values refer to different years, it provides a useful indication of the differences between the older terminals and the new one in Port Botany. The comparison between CTAL and STL is most pertinent, given that CTAL grew out of the corporate structure of STL and its terminal was intended to serve vessels of similar consortia to those served by STL. The average alongside time for the new terminal in 1983 was just over half that for STL over the three years 1977, 1979 and 1981, although a large standard deviation rendered the mean a poor indicator. Moreover, in 1983, for more than half the vessel calls, two days or less were spent at the terminal, compared with only 20 per cent for the STL terminal. Eighteen per cent of vessel calls at the STL terminal lasted more than four days compared with just over 4 per cent for the Port Botany terminal.

Work times

Gross working time

Gross working time (GWT) is alongside time less non-operational delay time (see Figure 4.1 and Table 4.1) and is a measure of the actual time available for handling containers. For a proper understanding of the measure, some clarification of the meaning of the term non-operational delay is necessary. A description of some of the components follows.

TABLE 4.4-COMPARISON OF VESSEL ALONGSIDE TIME DISTRIBUTIONS FOR CTAL IN 1983 AND GLEBE ISLAND AND STL TERMINALS IN 1977, 1979 AND 1981

Alongside time (hours)	*CTAL*[a]		*Glebe Island*[b]		*STL*[b]	
	per cent	*Cumulative per cent*	*per cent*	*Cumulative per cent*	*per cent*	*Cumulative per cent*
0 - 24	12.4	12.4	14.9	14.9	2.5	2.5
25 - 48	42.5	54.9	38.5	53.4	17.0	19.5
49 - 72	23.9	78.8	30.6	84.0	33.1	52.6
73 - 96	16.8	95.6	10.0	94.0	19.1	71.7
> 96	4.4	100.0	6.0	100.0	18.3	100.0

a. For 1983.
b. Aggregated over the three years 1977, 1979 and 1981.

Notes: 1. Average alongside times were 51 hours, 54 hours and 94 hours for CTAL, Glebe Island and STL respectively.
2. Number of vessel calls were 113, 582 and 399 for CTAL, Glebe Island and STL respectively.

Sources: CTAL records (1983). BTE (1984a).

Waiting for labour aboard

Delays may be incurred, for example, because the ship comes on to the berth before the start of a shift, when labour becomes available. If a ship berths at 6.00 am, for example, it will wait for labour aboard for one and a half hours until the day shift begins at 7.30am. There will not normally be delays attributable to labour itself.

Waiting for the vessel to sail

A vessel may not deberth immediately after all work is finished but remain on the berth to allow crew ashore or to avoid being at a following port on a weekend when no work is done or for numerous other reasons. If necessary, the terminal operator may order the vessel from the berth, though in periods of low utilisation, berths will be free for a large proportion of the time. In 1983, for example, the CTAL estimates for berth occupancy varied between a low of 25.8 per cent in July and a high of 43.5 per cent in August (see Table 4.5).

Handling breakbulk cargo

This is a delay only to the exchange of containers but is often a normal part of cellular container vessel operations. Breakbulk cargo is non-containerised general cargo and is commonly machinery, transport equipment, yachts and boats.

TABLE 4.5-ESTIMATES OF BERTH UTILISATION FOR THE CTAL TERMINAL, 1983

Month	*Berth utilisation (per cent)*
January	27.4
February	39.3
March	35.5
April	26.7
May	35.5
June	36.7
July	25.8
August	43.5
September	36.7
October	27.4
November	35.0
December	40.3
Average	34.2

Source: CTAL records (1983).

Midnight shift
That the third and expensive shift is not worked at the terminal is a matter of management policy. Importantly, if the vessel has finished its work at the berth but waits through a midnight shift to sail (for example, it finishes all work at 8.00 pm but waits to sail until early next morning), the midnight shift time will *not* be included as a non-operational delay but will be listed under the waiting to sail variable.

Given these points, Table 4.6 has been included to show some of the characteristics of the vessel turnaround time profile and the structure of GWT for three randomly-selected vessels which used the terminal in 1983. It indicates the variety of possible combinations of delay factors and their magnitudes which affect ship working.

For *Vessel A*, for example, delays were incurred in waiting for labour to come aboard, in the changeover from one shift to another, in handling breakbulk cargo (one large box of machinery in this case), one midnight shift was not worked and, after all work was completed, it was two hours and 45 minutes before the vessel actually deberthed. The vessel was not held up because of delays for tugs or tide or waiting for the gangway to be secured or cargo to arrive at the berth, nor did weather interrupt work (either, for example, by heavy rain or high winds, which may affect the stability of containers under the crane) and there were no industrial disputes, with work continuing through scheduled 'smokos' and breaks (two cranes were used to handle a total of 280 TEUs).

TABLE 4.6-TIME CHARACTERISTICS FOR SELECTED VESSELS AT THE CTAL TERMINAL, 1983

Characteristic	*Vessel A*		*Vessel B*		*Vessel C*	
Time vessel berthed	12/04[a]	7.10[b]	19/04[a]	9.40[b]	11/08[a]	8.10[b]
Labour aboard		10.00		10.00		8.40
Exchange commenced		10.40		10.20		8.40
Exchange completed	13/04	15.00	21/04	19.30	13/08	11.35
Labour ashore		15.00		19.30		12.00
Vessel sailed		17.45		21.10		13.00
Vessel alongside time	34 hrs 35 mins		59 hrs 30 mins		52 hrs 50 mins	
Non-operational delays (mins)						
Waiting						
Tugs		0		0		0
Tide		0		0		0
Crane boom		0		0		0
Gangway		0		0		30
Labour aboard		150		20		0
Cargo		0		0		0
Vessel to sail		165		100		60
Inclement weather		0		0		0
Industrial disputes		0		345		375
'Smoko' and breaks		0		106		62
Changing shifts		55		141		105
Handling breakbulk cargo		15		30		32
Midnight shift		530		1 020		1 020
Total non-operational delays	15 hrs 15 mins		29 hrs 22 mins		28 hrs 4 mins	
Gross working time	19 hrs 20 mins		30 hrs 8 mins		24 hrs 46 mins	

a. Date (day/month)
b. Time (24 hour clock).

Source: CTAL records (1983).

For *Vessel C* 6.25 hours were lost due to industrial matters during both day and evening shifts, three large pieces of earth-moving machinery took 32 minutes to unload, two midnight shifts (calculated from the end of the evening shift at 11.00pm until the beginning of the day shift at 7.30 am or 8.5 hours) were not worked, three cranes were used on the ship to handle 1034 TEUs, with two of the three cranes working through the scheduled breaks and the third crew taking 62 minutes in breaks, half an hour was spent waiting to secure the gangway and 145 minutes were lost in shift changes. Within one hour of labour going ashore the vessel sailed.

