Maritime business experience in Sydney: port logistics and shipping line management. Differences with the Barcelona's model

Bachelor's thesis

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Acknowledgements

I would like to dedicate this thesis to my family and friends, who have been supporting me during all the development of the project. But, above all, to my Australian family, who are the real “guilty” of this. They were able to arrange this experience for me, and to host me in their lovely house during my stay in Sydney. I will never forget how they looked after me, thank you Gina and Peter Wallington.

I don’t forget also all the teachers and professors of the Nautical Faculty of Barcelona who have been teaching me during the years of my career, but specially I would like to acknowledge to my tutor Xavi Martínez de Osés how much helpful he has been for me during the thesis. He has guided me perfectly during the project.

Last but not least, I would like to remember all the staff of the Port Authority of New South Wales. They received me as one of them and taught me things I will keep all the life. Their support and treatment made me feel like home.

Long life to seafarers!

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Abstract

The opportunity for a Barcelona's student to be part of a working experience in the Port Authority of New South Wales (Australia) doesn't show up every day. I was lucky to have it, so I took it without any doubt. It was a great experience, which brought me not only work experience, but also a lot of personal growth. So, why not trying to explain in a thesis, how I felt and what I learnt about this business. This is my motivation about this project and I think it satisfies what is, for me, the main rule: enjoy doing the project, because it is the best way to give the best of each one and transmit exactly what is wanted.

The Port Authority of New South Wales is a company unknown for the majority of us (It was for me before starting the experience). That's why it is important to do a big introduction of it in the thesis before entering in more technical aspects. I will try to explain in a way that all readers (not only the maritime sector experts) can achieve a brief idea on how the company works after reading it.

But, what is the purpose for people of Barcelona knowing about the business of one Port Authority of Australia? Be able to compare it with a local one, in this case, Barcelona. That's why after focusing on the Port Authority of New South Wales, I will develop a comparison between Sydney and Barcelona. Two big cities, separated for a lot of miles, with different cultures but running a similar business. Which of these two cities has more traffic? Which applies more expensive charges? We will figure it out during the thesis.

Resumen

La oportunidad para un estudiante de Barcelona de formar parte de una experiencia laboral en la Autoridad Portuaria de Nueva Gales del Sur (Australia) no aparece cada día. Yo tuve la suerte de tenerla, así que la cogí sin ninguna duda. Fue una experiencia genial, la cual no solo me aportó experiencia en el mundo laboral, sino que también me aportó un buen crecimiento personal. Por lo tanto, ¿por qué no intentar plasmar en una tesis de final de carrera, como me sentí y que aprendí de este negocio?. Esta es mi motivación sobre este proyecto y creo que satisface la que es, para mi, la consigna más importante: disfrutar realizando el proyecto, porque es la mejor manera de dar lo mejor de uno mismo y transmitir realmente lo que uno quiere.

La Autoridad Portuaria de Nueva Gales del Sur es una empresa desconocida para la mayoría de nosotros (lo era también para mi antes de empezar la experiencia). Por eso es importante hacer una gran introducción sobre la empresa en el proyecto antes de entrar en aspectos más técnicos. Lo intentaré explicar de una forma que todo tipo de lector (no solo expertos en el sector marítimo) pueda captar una breve idea de como funciona dicha empresa después de leerlo.

Pero, ¿que aporta para la gente de Barcelona conocer el negocio de una Autoridad Portuaria de Australia? Ser capaz de compararla con una local, en este caso, Barcelona. Por eso después de centrarme en la Autoridad Portuaria de Nueva Gales del Sur, desarrollaré una comparación entre Sídney y Barcelona. Dos grandes ciudades, separadas por muchos quilómetros y con culturas diferentes llevando a cabo un negocio semejante. ¿Cuál de estas dos ciudades tiene más tráfico?; ¿Cuál aplica unas tarifas más elevadas? Lo descubriremos durante el proyecto.

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Chapter 1. The Port Authority of New South Wales

The Port Authority of New South Wales (PANSW) was created on 1 July 2014 under the Ports and Maritime Administration. It is a statutory State Owned Corporation responsible for providing safe navigation to commercial shipping and facilitating the efficient movement of cargo and passengers within the ports of Yamba, Newcastle, Sydney, Port Kembla and Eden.

This company owns 345 employees spread across 8 locations, which the 80% of them are workforce marine professionals (Port officers, cutter crew, marine pilots, vessel traffic services, surveyors, harbour masters).

1.1. Port safety functions

To ensure the port safety, the PANSW has six functions. The delivery of each function is planned by the Responsible Manager in conjunction with the Chief Operation Officer forms an integral part of the services undertaken by PANSW in meeting the requirements of the Port Safety Operating License (PSOL). [1]

This functions and their objectives are:

1.1.1. Channel and berth depths

Port Authority of New South Wales, as the license, ensures that the depths in the shipping channels and the berthing boxes, which it controls, are maintained at depths equal to, or greater than those depths published and promulgated. This is achieved by a documented system of control which ensures, among other things that:

- A survey schedule for depths is prepared and regularly reviewed.
- There is internal reporting of depths reported or found to be less than the promulgated depths.
- There is a reporting system to promulgate shallower depths.

- That action is taken to restore depths to the promulgated figures within agreed time frames should be deemed necessary.

Surveying of the channel and berth depths is carried out by qualified surveyors.

1.1.2. Dangerous goods handling

With respect to dangerous goods handling, PANSW as license maintains a documents system with the aim of ensuring that persons involved with the handling of dangerous goods in the ports do so in a safe and efficient way. PANSW also produces guidance material for the management of dangerous goods in port areas, for the benefit of ship agents and terminal operators.

By a system of random inspections carried out by trained personnel, they monitor compliance with procedures, current applicable legislation and other applicable national and international codes and rules for the handling, storage and transportation of dangerous goods. Where non-compliance is detected, PANSW takes appropriate action to have it rectified.

Within its jurisdiction, maintains a documented system of control which:

- Approves the entry and movement of dangerous goods in bulk, containers and break bulk.
- Grants approvals for work on vessels including hot work, immobilisation and activities with an adverse environmental affect.
- Conducts random inspections to monitor compliance with its approvals/permits and maintains written records of such inspections.

1.1.3. Emergency response

Port Authority of New South Wales is capable of responding to port related emergencies within its defined areas of operation and to oil spills in State waters when so requested by the appropriately authorised officer.

They have a system that ensures that the necessary equipment and trained personnel are available to effectively respond to oil spills at any time on a 24 hour-a-day basis throughout the year and that emergency response plans are maintained and regularly updated.

With respect to the personnel, the documented system provides control of:

- Training to deal with oil spills and other port-related emergencies.
- Training in the use of equipment and other material under PANSW control.
- On-going training covering.
- Table-top and field exercises.

- Reporting and obtaining evidence in respect of offences under the relevant Marine Pollution Act.

1.1.4. Navigational aids operation

Port Authority of New South Wales provides navigational aids in the shipping channels and associated approaches to its ports and the berths (under its jurisdiction) which conform to the International Association of Lighthouse Authorities (IALA) specifications and performance standards.

The documented system ensures that navigation aids are maintained so as to operate effectively for shipping and includes controls to provide for:

- A maintenance schedule for navigation aids.
- The regular inspection of navigation aids.
- A replacement schedule.
- The intern reporting and the notification to shipping of navigation aids which are malfunctioning, out of position or missing.
- Rectification of situations arising from above.

1.1.5. Pilotage and exemptions from pilotage

The pilotage service is provided by the Pilots of the PANSW. Sufficient pilots are engaged to maintain an efficient pilot service on a 24 hour-a-day basis throughout the year. The Pilots maintain a documented system, which contains the procedures and practices by which pilots are appropriately trained and qualified to pilot the vessels to which they are assigned.

In addition, the Port Authority of New South Wales quality system ensures that a ship's master seeking to enter in port without a pilot has a valid Pilotage Exemption Certificate (PEC) issued by the PANSW, the Minister and the Minister's delegate. The documented system provides for control over:

- The requirements to obtain a PEC
- The requirements to maintain or update a PEC
- A master to utilise a PEC only in accordance with its conditions.

The documented system operated and maintained by the Pilots provides for:

- The requirements to obtain a pilot's licence.
- Initial and ongoing training of pilots in accordance with the Pilotage Code, including pilot related emergencies.
- The assignment of pilots to vessels and berths for which they are qualified.

- Reports detailing the number of times that each pilot has handled a particular category of vessel and the number of times that each pilot has berthed and un-berthed vessels from a particular berths sets of berths, and whether the movements were carried out during the day or night.

1.1.6. Port communications

Port Authority of New South Wales maintains the Vessel Traffic Services (VTS) as the communications system for the ports of Sydney Harbour and Botany Bay. The VTS is manned by appropriately qualified personnel 24 hours a day, 7 days a week throughout the year. In accordance with the Port Safety Operating Licence, Port authority of New South Wales maintains procedures which ensure that all communications operators:

- Hold a valid Restricted Operator's Certificate of Proficiency in Radio Telephony.
- Provide mariners with information on shipping movements.
- Provide mariners with marine warnings and the latest notices to mariners related to the port.
- Inform the appropriate combat agency about reports and sightings of oil spills.

1.2. Ports owned by the PANSW

Figure 1: Australia's map – Source: Google images

Figure 2: New South Wales map – Source: PANSW

As I said before, the PANSW is responsible for six ports along all the state. This review will focus on the Sydney ports (Sydney Harbour and Port botany), which are the two ports where I was. However, it would be useful to explain a little bit the others ports, just to have a brief idea about the size of this Port Authority.

1.2.1. Port of Yamba

Located at the mouth of the Clarence River in Northern New South Wales, Yamba is Australia's eastern most seaport.

Yamba serves the whole Northern Rivers and New England region. It is also the homeport of the state's second largest fishing fleet and handles a range of imports and exports. It has two divisions, pilotage and port services. [2]

The pilotage team is responsible for the provision of Pilotage in the Port. There are only 2 marine Pilots, who board or disembark all vessels requiring the service of a pilot cutter. [3]

The port services team is responsible for the safe and efficient transport of pilots to and from their allocated vessels. This includes:

- Embarking and disembarking pilots to and from vessels off shore, using our pilot cutter.
- The port services team also responds to marine oil and chemical spills within the area of response, and are on call to support other government agencies if requested.
- The team is also responsible for ensuring all vessels and port services equipment is fit for use and maintained according to schedule.
- The port services team is available on a 24/7 basis.

1.2.2. Newcastle Harbour

Newcastle is 162km north of Sydney and is the economic and trade centre for the Hunter region. The harbour provides a significant gateway to the resource rich Hunter Valley and for much of the north and northwest of NSW.

Newcastle Harbour is Australia's oldest export port and one of the country's largest tonnage throughput ports. Coal exports represent more than 90% of total tonnage, which includes other bulk cargoes such as grains, vegetable oils, alumina, fertiliser and ore concentrates. This harbour, as for his big size, has six divisions, four more than Port of Yamba. [2]

The pilotage team is composed by 22 marine pilots, which offers the service 24/7 and the 80% of transfers are done by Helicopter. [3]

The port services team have the same duties explained above in Port of Yamba, but obviously with a bigger team.

Apart from these two divisions, there are: Vessel Traffic Information Centre (which provides permanently communication and management of the vessels that arrive or depart from Newcastle),

safety and compliance (which provides training and safety leadership to the personnel), legal (provides legal support to the PANSW) and Information Technology.

1.2.3. Port Kembla

Located on the east coast of NSW, Port Kembla was established in the late 1890s to facilitate the export of coal from the mines of the Illawarra region. Since that time it has rapidly grown to accommodate both the expansion of traditional industries along with the development of new ones. [2]

The port Kembla team is responsible for a number of functions: [4]

- Port Marine Functions including VTIC and Pilotage (9 pilots).
- PSOL functions including Dangerous Goods, Surveys and Navaids.
- Emergency Response.
- Waterside Security

In 2015-16, there were 870 trade vessel visits to Port Kembla. Shipping numbers were stable in comparison to 2014-15. The port managed 1776 pilot movements to and from commercial vessels.

Port Kembla has a diversified trade base including motor vehicle imports, general and break bulk cargoes, steel, containers, gypsum, soda ash, fertilisers, iron ore, iron sands, coke, coal, copper concentrate, clinker, sulphuric acid and oil products. It is also the principal grain export port for procedures in Southern and South-Western NSW.

1.2.4. Port of Eden

Port of Eden is the southernmost deep-water harbour in NSW and is situated equidistant between Sydney and Melbourne. The Port provides a Harbour Master, 24 hour pilotage services, management of a Navy wharf and port security functions, the same as Port Kembla. [2][4]

The Port Authority looks forward to continuing growth in the number of cruise ships visiting this deep-water harbour, with approval granted for the building of an extended wharf. There were 69 total vessel visits to this port during 2015-2016, 22 of them were cruise ships. In 2016-2017, cruise ship visits have increased to 14 scheduled visits.

The commodities traded at Port of Eden include wood chip and logs. This port is also home to a fishing and navy fleet.

In the coming years, cruise ships will no longer have to anchor in the harbour, and berthing will make it an easier destination for larger ships, passengers, and support services – and economically better for the local community.