The aggregate values for GWT for vessel calls at the CTAL terminal in 1983 are shown in Table 4.7. It indicates that one-quarter of all vessel calls had a GWT of 16 hours or less and three-quarters 32 hours or less. More interesting, perhaps, than the absolute value of GWT is its relationship to the total time which individual vessels spent at berth, or the alongside time. Table 4.8 summarises this relationship.

On average, GWT was half the alongside time and about half the vessel

TABLE 4.7-DISTRIBUTION OF GROSS WORKING TIME FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Gross working time (hours)	*Vessel calls*	*per cent*	*Cumulative per cent*
5 - 8	5	4.4	4.4
9 - 12	13	11.5	15.9
13 - 16	11	9.7	25.7
17 - 20	22	19.5	45.1
21 - 24	19	16.8	61.9
25 - 28	10	8.8	70.8
29 - 32	6	5.3	76.1
33 - 36	7	6.2	82.3
> 36	20	17.7	100.0
Total	113	100.0	

Notes: 1. Mean - 24.4 hours
Standard deviation = 10.9 hours
Median = 22.3 hours.
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 4.8-DISTRIBUTION OF THE RATIO OF GROSS WORKING TIME TO ALONGSIDE TIME FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Gross working time / Alongside time (per cent)	*Vessel calls*	*per cent*	*Cumulative per cent*
21 - 30	2	1.8	1.8
31 - 40	21	18.6	20.4
41 - 50	27	23.9	44.2
51 - 60	39	34.5	78.8
61 - 70	16	14.2	92.9
71 - 80	6	5.3	98.2
81 - 90	2	1.8	100.0
Total	113	100.0	

Notes: 1. Mean = 51.2 per cent
Standard deviation = 12.6 per cent
Median = 50.6 per cent
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

calls had a GWT to alongside time ratio of 51 per cent (the median). The table clearly indicates a clustering of vessel calls (slightly more than three-quarters) with GWT values between 31 and 60 per cent of alongside time. In summary, for three out of four vessel calls for every 10 hours spent alongside, between three and six hours were available for handling containers. For only 21 per cent of vessel calls was GWT more than 60 per cent of alongside time.

Net working time

Net working time (NWT) is GWT less interruptions created by operational delays (see Figure 4.1 and Table 4.1). It is a measure of the actual time spent handling containers. For 1983, its average value was 17.2 hours with a median of 16.3 hours. For eight out of 10 vessel calls, however, NWT was less than or equal to 24 hours (see Table 4.9).

Again, the comparison of NWT with alongside time is somewhat more revealing. For 93 per cent of vessel calls, NWT was less than or equal to 50 per cent of their alongside time and for 41 per cent of vessel calls, NWT was between 31 and 40 per cent of alongside time (see Table 4.10). On average in 1983, only 36 per cent of alongside time was spent in handling containers.

TABLE 4.9-DISTRIBUTION OF NET WORKING TIME FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Net working time (hours)	*Vessel calls*	*per cent*	*Cumulative per cent*
1 - 4	3	2.7	2.7
5 - 8	15	13.3	15.9
9 - 12	20	17.7	33.6
13 - 16	26	23.0	56.6
17 - 20	19	16.8	73.5
21 - 24	10	8.8	82.3
25 - 28	7	6.2	88.5
29 - 32	9	8.0	96.5
33 - 36	3	2.7	99.1
> 36	1	0.9	100.0
Total	113	100.0	

Notes: 1. Mean = 17.2 hours
Standard deviation = 8.0 hours
Median = 16.3 hours
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 4.10-DISTRIBUTION OF THE RATIO OF NET WORKING TIME TO ALONGSIDE TIME FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Net working time / Alongside time (per cent)	*Vessel calls*	*per cent*	*Cumulative per cent*
0 - 10	1	0.9	0.9
11 - 20	2	1.8	2.7
21 - 30	29	25.7	28.3
31 - 40	46	40.7	69.0
41 - 50	26	23.9	92.9
51 - 60	7	7.1	100.0
Total	113	100.0	

Notes: 1. Mean = 35.9 per cent
Standard deviation = 8.9 per cent
Median = 35.8 per cent
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

Delay times

Non-operational delay time
Care needs to be taken in interpreting the non-operational delay times (NODT) as delays, because some of them were part of operating procedures. Nonetheless the variable gives a general measure of the amount of time which was not available for working containers.

Average NODT for vessel calls at the CTAL terminal in 1983 was 26.4 hours and slightly more than half the vessel calls, 53.1 per cent, had a NODT value of 24 hours or less (see Table 4.11). For more than 20 per cent, however, NODT exceeded 36 hours.

Table 4.12 indicates the relationship between NODT and alongside times for vessel calls and suggests that, for a large proportion of them, NODT made up a considerable part of the total time which vessels spent at berth. About 80 per cent of vessel calls, for example, had a NODT greater than 40 per cent of alongside time. About one vessel call in three had between 41 and 50 per cent of its alongside time as NODT and slightly less than 20 per cent had a NODT of between 61 and 80 per cent of vessel alongside time.

TABLE 4.11-DISTRIBUTION OF NON-OPERATIONAL DELAY TIMES FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Non-operational delay time (hours)	*Vessel calls*	*per cent*	*Cumulative per cent*
1 - 4	10	8.8	8.8
5 - 8	2	1.8	10.6
9 - 12	8	7.1	17.7
13 - 16	16	14.2	31.9
17 - 20	9	8.0	39.8
21 - 24	15	13.3	53.1
25 - 28	9	8.0	61.1
29 - 32	12	10.6	71.7
33 - 36	8	7.1	78.8
> 36	24	21.2	100.0
Total	113	100.0	

Notes: 1. Mean = 26.4 hours
Standard deviation = 15.9 hours
Median = 24.6 hours
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 4.12-DISTRIBUTION OF THE RATIO OF NON-OPERATIONAL DELAY TIME TO ALONGSIDE TIME FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Non-operational delay time / *Alongside time* *(per cent)*	*Vessel calls*	*per cent*	*Cumulative per cent*
11 - 20	1	0.9	0.9
21 - 30	6	5.3	6.2
31 - 40	15	13.3	19.5
41 - 50	40	35.4	54.9
51 - 60	28	24.8	79.6
61 - 70	20	17.7	97.2
71 - 80	2	1.8	99.0
> 80	1	0.9	100.0
Total	113	100.0	

Notes: 1. Mean = 49.6 per cent
Standard deviation = 12.9 per cent
Median = 49.5 per cent
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

Table 4.13 lists the parameters of seven of the most important individual delay times within the total NODT. For most of these delay times, however, the large value of the standard deviation relative to that of the mean suggests a large amount of variability in the data and care needs to be taken in interpreting the summary values. In the following discussions, therefore, reference will be made to the computed statistical distributions of the variables although the tables are not included in the text.