1.3. Port highlights

In the ports that the PANSW owns, the commercial year is counted from July to June of the next year. As the season has not finished yet, the numbers below are for the season 2015-2016. This is a good data to compare the vessel's movements in all the PANSW ports. [5]

	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun	Total 2015-16	Total 2014-15
Port Botany	141	140	147	140	144	136	134	135	148	144	145	146	1.700	1.674
Sydney Harbour	91	67	90	99	110	119	116	120	109	97	86	65	1.169	1.083
Newcastle	184	193	153	174	170	202	183	184	208	183	175	178	2.187	2.209
Port Kembla	64	71	74	77	71	74	68	70	77	75	70	79	870	870
Eden/Yamba	3	13	5	10	6	9	6	13	6	4	5	7	87	91
TOTAL	483	484	469	500	501	540	507	522	548	503	481	475	6.013	5.927

Table 1: Total vessels traffic – Source: PANSW

	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun	Total 2015-16	Total 2014-15
Port Botany	141	140	147	140	144	136	134	135	148	144	145	146	1.700	1.674
Sydney Harbour	81	61	74	73	72	83	74	75	78	70	69	48	858	802
Newcastle	184	193	153	174	168	202	181	181	206	183	174	178	2.177	2.200
Port Kembla	64	71	74	77	71	74	68	70	77	75	70	79	870	870
Eden/Yamba	3	13	5	10	4	8	5	10	5	4	5	7	79	88
TOTAL	473	478	453	474	459	503	462	471	514	476	463	458	5.684	5.634

Table 2: Trade vessels traffic – Source: PANSW

	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun	Total 2015-16	Total 2014-15
Sydney Overseas Passenger Terminal	6	2	8	20	20	24	22	24	23	17	7	9	182	171
Sydney White Bay	3	4	8	6	12	12	18	17	7	10	10	8	115	100
Sydney other	1	0	0	0	6	0	2	4	1	0	0	0	14	10
Newcastle	0	0	0	0	2	0	2	3	2	0	1	0	10	9
Eden	0	0	0	0	2	1	1	3	1	0	0	0	8	3
TOTAL	10	6	16	26	42	37	45	51	34	27	18	17	329	293

Table 3: Passenger ships traffic – Source: PANSW

1.4. Port Jackson

Port Jackson is the main name for the recreational port in Sydney, which is located in the waters of the bay inside the city. In other words, Port Jackson is all the water that enters from the ocean to all parts of Sydney. It is very big, so it is divided in three main harbours.

Figure 3: Port Jackson chart with the three harbours indicated – Source: PANSW

As it appears in the image above, there are three main entrances of sea in land. Each entrance is considered a harbour, which belongs to Port Jackson.

The first bay, just entering Port Jackson to the right, is the north Harbour. The second one is middle harbour and the last one, the biggest entrance, is Sydney Harbour.

North Harbour is the smallest entrance in Port Jackson. The most important thing here is the manly pier. There is a very popular beach there (Manly beach) so there are a lot of ferries that transport people from the city centre (Sydney Harbour) to the manly pier.

Middle Harbour is a completely recreational harbour. Is a natural sea entrance with plenty of little bays. There are a lot of houses in this area, where people have their own boat in these bays, near their homes. In Middle Harbour we can see both marinas with pears and a lot of boats and quiet bays with boats in buoys. It is really an amazing place.

1.4.1. Sydney Harbour

As I said before, Sydney Harbour is the emblematic harbour in Sydney. The one that is inside the city.

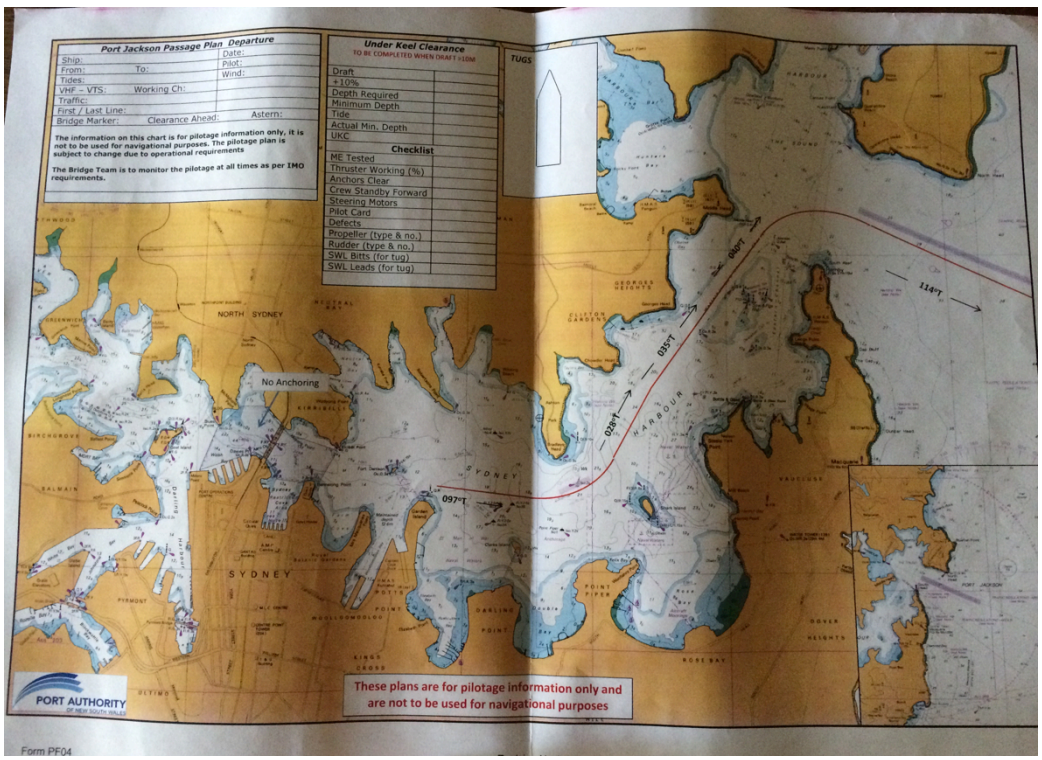

Figure 4: Sydney's Harbour chart – Source: PANSW

It is, as the other parts of Port Jackson, a recreational port. However, apart from the private boats, there are two cruise terminals and one bulk terminal.

Entering from the Pacific Ocean between the North Head and the South Head, Sydney Harbour is just on the left, Between the same South Head and Middle Head. In other words, is the left part of Port Jackson, just where the red line is in the image above.

The Harbour is plenty of little bays where there are private boats in buoys or marinas and little beaches where people can go for a swim next to their homes. It's not until the harbour bridge (the heart of the city) when the big ship's docks appear.

Before explain where are the big terminals situated, it's important to have a look at the obstacles that the big ships find in Sydney Harbour before arrive at the terminal.

It is a big entrance of water in land, so the first worry for the vessels is the draft. Fortunately, it is a deep Harbour, but it doesn't mean there aren't some conflictive points.

Surprisingly, the more shallow waters are at the beginning of the Harbour. In fact, the main channel was dredged to make possible the entrance of the biggest vessels. The two images below show the main channel. The one on the left is a nautical chart and the right side one is a survey chart developed by the survey department in the PANSW. The green waters are deeper than red ones.

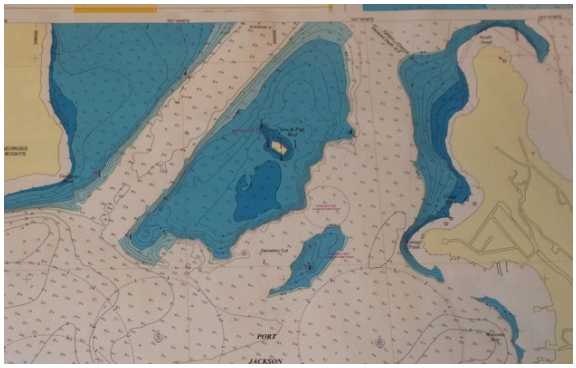

Figure 5: Main channel of Sydney Harbour – Source: PANSW

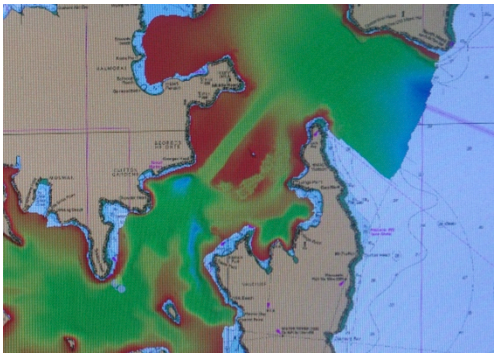

Figure 6: Survey's depth chart – Source: PANSW

As we can see, after this main channel dredged, the waters are much deeper so there is no risk on shallow waters for the big vessels. Continuing entering to the port, there are more bays (some of them with beaches inside the harbour) and three little consecutive islands that vessels have to avoid. These are (from outside to inside the harbour) Shark Island (1), Clark Island (2) and Fort Denison (3). The big vessels have to leave the three of them on portside.

After these three islands, there is the main issue: the harbour bridge. Is one of the most emblematic constructions of the city, and also connects two parts of it, but it is a big deal for the big ships, especially the ones with a big air draft, because they can't pass under the bridge.

Figure 7: Sydney Harbour chart with the three islands indicated – Source: PANSW

Sydney Harbour Bridge

The Harbour Bridge is, after the Opera house, the most important construction in the city. It connects the centre with north Sydney and suburbs, so it absorbs a lot of traffic of people that goes to the centre for working. It is not a problem for the majority of vessels, but there are a few that can't pass under it because of its dimensions. [6]

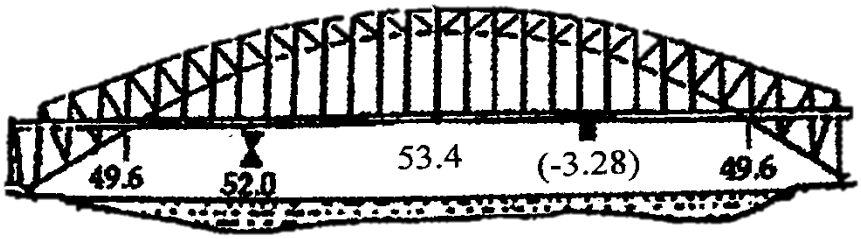

Figure 8: Harbour Bridge clearances – Source: PANSW

The next clearances are for 0.00m tide:

- Clear headway at centre is 53.4 metres.
- The painting gantries are 3.28m below the bridge.
- The clearance is reduced to 52.8 metres when 80 metres either side of centre.
- The clearance in the deepest point of the bridge is 52 metres.

The minimum clearances under Sydney Harbour Bridge are 2.0m underside of the bridge and 1.0m underside of a painting gantry. These clearances are between the highest point on any vessel and the listed structures.

Due to the restrictions of the Harbour Bridge, there is one of the most important docks before the bridge, for those vessels that can't pass under it. These are the cruise ships and the dock is called Overseas Passenger Terminal (OPT).

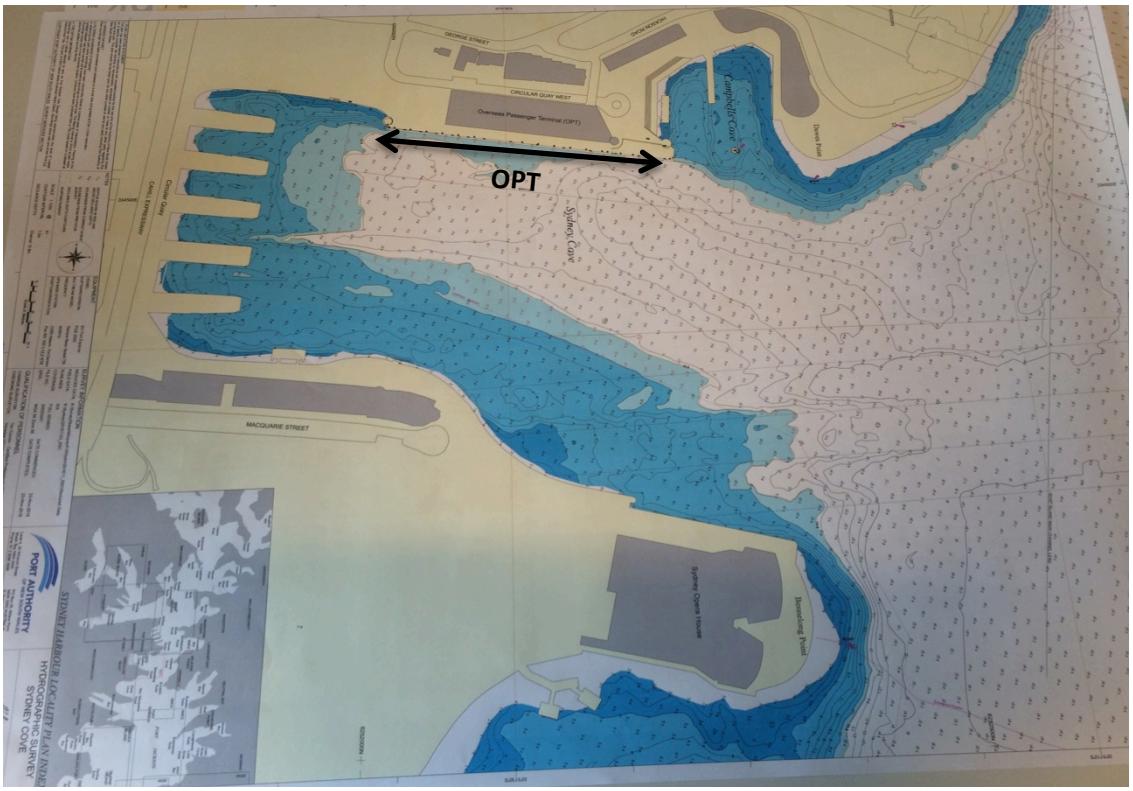

Figure 9: Sydney Harbour chart with Overseas Passenger Terminal – Source: PANSW

Just to know the location, the Harbour Bridge would be in the front right side of the image above. As we can see, after passing the Opera House, on the left we found the Overseas Passenger Terminal, which can deal with cruise ships up to 300 hundred metres of length overall. If we continue to the left, we can see the circular quay. It's the ferries dock that connects the people to the entire Sydney harbour bay. There is a huge traffic there, that' the reason why ferries are not allowed navigate while cruise ships are manoeuvring on the OPT.

Just on the other side of the bridge, on the left, after a few recreational docks (Walsh Bay), we find the main operation centre of the PANSW in Sydney Harbour. It is called Moores Wharf and there are a few

docks with all the PANSW fleet, with a beautiful building for the crew, where they can rest and do paperwork. As a curiosity, just in front of these docks, there is the deepest point of Sydney Harbour.

Taking as a reference the image below, we can see that the harbour continues being very big, with a lot of bays. But there are two spots that are important to mention. At the bottom there is the White Bay. It is the second cruise terminal in the harbour and receives the same name of the bay (White Bay Cruise Terminal). In this terminal call the ships that its sizes can fit under the bridge. It is a long deck, which can berth two cruise ships at the same time.

Just on the opposite side (at the top of the image) there is an important terminal called gore cove. It is a bulk terminal that can handle with big bulk carriers. These types of vessels normally have less air draft than the cruise ships, so they don't have the issue with the bridge.

Figure 10: Sydney Harbour chart west of Harbour Bridge – Source: PANSW

1.5. Port Botany

Port botany is the commercial port of Sydney. It is situated a few miles South, so it is completely independent of Port Jackson. It is Australia's largest container port and is also specialized in trade in manufactured products and bulk liquid imports including petroleum and natural gas.

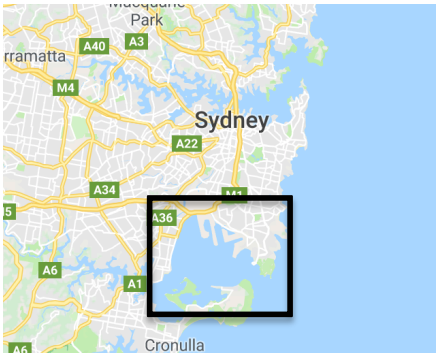

Figure 11: Sydney's map – Source: Google maps

Figure 12: Botany Bay extension (chart) – Source: PANSW

The structure of port botany is very simple. Entering through the main channel, which has been also dredged (like the Sydney Harbour one), we have a bulk terminal on the left, called Kurnell nº 3. If we continue in the main channel, a few meters more, we find (on the right side) a bulk liquid dock (called BLB) and next to them, the three container terminals.

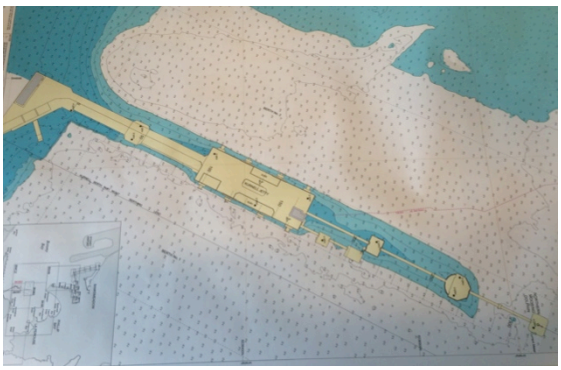

Figure 13: Kurnell nº 3 terminal – Source: PANSW

The bulk terminal Kurnell nº 3 is a curious structure inside Botany Bay. Instead of having a normal deck, it is a huge platform that goes into the sea, making possible to the ships to berth both sides of it, as it is shown in the picture. It is not easy to berth big vessels there, so apart from the usual lines coming from the dock, there are buoys on the other side to fix better the vessel in the correct position. This terminal can handle two ships (one on each side of the dock) and the part that has more width is where there are the cranes and pipelines to load or unload the cargo.

The Bulk Liquid Berth (BLB) is prepared to handle any type of bulk liquid products. It has direct pipeline access to nearby storage facilities, which are operated by private companies. The terminal is prepared to berth 2 ships at the same time, but depending on the length overall of the ships, there is only place for one.

Figure 14: Botany Bay container terminals (Chart) – Source: PANSW

The container terminal in Botany Bay is divided in three sub terminals operated by different stevedores. Next to the Bulk Liquid Terminal, there is the oldest terminal in Port Botany. It is operated by DP world and it has berths number 10, 11 and 12 with a total area of 39,5 hectares. In front of it, there is the Patrick terminal, which has berths number 6, 7, 8 and 9 with 63 hectares of area. Finally, next to the airport and adjacent to Patrick's, with an area of 48 hectares, there is the Hutchison terminal with berths 1, 2, 3, 4 and 5. It is very new and at the moment is not working as much as the other two.

Between the terminals of DP World and Patrick, there is the building and the fleet of the PANSW. The team and the organization is the same, but due to the distance between Port Botany and Sydney Harbour, the PANSW needs to have two different logistic centres to run the business efficiently.

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Chapter 2. Departments of the Port Authority of New South Wales

The PANSW is divided in 6 departments that ensure the good functionality of the harbour. Each one of them has a different duty and all together make a great team that can deal with any issue. The aim of these departments is to provide the port safety functions explained at the beginning of this project. [7]

2.1. Marine operations

The marine operations team operate 24/7 in the ports of Sydney and Botany Bay where they provide maritime expertise to all Port users.

The Port Safety Operating Licence (PSOL) issued by the State Government to the Port Authority, ensures the Ports are managed to a very high degree of safety and compliance.

Marine operations liaises with both internal and external stakeholders and government agencies to assist, advise, participate and promote all Port functions necessary for the Ports to operate safely and efficiently.

The marine operations team is responsible for an array of operational activities including:

- Emergency incident response.
- Pilot cutter operations.
- Pollution response.
- The provision of key members to the state response team and national response team.
- The auditing of Port users to ensure compliance with Port regulations.
- Auditing the safe transfer of dangerous bulk liquids in the Ports.
- The escorting of seagoing ships, ensuring safe passage through their busy ports.
- The operation of the gangways at the Overseas Passenger Terminal.
- Navigational aid compliance and fitting of temporary navigational aids.

- The facilitation and participation of exercise with key Port stakeholders.
- Ceremonial salutations to maiden voyages entering their Ports.
- Participation in public events such as New Years Eve and Australia Day.
- The review and approval of Aquatic Events such as sailing regattas and fireworks displays.

To provide all these operation activities, the marine operations team is constituted by 75 operational shift personnel (including captain's, deckhands, crane operators, etc.) plus four leading members:

- Jeanine Drummond – Operations and Deputy Harbour Master.
- Phil Azzopardi – Manager.
- Brendan Wiseman – Assistant manager.
- Maureen Townsend – Roster co-ordinator and operations assistant.

The marine operation members do 12 hours shifts, 4 shifts per week. In total they work 48 hours per week. It's important that the personnel can rest enough time. Their 12 hours shifts are quite exhausting and they need to be very fresh to give the best of them.

As an example of the work that marine operations do, they give me the highlights of the year 2015-2016 (the most current data they had, because I was there on March 2017 and the season hadn't finished yet). So, during this reporting year, the Marine Operations division in Sydney Harbour and Botany Bay: [5]

- Managed 4441 pilot movements to and from commercial ships. An average of 12 per day.
- Provided 2979 ship escorts.
- Completed 1413 bulk dangerous goods transfer checks.
- Undertook 527 work permit audits.
- Responded to 362 calls to reports of pollution of fire, boom operations or vessels needing assistance or towage. More in detail, those emergencies were:
  - 147 reports of pollution
  - 146 booming operations
  - 31 emergency towage and vessel assists
  - 8 fire fighting operations
  - Supporting a number of medical evacuations from cruise ships
- Conducted five fire-tug water displays.
- Carried out several navigation and security patrols.

2.2. Survey

The survey team play an integral role in ensuring navigational safety for the business. Hydrographic charting products are produced for the Pilots and Harbour master promulgated depths based on high quality survey information. The survey role involves assisting other divisions by providing accurate high precision information to aid with greater decision making. The survey team also conduct external hydrographic surveys by request, under contract as and when the annual survey schedule can allow. The survey team has de following members:

- Vanessa O'Connell – Survey manager level 1 hydrographic surveyor.
- Tim Connor – Level 1 hydrographic surveyor.
- Andrew Tsaccounis – Level 2 hydrographic surveyor and coastal specialist.
- Martin Tunwell – Hydrographic surveyor.
- Matthew English – Hydrographic surveyor.
- Belynda Gibbons – Senior CAD specialist.

To carry out all this performance, the survey team uses a boat (called Port Explorer), which is equipped with a high technology sounder and a computer to watch and save all the data that the sounder provides. It's the main instrument of the team and with it they can do the majority part of their duty. Moreover, they have also a sophisticated GPS device, linked with the sounder. Together, they provide value information to the computer such as situation, depth or condition of some buoy or beacon, for example.

Figure 15: Hole on the boat for the sounder – Own source

Figure 16: High technology sounder – Own source

This data that the sounder provides is executed in the computer to produce charts or other information with high value. That's the second part of their job. They collect information with the boat and its devices and then they execute this data in the office. As an example, this is one of the things they can do with their equipment: analyse the seabed and its depth. In this case, they found and important wreck inside the Sydney Harbour.

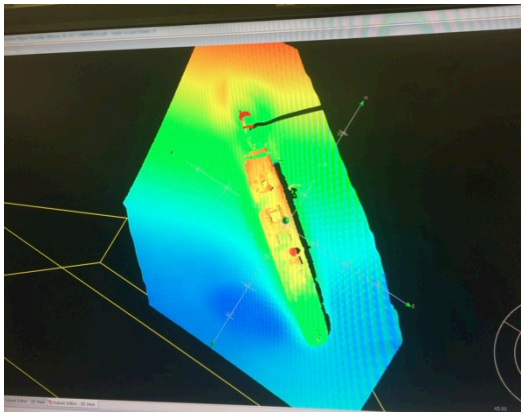

Figure 17: Data provided by the sounder – Source: PANSW

2.3. Dangerous Goods

The PANSW has the responsibility under the legislation to control the conditions under which dangerous goods are handled and/or kept in the defined port operational areas. Port Authority draws on information and advice from the following:

- Port Authority provide guidance material on management of dangerous goods within Sydney Ports Areas that outlines relevant criteria for dangerous goods cargoes and covers imports, export, transhipment and dangerous goods in transit.
- Port Authority must be advised of all dangerous goods to be imported or exported by vessel, including transhipments and/or goods transiting the ports.
- The method of notification of the dangerous goods is through electronic lodgement in Sydney's Integrated Port System (ShIPS).

Sham Kunchiraman is the Dangerous Goods Officer.

2.4. Vessel Traffic Services (VTS)

Sydney Ports Vessel Traffic Services (VTS) provides a continuous service to monitor the movement of participating vessels within the VTS areas of Sydney Harbour and Botany Bay in order to improve the safe and efficient movement of such vessels and to protect the environment and infrastructure. [7][13]

Sydney Ports VTS provides navigational advice based on information from radar, closed circuit television, a ship's own Automatic Identification System (AIS) and VHF radio, and records this information as well as communications. The VTS functions are the following:

- Monitor the movement of participating vessels.
- Provide vessel movement updates and information.

- Direct vessels as required.
- Provide an efficient communications base during any emergency situation which may develop in these ports.
- Advise mariners on the initiation, continuation and termination of activities within the port areas which may affect the safe passage of vessels.
- Provide navigational information and warnings to mariners.
- Notify the appropriate organisations about vessels known of believed to be in distress and in need of assistance.

To assist agents and service providers, Port Authority, operates the Sydney Integrated Port System (ShIPS). Sydney Ports VTS operate the ShIPS internet based computerised system 24 hours a day. ShIPS provide the ability to:

- Coordinate vessel movement schedules and bookings, allowing port services providers to confirm their ability to provide services in a real time environment.
- Facilitates the real time lodgement and approval of work permit and bunker applications.
- Enables the real time lodgement and acknowledgement of Dangerous Goods declarations.
- Allows the real time lodgement of Dangerous Goods information by agents or freight forwarders.
- Allows Port Authority to provide dangerous goods information to emergency services.
- Allow stevedores, government agencies and associated industries to view vessel schedules and relate information.

The team of VTS has a total of 10 Vessel Traffic Operators, 5 Duty Vessel Traffic Service managers and Wendy Doran (VTS manager).

The communications are with the call sign “Sydney Ports VTS” and VHF channel 13 for Sydney Harbour and 12 for Botany Bay.

The VTS must be used by all vessels of LOA 30m or over. The vessels towing or pushing a tow, where the combined length of the tug and tow is equal to or grater than 30m are also required to participate in the Vessel Traffic Service.

All vessels that are required to participate in the VTS shall, just prior to entering a VTS area, seek clearance from Sydney Ports VTS, to enter the area.

When seeking clearance to move within or enter a VTS area, masters or pilots of participating vessels are to:

- Advise position
- Advise drafts and displacement
- Advise destination or intentions
- Advise number of persons onboard (only for recreational vessels).

All those vessels that must participate in VTS, are also required to report to VTS al these following circumstances:

- Notification of ETA (Estimated Time of Arrival)
- When five miles from the Pilot Boarding Place
- When requiring clearance to enter
- When passing a reporting position
- When anchored or arrived
- If disabled, leaking, on fire or has been on fire
- If involver in collision, grounding, close quarters situation
- Notification of removal
- Notification of departure
- When requesting clearance to depart
- When requesting clearance to proceed
- When commencing and completing bunker operations
- When commencing and completing work that requires a work agreement
- When port safety or the environment may be compromised of the Master considers a report is warranted.