Midnight shift time

The loss of time attributable to the fact that no midnight shift was worked averaged 10.7 hours for vessel calls at the terminal and was the most important component of NODT. For 40 per cent of the vessel calls, however, midnight shift time exceeded 12 hours, 23 per cent lost between eight and nine hours (or one midnight shift) and 35 per cent were either not affected or lost less than one hour.

Shift changes

There was considerable variability around the mean value of 4.3 hours. For half the vessel calls, two hours (the median value) were lost but for almost three-quarters less than three hours were lost.

TABLE 4.13-PARAMETERS OF SELECTED NON-OPERATIONAL DELAYS FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983
(hours)

Delay	*Mean*	*Standard deviation*	*Median*	*Maximum time*
Midnight shift delays	10.7	10.2	8.5	34.0
Delays due to shift changes	4.3	5.8	2.0	28.2
Waiting to sail	4.0	6.4	1.5	36.1
Waiting for labour to board	2.0	5.5	0.5	39.8
Industrial disputes	1.8	4.0	0.2	24.4
Delays incurred in handling breakbulk cargo	0.8	1.2	0.4	8.0
Delays due to smokos and breaks	0.7	0.9	0.3	3.9

Note: Number of vessel calls = 113.

Source: CTAL records (1983).

At the upper end of the scale, however, for 20 per cent of the vessel calls more than six hours were lost.

Waiting to sail

Although the computed average delay was four hours, for three-quarters of all vessel calls, less than four hours elapsed before deberthing and for 38 per cent sailing occurred within one hour of sending labour ashore. But for 15 per cent of vessel calls more than seven hours passed and for one vessel call, because of stoppages, deberthing was delayed by 36 hours.

Waiting for labour

Again, large variability in the data makes the mean of two hours a poor indicator. For 87 per cent of vessel calls, less than two hours passed before labour was aboard and for about one-quarter there were no delays. About 10 per cent involved waiting for more than four hours and 5 per cent for more than 12 hours, with one vessel call having a delay of almost 40 hours.

Industrial matters

This variable includes not only time lost due to industrial action such as strikes, but also to time given to meetings for the discussion of local, portwide and even more general matters. Only one dispute occurred on the terminal in 1983 arising directly from problems at the terminal and then it lasted for only 50 minutes. All other stoppages either did not originate in the terminal or were part of the general meetings policy of the-terminal management.

Table 4.13 shows that average industrial disputes time was 1.8 hours for each vessel call but the relatively large standard deviation suggests that the value is unrepresentative. In the computed statistical distribution for this variable, about three quarters of the vessel calls involved a loss of up to two hours through industrial disputes, 15 per cent had delays of more than four hours and 5 per cent eight hours or more.

These values have been derived from ship-based statistics which do not give a complete description of the time lost in industrial matters on the terminal. Table 4.14 has been compiled to indicate the terminal-based pattern and also includes vessel time lost.

A number of points are of interest. First, only one month was free of time lost due to industrial matters, although for two other months stoppages occurred on only one and two days respectively. For the whole year, however, one day in five was affected to some degree by industrial meetings or stoppages or port closure. On many days, disruptions lasted for part of a shift and, in numerous cases, because of low terminal utilisation in 1983, no vessel was affected. There were also several occasions when stoppages affected only specific rather than all port operations. Strikes by rail unions, for example, prevented movement of containers to and from the port by rail although other operations continued. Similarly, bans imposed by the shipping clerks in June on the handling of particular containers stopped only a part of the overall container movement.

The handling of breakbulk cargo

For 36 per cent of vessel calls, no breakbulk cargo was carried, for about 40 per cent less than one hour was spent handling it and for only 10 per cent of vessel calls did the handling of this type of cargo take more than two hours.

'Smokos' and breaks

For about 35 per cent of all vessel calls, scheduled breaks were worked without interruption and for another 40 per cent, interruptions lasted less than one hour. Only one ship call had a delay of more than three hours for this reason.

Clearly, there is a great deal of variability in the magnitude of the

TABLE 4.14-INDUSTRIAL STOPPAGES[a] AND PORT CLOSURES, CTAL TERMINAL, 1983

Date	*Nature of disruption*	*Time lost (hours)*	*Number of vessels affected*	*Vessel time lost (hours)*
January				
12	WWF stopwork meeting (rail/road movements disrupted)	8.0	0	0.0
February				
8	ASSA stoppage	3.5	1	3.5
	WWF Picnic Day	16.0	1	16.0
14-15	SRA strike - no rail movements	32.0	0	0.0
March				
1	WWF)	5.3	0	0.0
15	WWF) Stopwork meetings	8.0	0	0.0
17	WWF)	5.3	1	5.3
19-25	SUA refusal to man tugs	96.0	1	96.0
25	SSC stoppage	16.0	2	32.0
28	SUA refusal to man tugs	16.0	1	16.0
April				
1	Good Friday - port holiday	16.0	0	0.0
7	WWF and AFSA stopwork meeting	4.0	1	4.0
16-17	Port closed due to low level of activity	32.0	0	0.0
20	AFSA stopwork meeting	5.3	1	5.3
24	Port closed	16.0	0	0.0
25	Anzac Day - port holiday	16.0	0	0.0
30	Port closed	16.0	0	0.0
May				
4	WWF stoppage	5.3	0	0.0
	SSC stoppage	3.5	0	0.0
6	WWF stoppage	2.5	1	2.5
9	AFSA stoppage	3.3	2	6.5
10	Tradesmen's stoppage	4.0	2	0.0
12	AFSA stoppage	7.0	2	14.0
13	WWF stoppage	2.0	2	4.0
25	AFSA stoppage	16.0	1	16.0

TABLE 4.14 (Cont)-INDUSTRIAL STOPPAGES[a] AND PORT CLOSURES, CTAL TERMINAL, 1983

Date	*Nature of disruption*	*Time lost (hours)*	*Number of vessels affected*	*Vessel time lost (hours)*
June				
1	WWF stoppage	5.3	0	0.0
3	AFSA stoppage	6.0	0	0.0
15	AFSA stoppage	2.5	0	0.0
17-27	SSC place bans on receival/delivery of all OCL, AJCL and ASCL containers			
29-30	SRA strike - no rail movement			
July				
1-15	SRA strike (continued)			
12	WWF stoppage	1.0	0	0.0
13	WWF stoppage	1.7	0	0.0
14	WWF stoppage	1.0	0	0.0
28	SSC stoppage	1.5	1	1.5
August				
3	SSC meeting	6.5	2	13.0
9	WWF stoppage	1.0	0	0.0
12	WWF stoppage	6.3	2	12.5
September	No disruptions			
October				
12	WWF stopwork meeting	8.0	2	16.0
18	ASSA strike	16.0	0	0.0
19	ASSA strike	5.5	0	0.0
25	WWF stopwork meeting	5.3	1	5.3
November				
7	WWF stopwork meeting	0.8	1	0.8
30	WWF stopwork meeting	5.3	0	0.0

TABLE 4.14 (Cont)-INDUSTRIAL STOPPAGES[a] AND PORT CLOSURES, CTAL TERMINAL, 1983

Date	*Nature of disruption*	*Time lost (hours)*	*Number of vessels affected*	*Vessel time lost (hours)*
December				
7	WWF stopwork meeting	1.5	2	3.0
8	WWF stopwork meeting	1.0	2	2.0
	SSC stopwork meeting	2.0	2	4.0
12	WWF dispute	0.8	2	1.6
22	WWF stopwork meeting	1.6	1	1.6

a. Stoppages include delays due not only to industrial action but also to time devoted to meetings of union members.

Notes: 1. A full-day stoppage is regarded as disruption to two shifts and equal to 16 hours.
2. SRA = State Rail Authority
WWF = Waterside Workers' Federation
SUA = Seamen's Unions of Australia
SSC = Sydney Shipping Clerks
AFSA = Australian Foreman Stevedores Association
ASSA = Australian Superintendents and Supervisors Association
ASCL = Australia Straits Container Line

Source: CTAL records (1983).

components of NODT for each vessel but, as noted above, the individual components in sum make a considerable proportion of vessel alongside time non-productive.

Operational delay time

The average vessel operational delay time (ODT) of 7.1 hours was less than one-third the average value of NODT and, for almost three-quarters of the vessel calls, was less than eight hours (see Table 4.15). Only a small number of vessel calls, 9 per cent of the total, fell into the highest ODT category of between 13 and 16 hours. For the most part, therefore, ODT was a relatively small proportion of vessel alongside time (see Table 4.16) and the average was 15.2 per cent. For almost two-thirds of the vessel calls, ODT was between 11 and 20 per cent of alongside time and 81 per cent had a ratio of between 0 and 20 per cent. Only one call was in the highest ratio category of 31 to 40 per cent.

Table 4.17 lists the parameters of the most important components of

ODT. Again, it is useful to refer to the computed statistical distributions of each of the components although the tables are not included here.

TABLE 4.15-DISTRIBUTION OF OPERATIONAL DELAY TIMES FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Operational delay time (hours)	*Vessel calls*	*per cent*	*Cumulative per cent*
1 - 4	38	33.6	33.6
5 - 8	44	38.9	72.6
9 - 12	21	18.6	91.2
13 - 16	10	8.8	100.0
Total	113	100.0	

Notes: 1. Mean = 7.1 hours
Standard deviation = 3.5 hours
Median = 6.1 hours
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 4.16-DISTRIBUTION OF THE RATIO OF OPERATIONAL DELAY TIME TO ALONGSIDE TIME FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Operational delay time / Alongside time (per cent)	*Vessel calls*	*per cent*	*Cumulative per cent*
0 - 10	20	17.7	17.7
11 - 20	72	63.7	81.4
21 - 30	20	17.7	99.1
31 - 40	1	0.9	100.0
Total	113	100.0	

Notes: 1. Mean = 15.2 per cent
Standard deviation = 6.0 per cent
Median = 14.4 per cent
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 4.17-PARAMETERS OF SELECTED OPERATIONAL DELAYS FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

(hours)

Delay	*Mean*	*Standard deviation*	*Median*	*Maximum time*
Portainer crane downtime	2.7	1.8	2.2	9.4
Handling hatch covers	1.9	0.9	1.7	5.8
Removing/placing bridging pieces	1.6	1.5	1.3	7.0
Lashing and unlashing containers	0.7	0.9	0.4	5.3

Note: Number of vessel calls = 113.

Source: CTAL records (1983).

Portainer crane downtime

The average value of crane downtime per vessel call was 2.7 hours, with a median of 2.2 hours. For only 20 per cent of vessel calls, crane downtime exceeded four hours and, for 10 per cent, downtime ranged between five hours and the maximum value for one vessel call of 9.4 hours.

Handling hatch covers

For 54 per cent of vessel calls, container handling was delayed for between one and two hours to handle hatch covers and, for 92 per cent, less than three hours.

Removing/replacing bridging pieces

For most vessel calls (72 per cent), this activity delayed container exchange for less than two hours. Less than 10 per cent of vessel calls involved a delay of more than four hours, but, for one, the delay to container exchange was seven hours.

Lashing and unlashing containers

For 80 per cent of all vessel calls, container exchange was delayed for less than one hour for lashing or unlashing containers and for only 5 per cent of vessel calls did the interruption last for more than two hours.

Total delay time

The sum of the two delay time measures plus net working time equals the alongside time of vessels so that total delay time (TDT) is simply the complement of net working time.

Table 4.18 shows TDT as a proportion of vessel alongside time and provides a clear indication of the amount of time which vessels spend alongside but not working. On average, this was 65 per cent. But, for almost one vessel call in four, TDT was between 71 and 80 per cent of alongside time, while, for the modal group representing 43 per cent of calls, between 61 and 70 per cent of alongside time was spent not handling containers. Overall 91 per cent of calls had a TDT of between 51 and 80 per cent of alongside time.

CONTAINER HANDLING RATES

It was possible to establish three measures of container handling rates for vessels which used the CTAL terminal in 1983, namely:

- the alongside handling rate derived from the alongside time;
- gross container handling rate derived from the gross working time of the ship; and
- the net container handling rate derived from the net working time of the ship.

Since the amount of time involved for contaiı.er handling is

TABLE 4.18-DISTRIBUTION OF THE RATIO OF TOTAL DELAY TIME[a] TO ALONGSIDE TIME FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Total delay time[a] / *Alongside time (per cent)*	*Vessel calls*	*per cent*	*Cumulative per cent*
41 - 50	7	6.2	6.2
51 - 60	26	23.0	29.2
61 - 70	49	43.4	72.6
71 - 80	28	24.8	97.3
81 - 90	3	2.7	100.0
Total	113	100.0	

a. Total delay time = non-operational delay time plus operational delay time.

Notes: 1. Mean = 64.7 per cent
Standard deviation = 10.0 per cent
Median = 64.3 per cent
2. Figures may not add to totals due to rounding.

Source: CTAL records (1983).

progressively reduced in the calculation of the above measures, alongside handling rates provide the numerically lowest measures and net container handling rates the highest measures.

Fifty-nine per cent of vessels used three cranes, 40 per cent operated with two cranes and only one vessel used one crane and, for the great majority of container exchanges, cranes operated in the twin-lift configuration. On average, 77.2 per cent of all containers were handled as twin-lifts.

Alongside handling rate

The alongside handling rate is defined as the total number of containers, expressed as TEUs, handled per hour of vessel alongside time. No allowance is made for delays of any sort so that the rate is a general measure of the terminal productivity during the ship's stay. In 1983, the average alongside handling rate was 16.2 TEUs per hour, with a median value of just over 15 (see Table 4.19). This rate is directly comparable with that established in the earlier study of Glebe Island and STL terminals in Port Jackson (see BTE (1984a)). For both those terminals over the three-year period 1977, 1979 and 1981, the average alongside rate was 9.4 TEUs per hour. Notwithstanding the time interval between this and the earlier study, it is clear that there has been a considerable improvement in the alongside handling rates at the new CTAL terminal over those achieved at the older terminals.