All these communications (and much more) are done in a special room at Brotherson Dock (Botany Bay), where the VTS team work. From there, they control all the movements of Botany Bay and Sydney Harbour. The room, as I said before, is prepared with all the equipment necessary to make the VTS a good aid for navigation in these top ports. The room is a dark and very quiet place, it is important that the people working there can be focused on they desk and listen correctly all the communications.

There are 3 persons working at a time. The manager in the middle and one VTS officer on each side. The one on the left is on charge of Botany Bay, and the one on the right is on charge of Sydney Harbour. Only one person for each port. The manager supervises the two officers and performs other duties

indispensables for the VTS. Moreover, he can replace the officers when they need a little break. The two ports can't be never unattended even only a second. The 3 VTS employers on duty, do 4 shifts of 12 hours, and then have 4 days off.

As I said before, each VTS office has a private desk with many monitors where it is possible to see all the traffic and all the vessels that are in the domain of Sydney Harbour or Botany Bay.

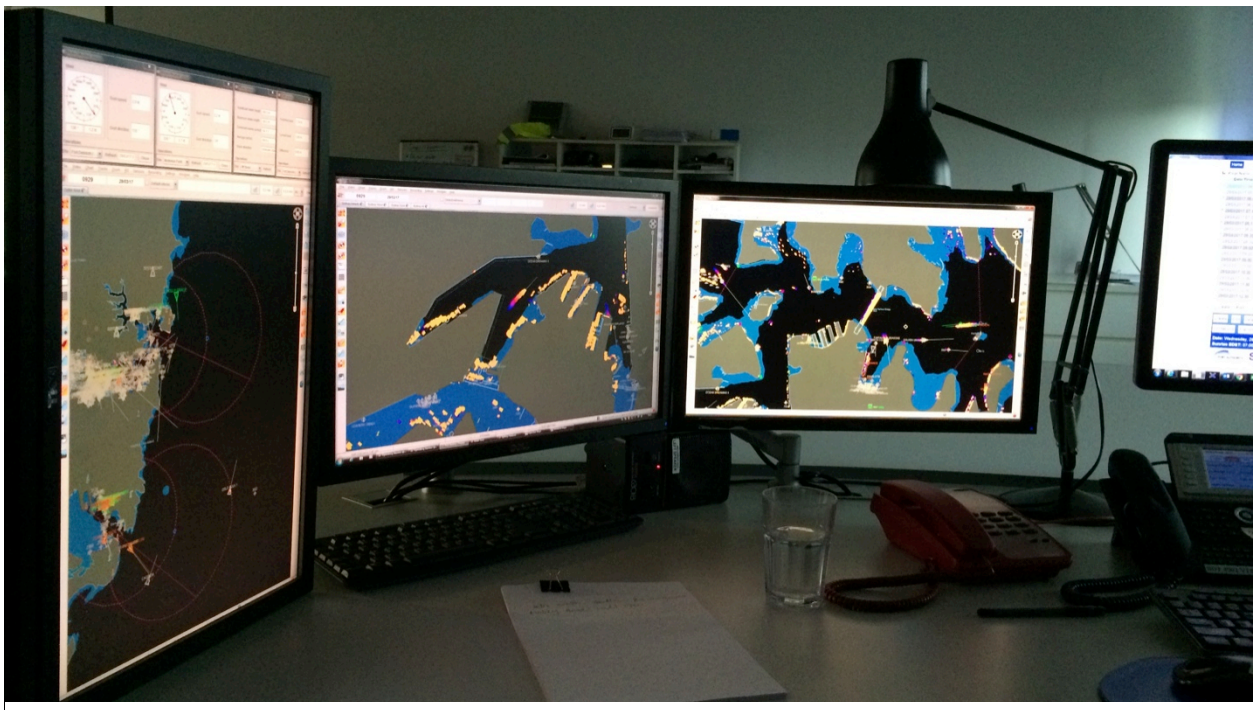

Figure 18: VTS office – Own source

It is not appreciable on the image above, but they have also a VHF device connected and a complete audio device to listen and talk correctly. In this case, the monitors show the Sydney Harbour traffic. The vessels on movement and also the moored ones. The program they have installed on the monitors, allow them to put the screen they want in every moment. A huge net of controllable cameras is also

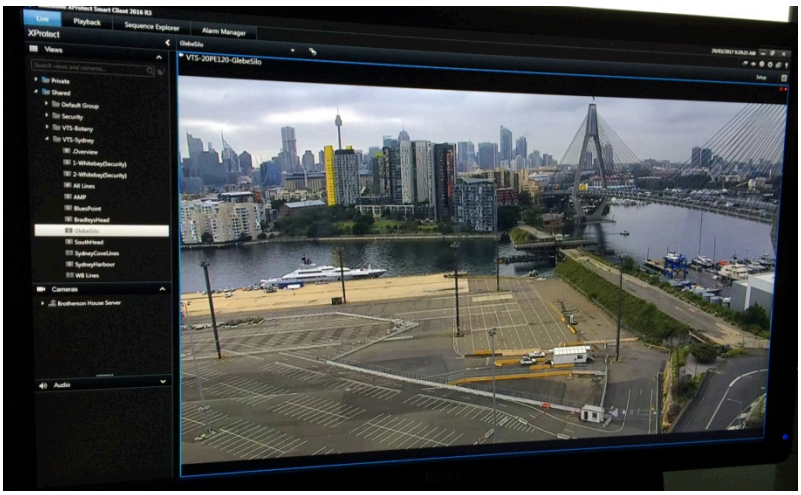

Figure 19: VTS harbour cameras – Own source

installed on the ports, so they can control the traffic with live views on the harbour. They have eyes everywhere and they have live videos on the strategic points.

Apart from this monitor job, they have to do a little written job. For every vessel entering to one of the ports, the VTS officers have to fill a particular card with the information required. This information, as you can see on the image, is the name of vessel, length over all, the berth where she would go, the pilot, and more other things. But maybe the most important, is the timings that the vessel do since she enter the port until she leaves it. This card is only completed when the ship has left the port and the card is filled with the necessary information. All these cards are archived because they have value data of the traffic that these ports have had.

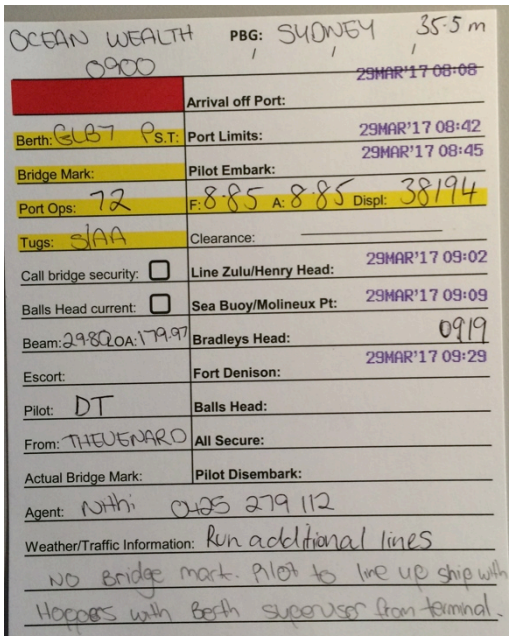

Figure 20: Vessel information card – Source: PANSW

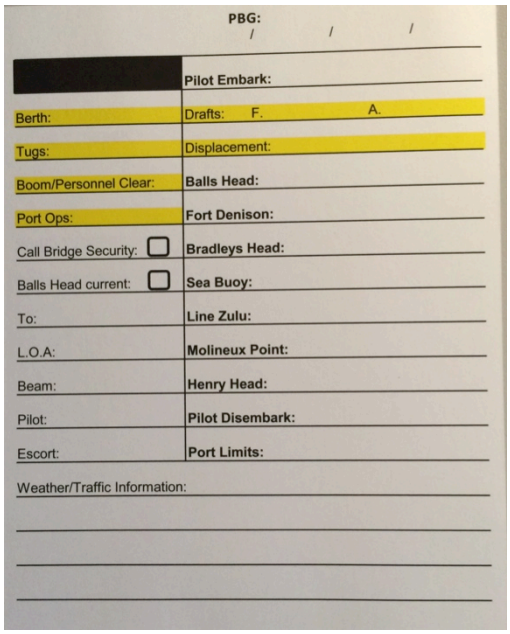

Figure 21: Vessel information card (second page) – Source: PANSW

2.5. Pilotage

Port Authority offers an on demand, professional and safe Pilotage service to ship masters into the ports of Sydney Harbour and Botany Bay. Pilotage is compulsory for all vessels 30m and over in length, unless the ones in possession of an exemption. The services of a pilot can be booked through the ShIPS system.

The pilot team consists on:

- Matt Stannard, pilot manager and deputy harbour master.
- Sharon Lloyd Senior Administration – Pilotage.
- 21 unlimited marine pilots.

2.5.1. Marine pilot licence level

There are 7 levels of marine pilot licence in Sydney Harbour and Botany Bay. The lowest level is 1A and the highest level is "Unlimited". [6]

The marine pilot licences for each port are distinct and separate. Therefore, a pilot may hold licences of different levels for each port.

The maximum length and tonnage restrictions for each level of marine pilot licence are defined in the following tables.

- Marine Pilot – level 1A

Ship Type	Length (m)	Displacement	Gross Tonnage
Container/General	185	30.000	-
RoRo/Vehicle/Passenger	165	-	28.000
Tankers/Bulk	150	20.000	-

Table 4: Marine Pilot restrictions with license level 1A – Source: PANSW

- Marine Pilot – Level 1B

Ship Type	Length (m)	Displacement	Gross Tonnage
Container/General	200	35.000	-
RoRo/Vehicle/Passenger	180	-	35.000
Tankers/Bulk	170	30.000	-

Table 5: Marine Pilot restrictions with license level 1B – Source: PANSW

- Marine Pilot – Level 2A

Ship Type	Length (m)	Displacement	Gross Tonnage
Container/General	225	40.000	-
RoRo/Vehicle/Passenger	225	-	45.000
Tankers/Bulk	195	40.000	-

Table 6: Marine Pilot restrictions with license level 2A – Source: PANSW

- Marine Pilot – Level 2B

Ship Type	Length (m)	Displacement	Gross Tonnage
Container/General	240	50.000	-
RoRo/Vehicle/Passenger	240	-	60.000
Tankers/Bulk	195	50.000	-

Table 7: Marine Pilot restrictions with license level 2B – Source: PANSW

- Marine Pilot – Level 2C

Ship Type	Length (m)	Displacement	Gross Tonnage
Container/General	261	60.000	-
RoRo/Vehicle/Passenger	275[1]	-	75.000
Tankers/Bulk	195	55.000	-

Table 8: Marine Pilot restrictions with license level 2C – Source: PANSW

[1] All passenger vessels with LOA greater than 240 moving west of Sydney Harbour Bridge are considered level 3 vessels.

- Marine Pilot – Level 3

Ship Type	Length (m)	Displacement	Gross Tonnage
Container/General	-	-	-
RoRo/Vehicle/Passenger	-	-	-
Tankers/Bulk	230[2]	-	-

Table 9: Marine Pilot restrictions with license level 3 – Source: PANSW

[2] The level 3 pilot is licensed to conduct pilotage in all vessels, except tankers with a LOA greater than 230 m and a beam greater than 40 m arriving/departing GOR1 and KUR3.

- Marine Pilot – Unlimited

The Unlimited Licensed pilot is now licensed to conduct pilotage on all vessels in the port which licence is held.

2.5.2. Minimum drafts, UKC and distances

As the first authority of ports, the harbour master and pilots have the capacity to make regulations that must be followed by all ships visiting these ports. Some examples of these regulations are the minimum drafts, Under Keel Clearance (UKC) and distances between ships. All these required in both ports, Sydney Harbour and Botany Bay. [6]

The minimum drafts required while manoeuvring are:

- Vessels with less than 100.000 tonnes of displacement

  Forward draft: 2% of LOA (Length Overall)

  Aft draft: 3% of LOA

- Vessels with more than 100.000 tonnes of displacement

  Forward draft: 3% of LOA

  Aft draft: 4% of LOA

2.5.3. Minimum Under Keel Clearance (UKC)

	Sydney Harbour		Botany Bay	
	Tankers	Other vessels	Tankers	Other vessels
Passage through harbour[1]	10% of maximum draft.	10% of maximum draft.	10% of maximum draft.	10% of maximum draft.
Brotherson and Hayes docks	N/A	N/A	1.0 m	1.0 m
In the berth box[2]	0.5 m	0.5 m	0.5 m (BLBs) 1.0 m (KURs)	0.5 m

Table 10: Minimum Under Keel Clearance (UKC) – Source: PANSW

[1] To the outer seaward limit of berths, with no purpose of mooring.

[2] To moor or sail purposes and whilst alongside the berth.

2.5.4. Minimum distances between vessels (when moored at berth)

At all berths, clearance of 20 metres must be allowed at each end of an arriving vessel, except at Brotherson Dock, where clearance to the inner end of the dock must never be less than 32 metres, unless approved. [6]

After berthing, clearance between vessels may be reduced to 10 metres and, in special cases; a further reduction may be possible after consultation with pilots.

2.5.5. Example of a berthing in Kurnell number 3 berth (Botany Bay)

All pilots have in their disposal, one manual of pilots. They use it as a guide for all the manoeuvres. In this manual, there are all the procedures they must do for a good berthing. Here is an example of one of these guides, in Kurnell number 3. [6]

Pre-boarding consultation and berth inspection

Check the swell height, wind and tide readings. During the pilot proceeding to the ship, the berth area should be inspected to assess, visually, the swell and sea conditions in the berth.