Table 4.20 shows that for 45 per cent of all vessel calls at the terminal, an alongside handling rate of between 11 and 15 TEUs per hour was achieved and, for one-quarter of the vessel calls, the rate

TABLE 4.19-PARAMETERS OF CONTAINER HANDLING RATES FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

(TEUs per hour)

Container handling rate	*Mean*	*Standard deviation*	*Median*
Alongside handling rate	16.2	5.9	15.3
Gross container handling rate	32.2	9.9	32.5
Net container handling rate	45.5	13.3	47.4

Note: Number of vessel calls = 113.

Source: CTAL records (1983).

was between 16 and 20 TEUs per hour. For 82 per cent of vessel calls, the rate was less than or equal to 20 TEUs per hour.

TABLE 4.20-DISTRIBUTION OF ALONGSIDE HANDLING RATES FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Alongside handling rates (TEUs per hour)	*Vessel calls*	*per cent*	*Cumulative per cent*
0 - 10	14	12.4	12.4
11 - 15	51	45.1	57.5
16 - 20	28	24.8	82.3
21 - 25	12	10.6	92.9
26 - 30	6	5.3	98.2
31 - 35	1	0.9	99.1
35 - 40	1	0.9	100.0
Total	113	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

Gross container handling rate

The gross container handling rate is defined as the total number of containers, expressed as TEUs, handled per hour of gross working time. It is the rate achieved in the time actually available for the exchange of containers, but does not exclude time lost due to crane and equipment breakdown and other operational delays. The average rate achieved was 32.2 TEUs per hour, with a modal class including almost one in four ship calls of between 31 and 35 TEUs per hour (see Table 4.21). For about 20 per cent of vessel calls, the rate exceeded 40 TEUs per hour and, for about 10 per cent, 45 per hour.

Net container handling rate

The net container handling rate is defined as the total number of containers, expressed as TEUs, handled per hour of net working time. It represents the rate of handling which is achieved when all delays are omitted from the handling time. The average rate, for this time period, was 45.5 TEUs per hour, although for the modal group the rate was between 51 and 55 TEUs per hour and, for 54 per cent, net container handling rates in excess of 45 TEUs per hour were achieved. For 12 per cent of vessel calls, the rate exceeded 60 TEUs per hour (see Table 4.22).

TABLE 4.21-DISTRIBUTION OF GROSS CONTAINER HANDLING RATES FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Gross container handling rates (TEUs per hour)	*Vessel calls*	*per cent*	*Cumulative per cent*
10 - 15	4	3.5	3.5
16 - 20	11	9.7	13.3
21 - 25	18	15.9	29.2
26 - 30	17	15.0	44.2
31 - 35	26	23.0	67.3
36 - 40	17	15.0	82.3
41 - 45	9	8.0	90.3
46 - 50	7	6.2	96.5
51 - 55	3	2.7	99.1
56 - 60	1	0.9	100.0
Total	113	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 4.22-DISTRIBUTION OF NET CONTAINER HANDLING RATES FOR VESSEL CALLS AT THE CTAL TERMINAL, 1983

Net container handling rates (TEUs per hour)	*Vessel calls*	*per cent*	*Cumulative per cent*
10 - 15	1	0.9	0.9
16 - 20	2	1.8	2.7
21 - 25	3	2.7	5.3
26 - 30	12	10.6	15.9
31 - 35	14	12.4	28.3
36 - 40	11	9.7	38.1
41 - 45	9	8.0	46.0
46 - 50	17	15.0	61.1
51 - 55	26	23.0	84.1
56 - 60	5	4.4	88.5
> 60	13	11.5	100.0
Total	113	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

SUMMARY OF FINDINGS

It is clear that vessels spent less time at berth at the CTAL terminal in 1983 than was the case for vessels which used the STL terminal in Port Jackson in the late 1970s and early 1980s and that vessel productivity has changed even though container loads have tended to remain relatively static. Some of the time and productivity measurements which were used in the earlier study of the Port Jackson terminals differ, sometimes only slightly, from those in the present study but the measures of alongside time and alongside handling rates were the same in both cases. The differences between these measures are quite marked. Over the three years 1977, 1979 and 1981, average alongside time at the STL terminal, working three shifts, was 94 hours with a median of 76 hours. For the CTAL terminal in 1983, operating only two shifts, the average was 51 hours with a median of 48 hours. The alongside handling rates also differed quite substantially, with 9.4 TEUs per hour of alongside time at the STL terminal over the three years 1977, 1979 and 1981 compared with 16.2 TEUs per hour at the CTAL terminal in 1983.

The measure described as the net container handling rate in both studies, the actual handling time exclusive of all delays, was also identical. Averages of this measure indicated that the CTAL terminal handled containers at a rate of 45.5 TEUs per hour, slightly more than twice the rate, 21.5 TEUs per hour, at the STL terminal over the three years 1977, 1979 and 1981 (see BTE (1984a)).

But even with such marked improvements in vessel alongside times and in productivity, the analysis has underlined the quite considerable amount of idle time in vessel alongside time at the terminal. On average, 65 per cent of vessel alongside time was made up of non-operational and operational delay times and, for nine out of 10 vessel calls, this total delay time represented between 50 and 80 per cent of total alongside time. It is important to note, however, that this calculation includes time devoted to the midnight shift, which is hardly a delay because it is not worked. Nor is the handling of breakbulk cargo anything more than a delay to the exchange of containers since it is not an unusual part of container vessel operation. The lashing and unlashing of containers is also a usual part of operation for many vessels, but there are components of the total delay time which can be reduced, or ideally, eliminated. For example, delays due to shift changes, industrial disputes, and 'smokos' and breaks may be amenable to change.

CHAPTER 5-LANDSIDE HANDLING

Poor site access, inadequate storage areas and inefficient landside handling procedures reduce terminal efficiency because they affect ship and yard operation. Certainly, the older Glebe Island and STL terminals in Port Jackson were seriously hampered by their limited site areas and difficulties, including environmental problems, associated with the movement of containers to and from the terminals by road. The 31 hectare site of the Stage 1 development of the CTAL terminal, with its 17 hectare import/export stacking area and good road access, at least in the immediate vicinity of the terminal, has ensured that these problems will not arise at the new terminal.

Particular attention was paid in the design of the terminal to the need for efficient truck handling operations at the interface between the terminal and the inland road system. Trucks arriving at the terminal to deliver or receive containers pass through the security gate to the truck reception parking area. Trucks are allocated an identification number and, after submitting appropriate documents, the driver waits for his vehicle identification number to appear on the truck call-up board. When yard equipment is available, the truck is called forward into the terminal working area, receives or delivers the container(s), proceeds to the security gate and, after appropriate checks, leaves the terminal.

From data available, it was possible to establish, for the delivery and receival of containers for both day and afternoon shifts for each day over a 242 day period in 1983, the number of containers handled and the average time taken from the time the driver presented documents to the time the truck received or discharged the container.

IMPORT CONTAINERS COLLECTED BY TRUCKS FROM THE TERMINAL

On average, 109 containers were collected from the terminal on each day shift in 1983, with each delivery being completed in half an hour. The number collected on the afternoon shift was significantly fewer, averaging only 33, and took a slightly shorter time (see Table 5.1). Table 5.2 indicates the variations in the number of containers collected from the terminal on day and afternoon shifts.

TABLE 5.1-PARAMETERS OF THE NUMBER OF IMPORT CONTAINERS COLLECTED BY TRUCKS FROM THE CTAL TERMINAL ON DAY AND AFTERNOON SHIFTS AND THE AVERAGE TIME TAKEN, 1983[a]

	Number of deliveries completed[b]		*Average time taken (minutes)*	
Parameter	*Day shift*	*Afternoon shift*	*Day shift*	*Afternoon shift*
Mean	109.0	33.0	29.5	25.0
Standard deviation	58.5	26.4	16.7	15.5
Median	105.5	26.5	24.5	21.6
Maximum	311.0	130.0	112.0	97.0

a. 242 days
b. Total number of containers delivered on day shift = 26 285, afternoon shift = 8 011, total both shifts = 34 296

Source: CTAL records (1983).

TABLE 5.2-NUMBER OF IMPORT CONTAINERS COLLECTED BY TRUCKS ON DAY AND AFTERNOON SHIFTS AT THE CTAL TERMINAL, 1983

Number of deliveries completed	*Day shift*			*Afternoon shift*		
	Days	*per cent*	*Cumulative per cent*	*Days*	*per cent*	*Cumulative per cent*
0	4	1.7	1.7	5	2.1	2.1
1 - 50	37	15.3	16.9	189	78.1	80.2
51 - 100	73	30.2	47.1	42	17.4	97.5
101 - 150	63	26.0	73.1	6	2.5	100.0
151 - 200	53	21.9	95.0	0	0.0	100.0
201 - 250	11	4.5	99.6	0	0.0	100.0
> 250	1	0.4	100.0	0	0.0	100.0
Total	242	100.0		242	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

The distribution of the times taken by trucks to receive containers from the terminal in 1983 is indicated in Table 5.3. Clearly, on only a few shifts did the average time taken to deliver containers exceed one hour and, for two-thirds of the day shifts, deliveries took between one-quarter and half an hour. On afternoon shifts, the average delivery time for more than 90 per cent of shifts was less than 45 minutes.

TABLE 5.3-DISTRIBUTION OF TIME TAKEN FOR THE DELIVERY OF IMPORT CONTAINERS TO TRUCKS FROM THE CTAL TERMINAL, 1983

Time taken for deliveries (minutes)	*Day shift*			*Afternoon shift*		
	Days	*per cent*	*Cumulative per cent*	*Days*	*per cent*	*Cumulative per cent*
0 - 15	15	6.2	6.2	51	21.1	21.1
16 - 30	156	64.5	70.7	135	55.8	76.9
31 - 45	38	15.7	86.4	37	15.3	92.1
46 - 60	18	7.4	93.8	9	3.7	95.9
61 - 75	9	3.7	97.5	5	2.1	97.9
76 - 90	3	1.2	98.8	3	1.2	99.2
91 - 105	1	0.4	99.2	2	0.8	100.0
106 - 120	2	0.8	100.0	0	0.0	100.0
Total	242	100.0		242	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

EXPORT CONTAINERS RECEIVED FROM TRUCKS AT THE TERMINAL

The smaller export movement of containers at the terminal is underlined in the parameters of the number of containers received from trucks at the terminal in 1983 (see Table 5.4). On average, 65 containers were received on each day shift and 29 on each afternoon shift. Average times taken were only marginally smaller than for deliveries. Table 5.5 indicates variations in the number of containers delivered by trucks on day and afternoon shifts. The distribution of the times taken by trucks to deliver containers is given in Table 5.6.

TRUCK QUEUING

From the above results, it would perhaps appear that there is no evidence to support the view put forward at the Shore-Based Shipping Costs Seminar (see BTE (1984b)) that truck queuing at the CTAL

TABLE 5.4-PARAMETERS OF THE NUMBER OF EXPORT CONTAINERS RECEIVED FROM TRUCKS AT THE CTAL TERMINAL ON DAY AND AFTERNOON SHIFTS AND THE AVERAGE TIME TAKEN, 1983[a]

	Number of receivals completed[b]		*Average time taken (minutes)*	
Parameter	*Day shift*	*Afternoon shift*	*Day shift*	*Afternoon shift*
Mean	65.0	29.0	26.7	23.4
Standard deviation	42.0	27.0	15.2	14.5
Median	56.0	21.0	22.1	20.6
Maximum	222.0	137.0	120.0	99.0

a. 242 days
b. Total number of containers received on
   day shift = 15 622
   afternoon shift = 7 113
   total both shifts = 22 735

Source: CTAL records (1983).

TABLE 5.5-NUMBER OF EXPORT CONTAINERS RECEIVED FROM TRUCKS ON DAY AND AFTERNOON SHIFTS AT THE CTAL TERMINAL, 1983

	Day shift			*Afternoon shift*		
Number of receivals completed	*Days*	*per cent*	*Cumulative per cent*	*Days*	*per cent*	*Cumulative per cent*
0	4	1.7	1.7	4	1.7	1.7
1 - 50	99	40.9	42.6	201	83.1	84.7
51 - 100	94	38.8	81.4	26	10.7	95.5
101 - 150	35	14.5	95.9	11	4.5	100.0
151 - 200	9	3.7	99.6	0	0.0	100.0
201 - 250	1	0.4	100.0	0	0.0	100.0
Total	242	100.0		242	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

TABLE 5.6-DISTRIBUTION OF TIME TAKEN FOR THE RECEIVAL OF EXPORT CONTAINERS FROM TRUCKS AT THE CTAL TERMINAL, 1983

Time taken for receivals (minutes)	*Day shift*			*Afternoon shift*		
	Days	*per cent*	*Cumulative per cent*	*Days*	*per cent*	*Cumulative per cent*
0 - 15	21	8.7	8.7	59	24.4	24.4
16 - 30	165	68.2	76.9	142	58.7	83.1
31 - 45	30	12.4	89.3	25	10.3	93.4
46 - 60	17	7.0	96.3	7	2.9	96.3
61 - 75	5	2.1	98.3	6	2.5	98.8
76 - 90	1	0.4	98.8	2	0.8	99.6
91 - 105	2	0.8	99.6	1	0.4	100.0
105 - 120	1	0.4	100.0	0	0.0	100.0
Total	242	100.0		242	100.0	

Note: Figures may not add to totals due to rounding.