Vessel pre-entry requirements

- The maximum draft for vessels arriving at Kurnell No. 3 is to be calculated to provide that a minimum UKL of 10% of the deepest draft can be maintained during the berthing process, where the minimum approach depth is 12.8 m.
- By agreement with Caltex (the owner of the berth) the Harbour master and pilots, all vessels will use a northerly approach to he berth.
- Good communications must be done between the linesboat and the pilots.
- Both anchors are to be ready for emergency use prior to passing Cape Banks.
- The ship engines are to be tested astern, preferably prior to the pilots boarding.
- The speed by Henry Head should be reduced to approx. 5 knots over the ground.

Tugboats

Depending on the LOA of the vessel, the number of tugs needed would be different.

- 2 tugs for vessels with a LOA of up to 200 m. Secure both tugs, as soon as possible, after passing Henry Head, as follows:
  - 1 tug on port or starboard shoulder (dependent on the direction of the wind)
  - 1 tug on the starboard quarter, forward of the bridge.

- 3 tugs for vessel with a LOA over 200 m and up to 259 m. Secure 2 of the 3 tugs as soon as possible after passing Henry Head, as follows:
  - 1 tug on centrelead aft.
  - 1 tug on port or starboard shoulder (dependent on the direction of the wind) to be made fast on the 2nd set of bitts, from forward.
  - 1 tug will be at the "pilots discretion" dependent on the prevailing conditions. However, it is suggested that the stands by the port quarter or port shoulder (not made fast) and used, as required. When satisfied that the turn has been successfully achieved this tug should be relocated and made fast to the starboard quarter.
- 4 tugs for vessels with a LOA greater than 259 m or displacement in excess of 100.000 tonnes.

The suggested utilisation of the 4th tug would be to secure the tug on the other shoulder.

Wheel over position

For a Suezmax sized ship (LOA of 250-270 m) commence the turn to port, towards the Caltex Terminal, when abeam of bare Island (from the bridge).

For an Aframax sized ship (less than 250 m of LOA), commence the turn to port when the Refinery Leads (253ºT) are in line (from the bridge).

As a guide only, both turns require an approximate rotation of 15º/minute. Particular care should be taken during times of spring tides and for deep drafts vessels.

Anchoring and mooring summary

For safety of personnel securing the forward swamp moorings it has been determined that the vessel will be anchored and moored in the following order:

1. Port anchor. Let go the anchor.
2. 2 ship's mooring lines – TMB 1. It is preferable that these lines are kept slack until the stern is stabilised, i.e. ship's lines must be secured to TMB 5 and TMB 7. They may both be run from the starboard side of the forecastle to keep the port windlass free to manage port anchor.
3. After ship's mooring lines – TMB 5 and 7.
4. After ship's mooring lines – TMB 4 and 8.
5. Forward swamp moorings.
6. After swamp moorings – TMB 4 and 8.

2.5.6. Pre-arrival and pilot boarding information

The pilot boarding ground in Port Jackson is 4 sea miles due east of Hornby Light on South Head.

The pilot boarding ground in Botany Bay is 105ºT x 4 sea miles from Endeavour Light on Henry Head.

All vessels requiring a pilot shall provide a means of pilot access, in accordance with current SOLAS and IMO regulations governing the boarding and disembarking of pilots. This means that the pilot ladder must satisfy these regulations.

The pilot ladder shall be rigged on the vessel's lee side to the swell and the sea. The bottom of the ladder shall be about 2.5 metres above the water and two manropes shall be provided. The vessel's speed shall be between 7 – 9 knots during the pilot boarding or disembarking operation.

The pilot boarding time for an entering vessel shall be the arrival time booked by the ship's agent with the PANSW. The pilot boarding time for a departing vessel shall be 15 minutes prior to the departure time booked by the ship's agent with the PANSW.

While PANSW offers a 24-hour service, some pilotage operations in Sydney Harbour and Botany Bay are time or tide critical. A vessel not ready to pick up its pilot or to depart, at the booked time, may suffer unavoidable lengthy delays. PANSW requires an arriving vessel, which has booked a pilot, to comply strictly with the procedures and advise its exact ETA (Estimated Time of Arrival), by VHF radio, four hours prior to arrival.

2.5.7. Vessel arrivals

This procedure describes the means by which ship arrivals are planned and controlled by the Sydney pilots to ensure safe arrival of vessels and minimise risks to port installations. This episode covers the system by which all ships arriving at Sydney Harbour and Botany Bay are controlled through the various stages of the process.

First of all, it's important to introduce three concepts that will appear in these next paragraphs.

- Tidal: means vessels, which require sufficient amount of tide for a save arrival.
- Certificate of pilotage: is the form taken on board which the master of the vessel signs on the satisfactory completion of the pilotage act, or if the master relieves the pilot form his navigational duties.
- Pilot card: is a vessel information sheet containing the main characteristics of the ship.

The certificates of pilotage completed and signed should be returned (if possible) to the duty pilot before the end of the watch in which they are obtained. In any case, they must be returned within 24 hours.

In the event of a departure movement being cancelled after the requires one hour notice of departure has been given by a vessel, the allocated pilot should make out a Certificate of pilotage, detailing the circumstances and make every endeavour to obtain a signature from the master. The reason for a delay beyond the booked time for any vessel should be included on the certificate. If the pilot first proceeding to the job is unable to obtain a signed certificate he is to arrange for the pilot who finally does the pilotage to obtain a second signature covering the delay.

Whenever a pilot is required to attend a vessel that is anchored, secured to a mooring buoy, or berthed within the ports, a separate certificate of pilotage should be obtained for that attendance. If the attendance follows an arrival or precedes a departure, separate certificates are to be obtained for any such movements.

Pilots should advise the duty pilot and the VTS of any variations in the particulars of a vessel. When appropriate, the pilot should sight the tonnage certificate of a vessel.

Requests for pilotage services for vessels are received by the duty pilot via the ShIPS centralised booking system. Additional information can be received by telephone or fax. Allocating pilots to ships is done by the duty pilot.

Ship's data, as contained in ShIPS, is often passed via a number of persons and may be subject to data entry errors. Therefore, all ship's data is to be considered suspect and is not to be relied upon until it has been confirmed on the ship's pilot card or directly with the master.

It shall be the responsibility of the pilot to plan each specific pilotage using their criteria. This process shall also include consideration of a number of variables, for example: load conditions, drafts and displacement, LOA, beam, power of main engine, propeller, thrusters, type of ship, pilot ladder requirements, swell conditions, weather conditions, tugs, tide, berths conditions, navigation aids functioning, etc.

In the event that the pilot considers insufficient data is available to complete the planning process, the agent, VTS or other appropriate source shall be contacted for clarification, additional information, etc.

Operation

The pilot shall confirm the ships arrival time with the duty pilot. The duty pilot will liaise with the cutter master on the agreed time and place for pick-up.

The pilot shall then proceed to the ship at the appointed time. In assessing boarding conditions he shall have due regard for his personal safety and that of the pilot vessel and crew. If the pilot ladder does not comply with IMO regulations explained before or sea state is unfavourable (and it is considered unsafe), then the pilot should not board until the ladder complies or conditions improve.

After boarding the vessel and arriving on the bridge, the pilot shall assess the situation by exchanging relative information with the master. This exchange should include, but not be limited to the following:

- Completed standard pilot card to be reviewed.
- Until the con is formally handed to the pilot, the pilot has not taken pilotage charge of the vessel.
- The pilotage plan is to be completed and discussed.
- Tug requirements.
- Assessment of the crew and ship capability from visual clues, personal experience and any other reports from the vessels previous trips.
- The master shall agree to the plan and confirm the vessel is ready in all aspects to execute and monitor the intended pilotage plan. This should include confirmation by the master that the vessel's engines have been tested astern.

In the event that the assessment is unsatisfactory, the situation shall be rectified, if possible or entry must be postponed. If entry cannot take place, the VTS has to be informed, the Certificate of pilotage signed, pilot disembarks and vessel rebooks.

In the event that the assessment is satisfactory, the master completes and signs the certificate of pilotage. Then, the pilot accepts navigational control of the vessel from the master and commences manoeuvres, monitoring, correcting and adjusting navigation requirements.

When pilotage is completed, the pilot is responsible for the completion of all forms and paperwork, ensuring that the master's signature is obtained on the certificate of pilotage.

We have seen the procedure for the arrivals. It's necessary to explain that in the case of departures, the procedure is exactly the same, but the other way round. The paperwork and the steps are the same.

2.6. Cruise operations

As one of the world's greatest harbour cities, Sydney is Australia's premier cruise ship destination and an essential stop for any Australian cruise. [8]

Sydney is the only city in Australia to have two dedicated cruise terminals and four cruise berths. With more than 1.2 million passengers processed through the cruise terminals, this city continues to break records for passenger visitation within Australia.

As I said before, these two cruise terminals are situated in Sydney Harbour, and they are:

The Overseas Passenger Terminal (OPT)

- Centrally located with the icons of Sydney Harbour right outside the cabin door.
- Capacity to accommodate the largest cruise ships in the world.
- Close to trains, ferries, buses and taxis, and 30 minutes from the airport.
- Capacity to facilitate simultaneous embarkation and debarkation processing.
- Offers unique operational ability to service two cruise ships at berth at one time.

Figure 22: Overseas Passenger Terminal views – Own source

The White Bay Cruise Terminal

- Newly designed and award-winning terminal.
- Capacity for multiple berth operations and dual processing.
- White Bay is Sydney's hub for home-ported vessels.

The Cruise Operations department of the PANSW is on charge of everything about logistics in these two terminals. Berth bookings, communication and coordination with cruise ship, embarkation or disembarkation of passengers, maintenance of the terminals, etc. It is a huge department with a lot of work and responsibility. A lot of tourists are in their hands. John McKenna, as a General Manager of cruise department, manages the department with a competitive team. They have a big office near the OPT terminal from where they manage the paperwork, bookings and logistics. But a lot of work is also done "in situ" in the terminals. There is where the big problems can occur, and the best way to fix them, is being there to interact with the terminal and the authorities of the cruise ship.

Looking for the amount of people it moves, this department is the most important. So I think it is interesting to have a look in its history and the impact that the cruise ships do to the Australian economy. As a general review: [9]

- In 2001/2002 there were 60 calls, 47 to wharf 8 and 13 to OPT.
- In 2016/2017 there were 336 calls, 213 to OPT and 123 to White Bay precinct.
- Historically Sydney was a stop over transit International market with no homeport ships. Now a domestically sourced market with 8 homeport turnaround ships in the summer months.
- 1.2 million of Australians took a cruise last year (700.000 of them, in Sydney).
- Cruise Lines International Association (CLIA) predicts 2 million Australians to be cruising per year by 2020/2021.
- Market penetration per population for NSW is at 4,7%, number one in the world.
- Economic value nationally is now at 3.6 billion dollars. NSW makes up 67% equating to 2.4 billion dollars.
- The first Quantum Class ship to visit Sydney (2nd largest class in the world) was the Ovation of the Seas. She is 348m long and carries up to 4900 paxs.

2.6.1. Cruise industry outlook

The Cruise Lines International Association (CLIA) is the unified global organization that tries to help members (cruise lines) succeed. They revealed global cruise travel is growing year after year and the next table help us to confirm it. [10]

	Cruise Passenger (Millions)
2009	17.8
2010	19.1
2011	20.5
2012	20.9
2013	21.3
2014	22.34
2015	23.19
2016	24.2
2017 (projected)	25.3

Table 11: Number of cruise passenger in the world per year (Millions) – Source: PANSW

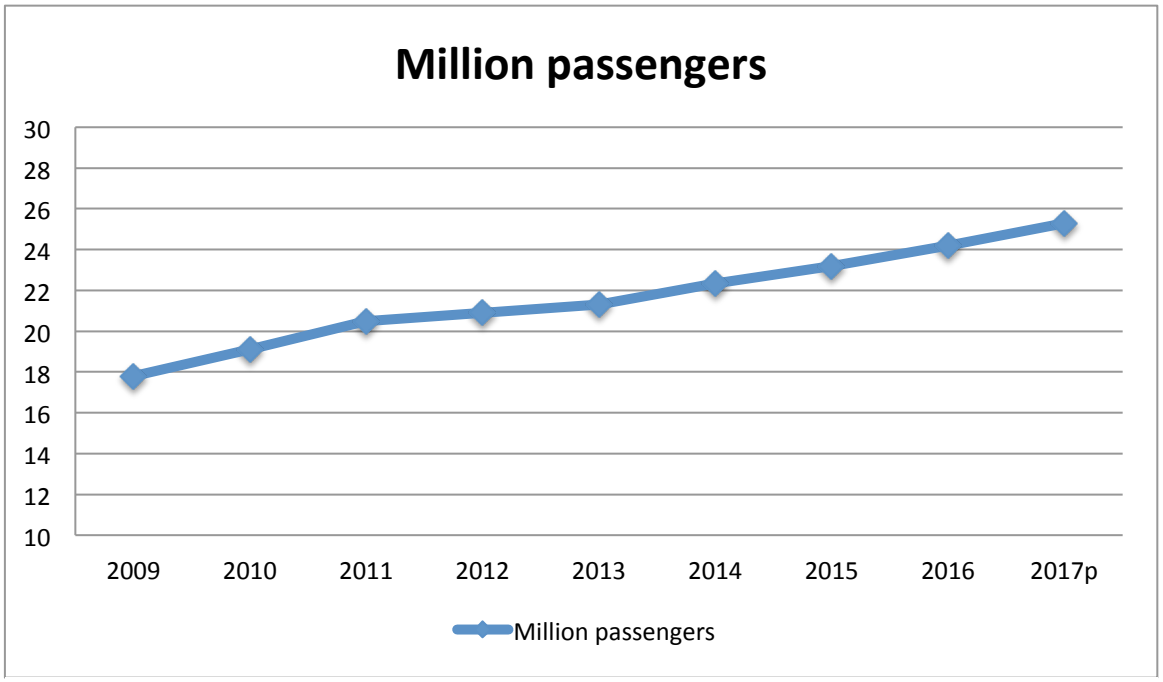

Figure 23: Graphic of cruise passengers in the world, per year

This huge amount of passengers comes from the entire world, but there are countries with more habit to take cruise ships. Some examples are:

1. USA: 11,28 million passengers
2. Germany: 1,81 million passengers
3. UK: 1,61 million passengers
4. Australia: 1,1 million passengers
5. China: 986.000 passengers.
6. Spain: 466.000 passengers.