Source: CTAL records (1983).

terminal was a major problem. However, these results represent only one component of truck queuing and problems may have arisen because of a lack of integration between port operators and the companies and individuals responsible for the daily arrangements of road transport, resulting in long queues of trucks outside the terminal gates. Some of the causes of truck queues identified at the seminar were the large variation in the number of trucks arriving both day-to-day and shift-to-shift and meal breaks and shift changes, with the first reason being the major cause.

RAIL HANDLING

The terminal is also served by rail and, in 1983, handled a total of 24 181 containers, or 29.8 per cent of the total number of containers handled, compared with 57 031 by road. On average, 465 containers were handled each week in 1983, even though, for two weeks, rail handling was discontinued because of a strike by employees of the State Rail Authority. Table 5.7 lists the number of containers handled on a weekly basis. For almost half the year, the total number of containers handled to and from rail was greater than 500 containers, although for only six weeks of the year were totals above 700 containers.

TABLE 5.7-THE NUMBER OF CONTAINERS HANDLED TO AND FROM RAIL AT THE CTAL TERMINAL, 1983[a]

Number of containers handled per week	*Number of weeks*
0 - 100	3[b]
101 - 200	2
201 - 300	6
301 - 400	6
401 - 500	10
501 - 600	13
601 - 700	6
701 - 800	3
801 - 900	3
> 900	0
Total	52

a. A total of 24 181 containers were handled in 1983.
b. Including two weeks in which no containers were handled because of a strike by State Rail Authority employees.

Source: CTAL records (1983).

Accurate figures are not readily available to show the breakdown of origins and destinations of rail-handled containers, but a large number are moving to and from Brisbane in the Australia/Europe service, since the ANZECS consortium does not make direct calls to the port of Brisbane. In addition to that movement, rail services were used for export containers of wool and cotton from country centres in NSW and for import and export LCLs to and from the container depots at Villawood and, for part of 1983 at least, Chullora.

SUMMARY OF FINDINGS

The analysis of data for the landside handling operations at the terminal suggests a number of points. First, it is apparent that trucks were able to deliver export containers to and receive import containers from the terminal very quickly indeed, with most trucks handling loads in less than 30 minutes and only a small proportion, about 5 per cent, taking longer than one hour. Second, landside handling operations at the terminal were obviously capable of much larger throughputs and there was considerable spare capacity in this part of the terminal operation, as in others. Third, the analysis clearly underlines the low utilisation achieved in the afternoon shift, with an average of 33 deliveries and 29 receivals. And finally, the modal split of container movements to and from the terminal in 1983 was very close to 70 per cent by road and 30 per cent by rail.

CHAPTER 6-CONCLUDING REMARKS

The CTAL terminal in Port Botany began operations in February 1982, 13 years after the first purpose-built container terminal at White Bay in Port Jackson commenced operations and nine years after the opening of the Glebe Island terminal. The planning and development of the CTAL terminal took rather longer than expected because, although the MSB decided to go ahead with the container terminal complex in Port Botany in early 1974, changes in the corporate structure of STL (the company which initiated moves to lease the terminal site), the formation of the new company CTAL and doubts about the viability of a new terminal extended initial planning.

Even after a commitment to develop a new terminal had been made, planning for the terminal was halted, together with development of the whole Botany Bay port development project, as a new State Government in mid-1976 sought ways and means of dealing with the environmental problems which were perceived to be associated with port projects, actual and proposed, in the Bay. The Simblist Inquiry, which was instituted to evaluate the developments, urged continuing development of the container terminal project. However, persistent environmental concerns about traffic movement to and from the proposed port facilities, including the container terminals, prompted a further inquiry. The Kirby Inquiry focussed not only on the Kyeemagh-Chullora road question but also, following a special brief from the Minister for Transport, on the so-called 'container issue'. The Inquiry began in September 1978, when the Commissioner was appointed and the terms of reference made public, and continued to January 1981 when the final report was completed. A separate report on containers was forwarded to the Government in October 1980. But the major recommendation that some containers should be railed to and from western depots rather than road-hauled has not been implemented. The State Government did, however, accept the recommendation that a container depot be established at the terminals in Port Botany, although this project has also yet to be implemented.

Finally, when the CTAL terminal began operations in 1982, it did so in an economic climate characterised by severely depressed trading conditions, overcapacity in the liner trades and consequent cost cutting and intense price competition in the shipping sector.

In 1983, the CTAL terminal was operating with a throughput of 91 000 TEUs, significantly lower than its design capacity. Berth occupancy ratios were low, with the estimated ratios for the year varying from a low of 25.8 per cent in July to a high of 43.5 per cent in August and for 10 of the 12 months occupancy being estimated at less than 40 per cent.

The analysis presented in this paper must be viewed against this background and gives a cross-sectional view of the operation of a new generation container terminal in a major Australian port. For the rest of this chapter, reference will frequently be made to Table 6.1, which summarises the productivity characteristics of the CTAL terminal and compares some of these with similar characteristics of STL during earlier years.

The terminal was designed with the needs of the long-haul Australia/Europe trade and vessels of the ANZECS consortium in mind as well as those of the Australia/Japan trade. In 1983, the terminal also served the Australia/Far East and Australia/Asia/Persian Gulf trades. Average vessel size tended to be large, about 28 000 DWT, with more than 80 per cent of the ships using the terminal larger than 20 000 DWT in 1983. Container exchanges averaged 786 TEUs and the largest exchange in 1983 was 1587 TEUs. In terms of ship and container traffic, and not surprisingly since the terminal took over the STL functions, the new CTAL terminal resembled the older STL terminal in Port Jackson.

But despite these similarities, average vessel alongside time at the new CTAL terminal was about half that for the older terminal at 51 hours compared with 94 hours over the three-year period 1977, 1979 and 1981. Alongside time is a very gross measure and can be influenced by many factors, but it gives some general indication of the differences between the older terminal and the new one.

It is the disaggregation of the vessel alongside time profiles and the calculation of a variety of container handling rates which provide detailed insights into terminal productivity. In this study, gross working time was defined as alongside time less non-operational delay time (including the time allocated to the midnight shift, industrial matters, waiting for the vessel to sail, 'smokos' and breaks). It was found that the average gross working time was 51 per cent of alongside time.