This growth is not only a good new for the CLIA and cruise industry, but also for the countries and people where these ships call. This industry generates 956.597 full time jobs in the entire world, which means 38 billion dollars on wages and salaries. The total output worldwide is about 117 billion dollars. These are numbers of the past years, but the forecast is that this industry hasn't got any end, so the numbers will continue growing.

2.6.2. Cruise tourism's contribution to the Australian economy

We have seen how the cruise industry is growing worldwide, but to focus on Australia, it's important to look at the next table. Here there is a growth comparison rates by state, in the last 10 years, which give a good idea on how important is the economic impact in Australia. [9]

Financial Year	Passenger vessel visits Sydney (TOTAL)	Passenger vessel visits Brisbane (TOTAL)	Passenger vessel visits Melbourne (TOTAL)
FY 06/07	97	54	30
FY 07/08	109	60	44
FY 08/09	126	62	56
FY 09/10	123	69	48
FY 10/11	151	74	36
FY 11/12	201	101	56
FY 12/13	243	105	55
FY 13/14	260	115	67
FY 14/15	272	134	75
FY 15/16	305	147	76

Table 12: Passenger ship visits in the last years in Sydney, Brisbane and Melbourne – Source: PANSW

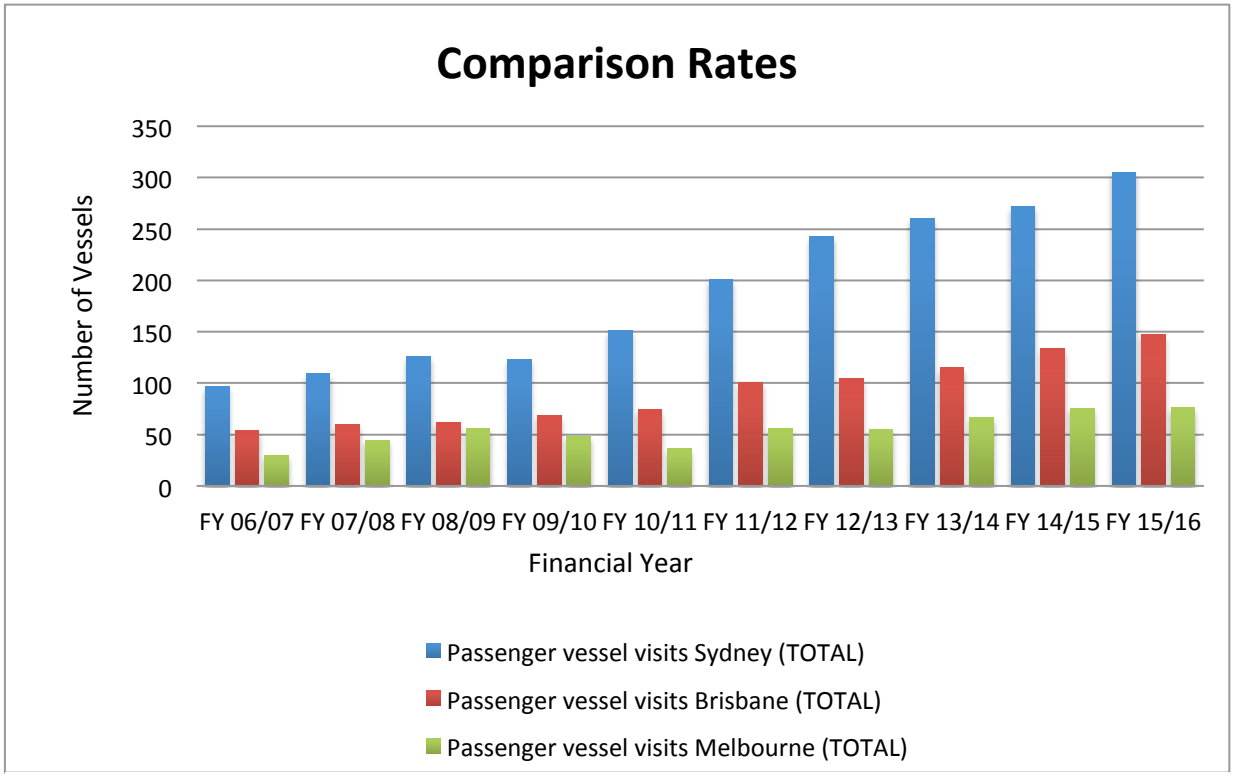

Figure 24: Comparison graphic of passenger vessel visits in Sydney, Brisbane and Melbourne

As the Australian cruise industry continues to experience a double-digit growth, its contribution to the Australian economy, both at a national and regional level, remains significant.

The 2015/16 has seen the industry's total national contribution grow by an impressive 27% to reach a record of 4.6 billion dollars. [11]

Other highlights of the year include:

- 39% growth in the overall cruise ships visit days.
- A 17% increase in passenger/crew visit days, which now exceed 2.8 million cruise visit days.
- It is estimated that the cruise industry brought close to 150.000 inbound international visitors to Australia spending around 158 million dollars.
- An 18% increase in direct passenger expenditure in Australian port cities reaching 959 million dollars.
- A 23% increase in Cruise Line expenditure to exceed 1.3 billion dollars.
- A 23% increase in Australians employed directly and indirectly by the cruise industry.

Cruise continues to be the success story of Australian tourism. Since 2004, the number of Australian cruise passengers has grown more than sixfold to now exceed 1 million annually, placing Australia as the fourth largest source market in the world. In 2015, 4.5% of all Australians took an ocean cruise, with the

well-established US market ranking second with 3.5% and the UK and Ireland at 2.6% market penetration.

The cruise industry continues to invest billions of dollars in new vessels. Australia will only benefit from the exciting new ship and cruise line deployments in their regions if steps are taken to ensure that infrastructure is available to support the continued growth. This will ensure further growth in both domestic and international passenger numbers as well as the overall contribution of the industry to the Australian economy.

Economic impact

The Australian cruise industry's contribution to the national economy grew at a significant rate, rising by 27% to reach a record of 4.6 billion dollars in the 2015/16 fiscal year. [11]

This growth reflects Australia's continuing appeal as a key market for the major global cruise brands to base their ships, either full time or seasonally, as evidenced by the significant 45% growth in homeported ships calls in Australia.

In the next table, there is a comparison between years 2015/16 and 2014/15 about the direct and indirect economic impact of the cruises in the Australian economy. It's important to say that during the project I talk about dollars. I'm always referring to Australian dollars, which have a different value than American Dollars.

Sector	Output ($ Mill)	Value-Added ($ Mill)	Compensation ($ Mill)	Employment (FTEs)
Direct	2.306	1.107	798	10.741
Indirect and induced	2.270	1.258	528	7.928
Total 2015/16	4.576	2.365	1.326	18.669
Total 2014/15	3.579	1.767	1.045	15.217
Growth	+997 (27,9%)	+598 (33,8%)	+281 (26,9%)	+3.452 (22,7%)

Table 13: Economic impact of cruises in Australia – Source: PANSW

Cruise line expenditure

Overall expenditure exceeded 1.3 billion dollars and represents an increase of 23% against the previous year. Apart from fuel, all categories of cruise line expenditure continue to increase, benefitting a wide range of industries. Excluding the significant impact of the drop in fuel prices, cruise line direct expenditure rose the 47%. [11]

The continued growth in the number of cruise ships homeported in local waters is driving the significant increase in direct expenditure by cruise line in Australia. Homeport calls rose 45% in 2015/16 and these remain key to maintaining the direct expenditure levels of the cruise lines to those ports.

New South Wales, as the principal cruise homeport state and administrative base, accounted for about 64% of the national economic contribution, a 20% increase.

This reinforces how critical it is for the national and regional economies to ensure that transit and homeport facilities and infrastructure continue to be developed, particularly in NSW, to attract new homeported ships and accommodate the growth in the size of ships being based in the region.

Expenditures	2015/16	2014/15	Growth %
Ship building & repair/machinery	168	112	50%
Food & beverages	174	160	9%
Port charges & fees	189	100	89%
Other costs (incl. supplies, security, sanitation)	200	78	157%
Shore excursions paid by cruise lines	129	68	90%
Travel agent commissions	152	145	5%
Advertising & promotion (professional services)	86	73	17%
Other business services	47	40	18%
Sub-total ($ mill)	**1144**	**776**	**47%**
Fuel	165	293	-43%
Total ($ mill)	**1310**	**1069**	**23%**

Table 14: Expenditure growth – Source: PANSW

Passenger expenditure

Overall, estimated cruise passenger expenditure grew by 18%, driven by the increase in passenger visits days. [11]

The increased contribution of homeported ships is also reflected in the estimated passenger expenditure numbers.

- Homeport passengers spent an estimated 821 million dollars, up to 18%, representing an 86% of total passenger expenditures.
- Transit passengers are estimated to have spent 138 million dollars, an increase of 16%.
- Homeport passengers spent on average 508 dollars per visit day while transit passengers spent on average of 159 dollars per visit day.
- International passengers boarding a ship spent an average of 708 dollars per day in homeport, while those visiting a transit port spent an average of 186 dollars per day.
- Inbound international passengers are estimated to have spent 158 million dollars in Australia.

Passenger and crew visit days

The number of passenger and crew visit days increased by 17% reflecting the continued growth in the number of homeported ships being deployed locally. [11]

- Cruise ship calls at Australian ports generated 1.177 cruise ship visit days, 2.5 million passenger onshore visit days and just over 336.000 crew onshore visit days.
- Visit days generated by passengers embarking on their cruises at Australian cruise ports totalled 1.6 million days, an increase of 18% over 2014/15 and accounted for 57% of total passenger onshore visit days during 2015/16.
- The arrival of P&O Cruises, Pacific Eden and Pacific Aria in the market in 2015/16 accounted for 55% on the increase in passenger visit days, and the inclusion of smaller expedition vessels in the data for the first time impacted the passenger visit days by a further 2%.

Visit days	2015/16	2014/15	CHANGE
Home passengers (mill)	1.6	1.4	17.8%
Transit passengers (mill)	0.9	0.7	16.0%
Total (mill)	**2.5**	**2.1**	**17.2%**
Crew (mill)	**0.3**	**0.3**	**16.3%**

Table 15: Crew and passenger visit days (Millions) – Source: PANSW

Cruise ship visit days (homeport and transit)

There were 1.079 cruise ship calls at Australian ports during 2015/16, which means an increase of 259 calls from 2014/15. Homeport visit days grew by 45%, demonstrating the major global cruise brands continuing commitment to base ships in Australia. [11]

At the same time transit visit days grew by 33% in 2015/16 reflecting the continued appeal of Australia as seasonal destination for the cruise lines planning their worldwide deployments.

In total these ports calls generated 2.6 million passenger ports days during 2015/16, which was an increase of 22%.

Passenger source – Domestic vs International

Domestic ships, i.e. ships with Australia homeports, accounted for 82% of the total passenger port days with 2.1 million days. Passenger port days generated by these domestic ships increased by 32% over 2014/15. International ships accounted for 18% of passenger port days. This was a 9.4% decline from 2014/15. [11]

This follows a similar decline in the prior year and reinforces the impact of capacity constraints such as the availability of berths and the ability to handle larger capacity cruise ships that are now being deployed in the wider region

	2014/15	2015/16	Change
Passenger port days – domestic ships			
Domestic (mill)	1.50	1.94	+28,70%
International (mill)	0.09	0.17	+87,40%
Total (mill)	1.59	2.11	32,10%
Passenger port days – international ships			
Domestic (mill)	0.27	0.24	-9,50%
International (mill)	0.26	0.23	-9,30%
Total (mill)	0.52	0.48	-9,40%

Table 16: Difference between domestic and international ship port days – Source: PANSW

Regional perspective

On a regional basis, the direct expenditures were concentrated in three states: New South Wales, Queensland and Victoria, which accounted for 92% of total direct expenditures throughout Australia with 2.1 billion dollars in direct spending during 2015/16. [11]

NSW remains the dominant state accounting for 63% of the overall economic contribution. However, NSW's share continues to show a decline year on year (from 68% in 2014/15). The other states, particularly Queensland, Victoria and Western Australia, have benefited as a result of a shift to regional Australia.

This again highlights the impact of the capacity constraints in Sydney in particular, which continues to drive the growth of the regional destinations at the expense of NSW.