TABLE 6.1-COMPARISON OF THE MEAN VALUES OF DEMAND, OPERATING AND PRODUCTIVITY PARAMETERS OF THE CTAL AND STL TERMINALS

Parameter	*CTAL*[a]	*STL*[b]
Demand characteristics		
Vessel size (DWT)	28 309	25 356
Load per vessel call (TEUs)		
Import	429	439
Export	338	329
Total (including restows)	786	785
Vessel times		
Alongside time (hours)	51	94
Gross working time (hours)	24	na
Gross working time/alongside time (per cent)	51	na
Net working time (hours)	17	37
Net working time/alongside time (per cent)	36	39
Operational delay time (hours)	7	na
Operational delay time/alongside time (per cent)	15	na
Non-operational delay time (hours)	26	19
Non-operational delay time/alongside time (per cent)	50	22
Container exchange rates (TEUs per hour)		
Alongside handling rate	16.2	9.4
Gross container handling rate	32.2	na
Net container handling rate	45.2	21.5

a. For 1983.
b. Aggregated over the three years 1977, 1979 and 1981.

na not available

Source: Chapters 3 and 4 and BTE (1984a).

The variable net working time defined the amount of time which was actually spent handling containers; this is, gross working time less operational delay time (including, for example, crane and equipment downtime, handling hatch covers, lashing and unlashing). It was found that the average net working time was 36 per cent of vessel alongside time.

There were also considerable differences in container handling rates between the new terminal and the older STL terminal, although only two of the measures of handling rates are strictly comparable. It was found that:

- the average alongside handling rate (the number of TEUs handled per hour of alongside time) for the CTAL terminal in 1983 was 16.2 compared with 9.4 at the older terminal for the three years 1977, 1979 and 1981;
- the average gross container handling rate (the number of TEUs handled per hour of gross working time) was 32.2; and
- the average net container handling rate (the number of TEUs handled per hour of net working time) was 45.5 at the CTAL terminal and 21.5 TEUs per hour at the older terminal.

Clearly, there was a large proportion of time which ships spent alongside the berth at the new terminal but were not actually working cargo. In practice, it is not possible to avoid some idle or delay time in the operations of a system as complex as a container terminal and some of the factors listed as delays in the terminal records and in this study are operationally unavoidable idle times. One of the most important tasks for management is to eliminate 'avoidable' idle time and to minimise those delays which are a normal part of terminal operations.

Operational delay times in the terminal records included time allocated to some activities that are a normal part of container working, such as lashing and unlashing, handling hatch covers and attaching and removing bridging pieces. They also included crane and equipment downtime which, although expected in terminal operations, can be minimised with good utilisation and maintenance policies. For 1983, average operational delay time for vessel calls accounted for about 15 per cent of vessel alongside time.

Average non-operational delay times for vessels accounted for virtually 50 per cent of vessel alongside time and, although a considerable proportion of this time is not used as a matter of deliberate policy, it does suggest that there was a large amount of spare capacity in the terminal system that could have been utilised if and when demand required it. The midnight shift, for example, was not worked and, on average, accounted for 10.7 hours of vessel alongside time in 1983. Vessels waited to sail, on average, four hours after completing work, a waiting time that was independent of terminal operations and could have been reduced if vessel schedules had been tighter. Ships waited for labour to board for an average of two hours, although this simply reflected the fact that the ship arrived at berth before shifts commenced. Other idle or delay times may, however, be minimised or eliminated. The time lost in shift changes averaged 4.3 hours per vessel call, although negotiations are now in hand to streamline and overlap shift times, and it is likely that this source of lost time will be eliminated.

On average, 1.8 hours per vessel call were spent idle as a result of meetings or stoppages related to industrial and labour matters. Largely because of the low berth utilisation at the terminal in 1983, there were relatively few ships affected by industrial matters, although a considerable amount of terminal working time was taken up with industrial meetings of one sort or another. The terminal was, however, virtually strike free from disputes which arose over terminal operations, although it suffered from strikes which affected other parts of the transport network, such as the rail system. Close management and labour relations is an important management policy on the terminal and accounts largely for the industrial harmony.

The site and access constraints on productivity that were a fact of life for the inner city Port Jackson terminals do not exist for the CTAL terminal. Nonetheless, despite shorter alongside times and significantly increased container exchange rates, the amount of time which ships spent idle at the berth in 1983 remained high. Some of this is obviously attributable to the generally depressed trading conditions but it seems apparent that the terminal, and possibly all Australian terminals, are locked into an operating environment which makes it difficult to achieve high productivity.

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ABBREVIATIONS

AAE	Asia Australia Express Ltd
AAO	Asia Australia Express Ltd, Australian National Line and Orient Overseas Container Line
AFSA	Australian Foreman Stevedores Association
AJCl	Australia Japan Container Line
ANL	Australian National Line
ANZECS	Australia New Zealand and Europe Container Service
ASCL	Australia Straits Container Line
ASSA	Australian Superintendents and Supervisors Association
CTAL	Container Terminals Australia Limited
DWT	deadweight tonnes
FCL	full container load
GWT	gross working time
ITV	internal transfer vehicle
LCL	less-than-container-load
MOL	Mitsui OSK Lines Ltd
MSB	Maritime Services Board
NODT	non-operational delay time
NWT	net working time
NYK	Nippon Usen Kaisha
OCAL	Overseas Containers Australia Proprietary Limited
OCL	Overseas Containers Limited
OOCL	Orient Overseas Container Line
SCNZ	Shipping Corporation of New Zealand
SPCC	State Pollution Control Commission
SRA	State Rail Authority
SSC	Sydney Shipping Clerks
STL	Seatainer Terminals Limited
SUA	Seamen's Unions of Australia
TDT	total delay time
TEU	twenty-foot equivalent unit
WWF	Waterside Workers' Federation
YSL	Yamashita-Shimmihon Steamship Co. Ltd.

GLOSSARY

Leverage lease	A finance lease in which a third party provides the bulk of the finance, allowing the lessor to achieve an increased return on his proportionately lower investment.
Bridging pieces	Structural members used in the stowage of containers.
DWT	Deadweight tonnage; the total weight in tonnes that a ship carries on a specified draft (usually the summer draft) including cargo, fuel, water in tanks, stores, baggage, passengers and crew and their effects but excluding water in the boilers.
ITV	Internal transfer vehicle; a generic term used to describe a vehicle used for transferring containers from the wharf area to the stacking area or within the stacking area.
Portainer	Portainer crane; a travelling gantry crane used for transferring containers on and off ship. Portainer cranes run on rail tracks laid along the wharf area. The name derives from the trade name used by Paceco Incorporated, USA for its ship-to-shore container cranes.
Reefer	Refrigerated container.
Ro-ro	Roll-on/roll-off vessel.
TEU	Twenty-foot equivalent unit; a container counting unit based on the International Standards Organisation (ISO) 20 feet by 8 feet by 8 feet container.

Transtainer	Transtainer crane; a travelling gantry crane used for moving containers in the container stacking area. Glebe Island transtainer cranes run on pneumatic tyres which allow for some maneouvrability. The name derives from the trade name used by Paceco Incorporated, USA for its container handling cranes.
Straddle carrier	A particular type of internal transfer vehicle. These carriers lift containers from the 'straddle' position and can commonly stack up to three high.