	Output (millions)			State share	
	2014/15	2015/16	% Growth	2014/15	2015/16
NSW	2.421	2.892	19.5%	68%	63%
QLD	638	976	53.0%	18%	21%
VIC	243	346	42.7%	7%	8%
WA	174	190	9.2%	5%	4%

TAS	45	60	32.4&	1%	1%
SA	30	51	72.0%	1%	1%
NT	30	62	106.0%	1%	1%
Total	3.580	4.577	27.8%	100%	100%

Table 17: Economic impact by states – Source: PANSW

NSW (New South Wales); QLD (Queensland); VIC (Victoria); WA (Western Australia); TAS (Tasmania); SA (South Australia); NT (Northern Territory).

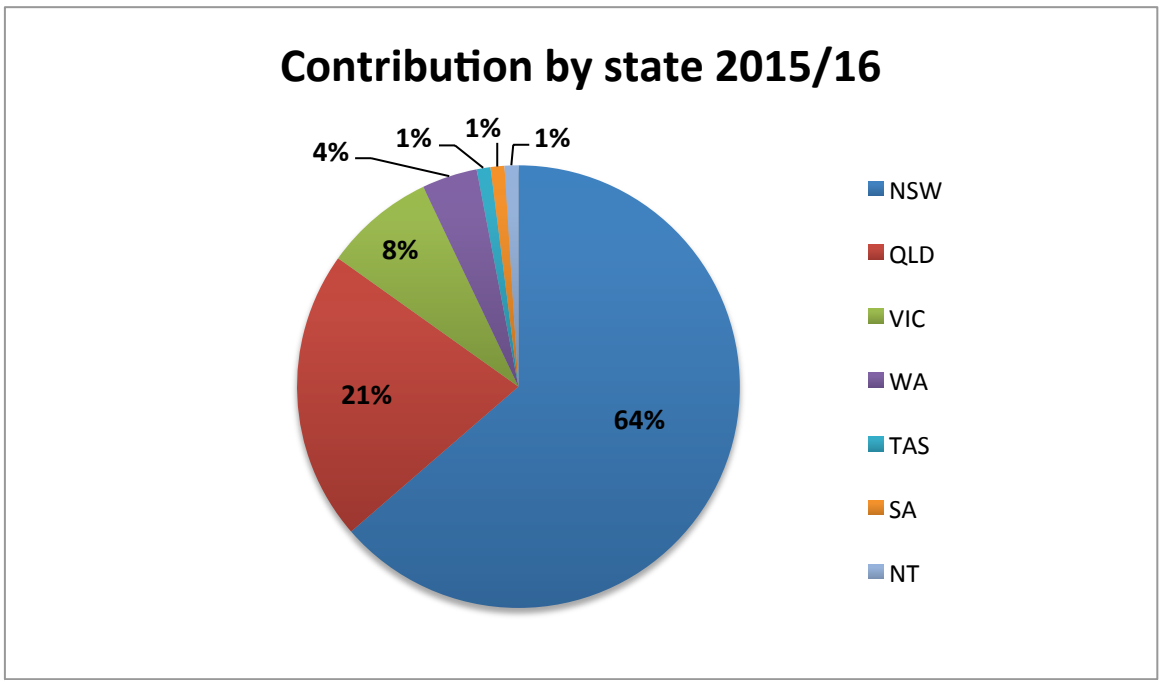

Figure 25: Economic contribution graphic by state

Future outlook

The outlook for cruise tourism in the Australia region is extremely positive with a number of global developments driving the growth opportunity. [11]

The industry continues to invest billions of dollars in new vessels with 67 new ships on order representing 197.796 new berths and worth an estimated 47 billion dollars. This new capacity requires both new destinations and source markets such as Australasia.

There are a number of exciting new ships and cruise line deployments in this region which will help to drive further growth in local passenger numbers.

The emerging markets of Asia (especially China) provide a significant growth opportunity. Australia is well placed to benefit from that growth, providing alternate seasonal deployment for China based vessels during the Chinese winter.

Australia will welcome unprecedented number of cruise ships the coming summer, with more than 40 vessels from CLIA member cruise lines to be based in Australia or visiting those waters.

The record season reflects the continuing surge in Australia cruise passenger numbers as well as the nation's growing popularity as an international cruise destination. Australia is the fourth largest source market for cruise passengers in the world with CLIA figures showing more than 1 million Australians took an ocean cruise in 2015 (a 14.6% increase on the previous year). Australian cruise passenger numbers have grown by almost 20% annually over the past decade.

The regional expansion of cruise tourism is expected to continue with five cruise lines making their first ever calls to a range of ports from Darwin in to Northern Territory to Burnie in Tasmania, while across the fleets, individuals ships will be making close to 70 maiden calls to coastal towns and cities.

However, this cruise industry's national, state and regional growth potential will only be realised if urgent steps are taken to ensure that infrastructure, particularly in the gateway port of Sydney, meets the requirements of the industry. Australia will lose out to other Asian ports if the local port infrastructure does not accommodate the bigger vessels and greater frequency being planned. Appropriate long term planning is urgently required to support the industry's growth potential.

One of this steps that the PANSW has taken this year to face this important growth is the double stacking in the OPT terminal (Sydney).

2.6.3. Double stacking

One of the biggest problems of the OPT in Sydney is that it is in the heart of the city. This is the most important incentive for the passengers to visit this city, but for the PANSW it means a problem. The OPT has grown to its limit and due to its situation, it is completely impossible to build another cruise terminal in the same area. There is no space enough. For this reason, and trying to face the demand, the PANSW is trying to implement a new system, the double stacking. [9]

This system consist in introduce two slots of 11 hours during the summer months (when there are more cruise ships), instead of only one slot per day. The first slot would begin in early morning until afternoon, and the other, since afternoon to midnight. This would be equal for the two ships visiting the OPT the same day. Both would have hours of darkness and hours of light, to enjoy the city.

The PANSW is considering this system for years, consulting with the cruise industry since early 2016. PANSW has given consideration to transport access, marine safety, harbour congestion, guest experience, noise, environment and border protection in case this system came into effect.

But as all the big changes, this involves the approval of many parts. And that has been the problem since the PANSW proposed the implantation of the system. The government of NSW supports the idea because it means an economic expenditure in the area. More vessels, more consumers, more money. But the real problem is in the cruise lines. Those who have been going to Sydney since years ago (Carnival and Royal Caribbean) have voiced their concerns because they see that their ships would be less hours in the city and their clients don't like it. However, those cruise lines trying to enter in this market (Norwegian and MSC) have voiced their support because they see a good opportunity to bring their vessels in Sydney.

Actually, nowadays, PANSW continues to work with the cruise lines and CLIA to develop the double stacking and catch more supports as an option for delivering capacity in the short to medium time. They are close and they are optimist that in few months, the double stacking will be a reality.

2.6.4. New booking system for cruise terminals

Port Authority of New South Wales is introducing a new booking system for berthing slots at Sydney's cruise terminals. The new booking system was introduced in 1 July 2017. [12]

It is the first of its kind anywhere in the world and has been developed in response to industry demand to increase capacity in Sydney, where growth in cruising is at record levels.

Port Authority is delighted at the potential opportunities the new booking process will provide the cruise industry. The key features are:

- Priority principles based model
- Designed to enhance port capacity
- Booking window open to all slot applications for 8 weeks at the start of each annual scheduling season
- Allocated season 3 years in advance

This new booking system consists on doing a scheduled season of 12 months, beginning on 1 July and ending on 30 June of the next year. The booking applications are taken three years in advance of the next scheduling season. When the application window is open, any cruise operator may apply in writing to PANSW for a slot, slots or slot group bookings.

Once a slot application is received and processed, if PANSW confirms the slot application in writing, a slot booking confirmations, the slot booking will become binding from the date of PANSW written confirmation. The next scheduling season confirmed slots booking indicative berth allocations are published by PANSW on 1 November each year.

After 1 November cruise operators may apply for any remaining available slots within the scheduling season, until six months prior to the slot date. Any applications submitted to PANSW within six months of the slot date may not be accepted. An updated confirmed slot bookings schedule will be published by PANSW from time to time.

Booking slot clash

A booking slot clash is the situation where two applications of different cruise operators seek the same slot. To determinate the ship that will be allocated the slot, the following principles, in descending order of priority, will be applied in each case:

1. A slot group booking;
2. A one day home port ship turnaround;
3. A one day non home port turnaround;
4. A part exchange passenger ship booking;
5. A transit passenger ship booking;

When two ships applying for the same slot, both fit the criteria above at the identical level, the ship with the largest passenger capacity will be given the slot.

PANSW may notify the unsuccessful cruise operator of any booking slot clashes after the close of the booking application window, but prior to the publication of the next scheduling season. On receipt of such notice, the cruise operator may apply in writing for an alternate slot in the scheduling season within 5 business days.

Where a cruise operator has been unsuccessful in securing a slot the subject of a booking slot clash, the cruise operator may also request to be placed on a waitlist for the originally desired slot. The PANSW will notify the cruise operator if the slot becomes available.

Slot swaps

Two or more cruise operators can apply (with prior agreement between parts) to swap slots and seek the approval of PANSW. However, a slot swap has no effect unless it is approved by PANSW.

In deciding whether or not to approve a slot swap, PANSW must consider the operational efficiency and costs impacts. If approved, PANSW will issue a slot booking confirmation.

Booking cancellations

Cruise operators have the option to cancel a booking, but it should be in writing to PANSW. The cancellation of a confirmed slot booking will incur a booking cancellation fee. The Port Authority will consider waiving the fee for cancelling a slot booking, if a case for an exceptionally adverse weather event can be clearly substantiated, and for no other reason. The application for waiver of the booking cancellation fee should be made in writing to the PANSW.

Failure to pay cancellation fees may affect the ability of a cruise operator on behalf of the cruise ship to make further slot applications.

If a cruise operator cancels a slot but is able to replace it with a cruise ship of substantially the same or larger passenger capacity making a visit at the same level, the application will be treated as a proposed slot swap. If the slot swap is approved, a cancellation fee will not be applied. If the replacement is of a lower passenger capacity, an adjusted cancellation fee will be applied. If the proposed replacement cruise ship is at a lower level of priority as described in the clauses above, then any waitlisted ships of a higher level of priority will be first invited to accept the slot.

Last but not least, it's important to remark that PANSW retains full discretion as to whether accepts the slots application, the allocation of berth arrival and departure times, and the most important: to cancel or terminate a slot allocation at any time for any reason.

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Chapter 3. Personal experience in the departments of the PANSW

This chapter explains day by day how I lived those two weeks in the PANSW, how they treated me, all the things I learned, etc. It's explained in first person, because it was my personal experience and it was written by me every day when I arrived home, after work, during those ten days, because there was when I had the things fresh.

3.1. Day 1 – Marine Operations

I have met Brendan Wiseman (assistant manager) at 9 am at moors wharfs. He has introduced me all his work mates. Today at port there was the Radiant Star (crude oil tanker IMO 9343211 Thailand flag) so at 9:30 am we have gone to do a random inspection. It's remarkable the high level of security, which that terminal has. The helmet and PPE (Protective Personal Equipment) were mandatory. Identification is necessary to go on board the tanker. While a workmate has been checking the main deck (pipelines and manifolds) the oil inspector and I have had a look to the charge panel and the checklist too. The level of the Inert Gas needs a special mention. The atmosphere of the tanks must have a level of oxygen under 8%, and after de revision, it was below 5%. The ship has passed correctly the inspection so we have return to the base.

Figure 26: Radiant star berthed in Sydney Harbour – Own source

The emergency plans for this type of vessels are checked often and all the crew knows which is their role in case of emergency. Before beginning any oil operation (charge/discharge) they connect all the fire fighting system in case they need it. Moreover, the ladder of the opposite side of the working pipelines is also launched in case there is a fire and the crew has to abandon the ship.

When charge or discharge is ended, the oil inspector of the port authority must be there to control the process of disconnection the lines.

Particularly in Sydney, since one day in the past they suffered an important oil spill in the water, they cover all the perimeter of the ship with a containment boom which is fixed when the ship berths and is removed when the vessel is ready to sail.

This random inspection mentioned before, has taken us about 1 hour, so we have returned to the base to proceed with the registration on paper of the inspection done before.

A days before, when I wasn't there yet, they suffered (through a water canal) a little diesel spill in the water. They didn't know how it happened, but their job was to stop it, so they went where the canal joins the open water and put a containment boom plus abstainers. Now was time to check if their job improved something. It did, the diesel stop spilling so the diesel left would be evaporated with the sunshine.

All this procedures are executed with a cutter boat, with two engines and prepared for all this activities.

During the afternoon, a lot of jobs have been done. The oil inspector has gone again to the tanker ship to disconnect the lines and remove the containment boom, and the cutter master and me, have patrolled all the Sydney Harbour looking for some irregularity (which we haven't found). It has been useful for me to acquire a big acknowledgment about all the Sydney Harbour and it's bays.

My workday ended here but the others had to stay there during all night. Patrolling and keeping on watch in case something happens.

3.2. Day 2 – Duty Pilot

The second day of my work experience has been about duty pilot. At 8:30 am I have arrived at port Botany. Once there, I have met the pilot manager, Matt Stannard. I have had a conversation with him on how the pilots work in NSW, specifically Sydney Harbour and Port Botany. He runs a huge team of experienced and very professional pilots, which do work periods of 12 hours per day during the 7 days of the week. Then, day have a week off and come back for another week of hard work.

Each week have 7 pilots in charge. They follow a table in which is shown when each pilot has to go on board. The first pilot listed in the table is the one who must go on board to entry or depart some ship. When he/she has done 3 different ships (doesn't matter if is entrance or departure) automatically goes at the bottom of the table. The second in the table will be the next one to go on board. It can happen that more than one movement has to be done in the same time. In that case, the first pilot in the table goes to a ship, an the second one to another, so the two of them will have 2 movements left to do before going at the bottom of the table. The same happens if some pilot doesn't have the enough license to do some sort of ship. The second one will do that and will have one ship less to do.

They have 4 pilot vessels, two in each port of those mentioned above. These pilot boats are fully competent and they comply with the regulation.

Later, on the afternoon, we have done two more oil random inspections on the ships Atlantic Mirage and SKS Delta (Norway). As I explained before, the inspections were about if the process of charging/discharging of the dangerous goods is executed following the regulations.

There was one vessel that was charging different sort of products (Diesel, 95 unloaded, etc.) but they were using only one manifold. They have had to clean the entire pipeline before changing the product. For doing this they use a particular system. Taking advantage of the pressure that is in the lines, they introduce a device called pig through the pig sender. This device goes through the lines cleaning all its walls until it arrives at the other side of the line. Now is all ready to continue the charging operations.

3.3. Day 3 – Survey

Today I was date at 7 am at moors wharf. There I have met Tim and Martin, the two survey's guys that I have spent all day with. After a coffee and a little introduction on how they work, we have prepared all the stuff. At 8 am we were departing from moors wharf on board port explorer, the survey boat in Port Jackson. This boat is perfectly equipped whit the necessary elements to do the survey's duties with success.

This team are on charge of all Port Jackson, Port Botany, Port Kembla, Port Yamba and Port Eden so they must work in all this areas. Today we had a job in Port Jackson so we have spent all day in it.

First of all, we have gone to middle harbour to take some photos to buoys that they put years ago. These buoys are only for navy fleet and the photos were to do a comparison on how they had deteriorated. If they had been changed of place, if they were in good condition, etc. This job has taken us about 1 hour.

Next, we have gone to the main entrance of Port Jackson (where the sea was pretty rough, by the way) and we have started what it has been the main job of the day. Using the high technology sounder, which the boat is equipped with, we have had to surround each buoy, mark or beacon of all Sydney Harbour and take readings of their position and depth. Cardinal buoys, moor buoys, wreck beacon, lateral buoys, isolated danger, safe water, special buoys, etc.

Figure 27: Sydney Harbour's main channel portside mark – Own source

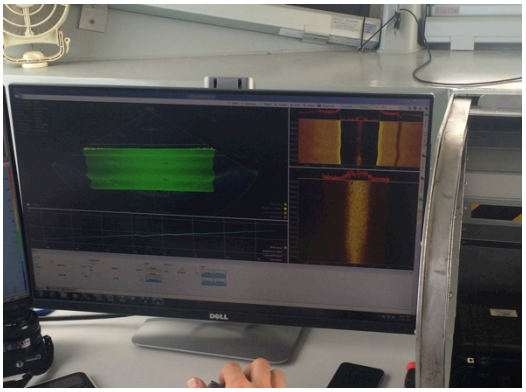

Figure 28: Data provided by the sounder on the boat's screen – Own source

We have spent 3 hours to do from the main entrance to the moors wharf (where we have had lunch and I have met Vanessa, the survey manager) and then 2 hours more to do the rest.

This is a job that is done twice a year. The reason of that is very simple: in a high frequented harbour and also were there can be rough seas (specially at the entrance) this buoys, marks or beacons mentioned before may suffer a displacement. With this sounder, we have been able to see the exact position and compare it with the readings of last years. Moreover, we have taken a photo of all of them for the same reason as before.

With this fresh information that the sounder provide, then they analyse the results at the office and they update the database. All the significant changes (of position, depth, etc.) that they could notice, will be updated also to the nautical charts of the Harbour that then will be at the disposal of everybody. That's why it's so important, because then when big ships entry in the port, a bad measure of the chart may produce an important accident.

The sounder is attached on the boat deck and is off the water. When its use is required, it is placed into the sea. The sounder sweep the bottom on the sea and projects the image in the screen on the wheelhouse. It provides a lot of information such as depth, tide level, wave level, etc.

3.4. Day 4 – Survey

It has been an office day. But office day doesn't mean it hasn't been an interesting day. We have started at 8:30 am and we have spent 2 hours processing the information that we collected the day before. It hasn't been an easy job so I will try to explain it as well as I can.

As I explained before, at the third day of my work experience in the Port Authority of NSW, we swept the entire seabed round the buoys, beacons and marks with the purpose of obtain its exact position and the relief of the seabed and its depth too. This information was quite good but it needed a few corrections to consider it exact information. First of all, they have recovered the files collected the day before from the database and have put them into a special program. We have obtained the track through Sydney Harbour that we did. Then was time to apply the corrections, which were:

- GPS correction: The exact position was obtained due to GPS satellite's triangulation. However, with this sort of things, it may occur a lost of signal in a particular time. After we have checked it through the computer, we have noticed that we suffered a lost of signal only one moment. It might was when we passed under the harbour bridge. We have applied the correction so we minimize the jump that our GPS receiver did and we have obtained a much better new one.

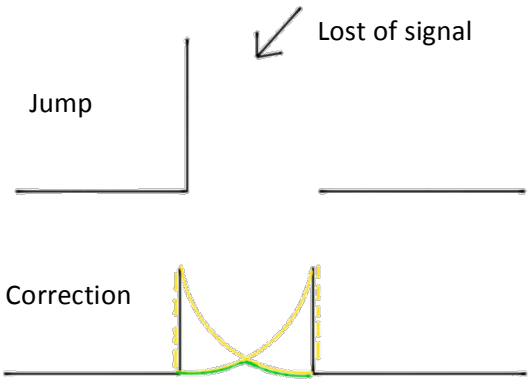

Figure 29: GPS correction – Own source

- Sounder correction: Due to the conditions and characteristics (salinity, temperature, reflectivity, etc.) of the water it may occur that in different depths, the scanning of the sounder could be faster or slower. It could produce a false read of the depth so it's important to apply it. We didn't measure the conditions of the water on Wednesday but in the survey database they had one file with the same conditions, so we have applied it.

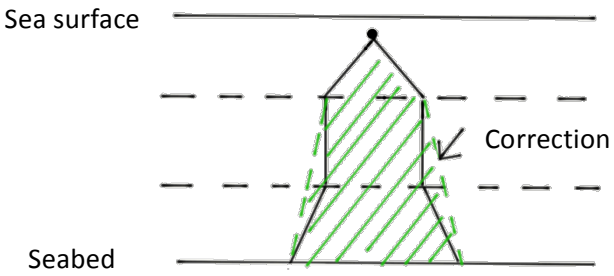

Figure 30: Sounder correction – Own source

- Tide correction: The tide at the moment of the measure can also influence to the depth. There are two ways to apply this correction:
  - Calculating the difference between the tide expected and the tide measured with the devices on board. That is easier but it's necessary to collect the measurements at that moment. Which we didn't do.
  - With the GPS system. It's possible to obtain the difference between the tide at one moment and the 0 tide with the GPS signal. It's more difficult that the one above but more exact and available at any time. We have applied this one.

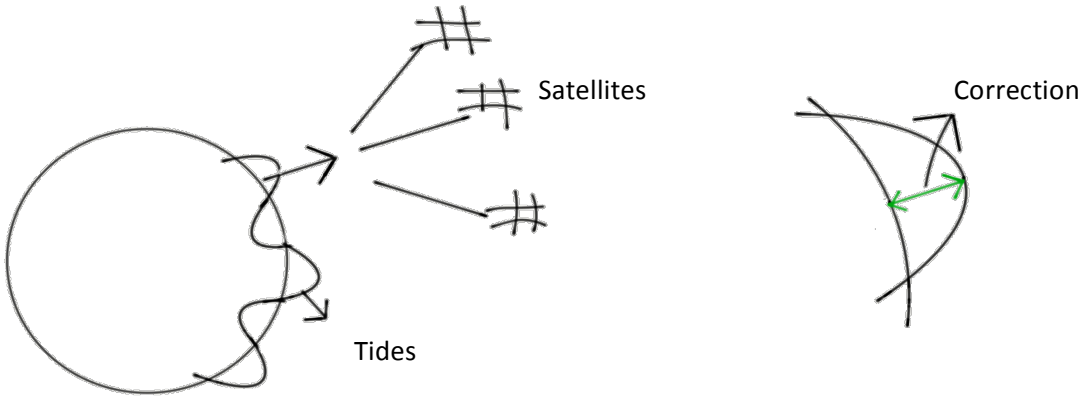

Figure 31: Tide correction – Own source

Once we have done all this things, the result is ready to send to the appropriate authorities (Pilotage, government, etc.) or also to develop the corresponding charts, which is a survey's department job.

3.5. Day 5 – Marine Operations

The fifth day of my working experience has been quite similar as the first. I have been with the marine ops department, in Sydney Harbour. It has been a busy morning, with a lot of different duties. We have started with a morning inspection in Alburaq Tanket (from Panamá) quite similar as the random inspection we did the first day. Later, we have done a different activity that I found interesting because I didn't know these things were made always. Today a P&O cruise ship was berth on White Bay, and it was refilling with a tanker barge. It is the duty of marine ops to check this process is done following all the regulations. We have gone there to check

Figure 32: Cruise ship refilling in Sydney Harbour – Own source

that the disconnection between the tanker barge and the cruise ship was done perfectly and there weren't any kind of spill.

Before having lunch, we have done a couple of things more. A routine inspection of the canal pollution (it was everything good) and check a boat wrecked inside the harbour. I can't remember what was the cause of the wreck, but it was the responsibility of PANSW to check that the wreck was stabilized and it doesn't cause more problems in the harbour.

The afternoon has been lighter. I don't know if it has been like this because it's Friday, but we have only done another inspection to the same tanker of the morning. It is a huge tanker and it is important to check that the entire regulations are followed by the tanker. Here ends my first week of the working experience with the Port Authority of New South Wales.

3.6. Day 6 – Cruise Operations

My day began at 9 am at Bond One. There I have met John McKenna (General Manager of Cruise operations) who, during an hour and a half, has made me an introduction on the cruise management in Sydney Harbour with its two terminals, Overseas Passenger Terminal (OPT) and White Bay. He has explained me the charges, the future expectations, kind of vessels that come, characteristics of the terminals, etc.

Then, he has introduced me the second on charge, Rob Rybanic. We have gone to the OPT where we have met Denise, the Carnival's director of shore issues. She has made us a fantastic tour through the entire Carnival Legend vessel, which happened to be on port that day. We have entered for the crew main entrance and we have seen all the crew deck and also the engine control room, where the chief officer has explained us how this room works. Later, we have continued the tour to the theatre, main restaurants, upper deck, etc. and we have finalised in the bridge. A huge bridge full-equipped.

Figure 33: Me on board Carnival Legend – Own source

Denise has had the courtesy to invite us for lunch in the vessel, so we have accepted it. After lunch, we have gone out the vessel and Rob has explained me how they run the terminal. Security, passenger boarding, commodities loading...

As a curiosity, The OPT, which was reconstructed few years ago, is a big building with enough space to run a first-world

cruise terminal, but all its furniture is movable in case the port authority rent it in the days where there is no cruise in it. Weddings, conferences, meetings, anything can be done there.

The boarding of passengers is done by time windows, to avoid an agglomeration of people. The entire luggage from the guests is passed through x-ray machines and depending on the ship berthed, there are some products that are not allowed (for example alcohol).

If it's a domestic cruise, the passengers only have to do the check-in, pass the security control and get on board. However, if it's an international cruise, there are customs on the terminal, which control all the passengers. My day experience on cruise terminal finished there, after learning how the OPT works.

3.7. Day 7 – Cruise Operations

As the day before, the day started at 9 am in John's McKenna office. We have had a talk during the next 30 minutes about the cruise operations, but more specifically, about the white bay terminal.

The White Bay cruise terminal is the one that is on the west of the harbour bridge, so there can only berth those ships that can pass under the bridge.

It's a terminal quite different than the OPT terminal. There is only one floor, enormous, where all the procedures required for the boarding are taken there. Check in, customs, security control, etc. Moreover, as the OPT terminal, its furniture is movable in case the port authority rent it for any event. There are two last-generation gangways made in Spain. The disembarking and boarding is made in the same gangways but in different timings. The berth is three times bigger than the OPT one, so the loading and movement of cargo is much easier and less stressful than the OPT.

Figure 34: White Bay Terminal – Own source

However, the White Bay terminal has a handicap. Is near a residence area, so they have received a lot of neighbours complains. The PANSW, particularly the cruise operations department, needed to develop a policy for the ships being respectfully in that berth. This policy includes no announcements in upper deck, engines shot down, maximum of air pollution permitted, etc. Actually, they have considered the possibility of putting electricity on berth, so the ships would have to connect to it and turn off its generators.

After the briefing with John, we have assisted on a meeting that the cruise ops team has every week. They are developing a new booking system, so this meeting was about to teach them on how it works. In this way, all the team will be familiarized with it by the time it will be available.

Next, Rob has taken me into the White Bay Cruise Terminal, where I have been able to see everything that John had explained to me a few hours before. There was no ship berthed there, so we have seen the terminal without any passenger. It has been very quiet.

After lunch, I have had a briefing with the duty manager of cruise ops, Julie, who has explained me how she does the reports on all the damage that occur in the terminal. Moreover, she has told me how they do the cruise schedule, which has bookings until 2021 (before the new booking system starts to run out the market).

Later, and as a final activity of this day, I have gone with Adam (Commercial management team) to Glebe Island, where the Port Authority of NSW owns a Sugar factory situated in a dock. We have gone to do a quick inspections and he also has shown me which parts of the area where owned by the Port Authority. I can say that the majority of docks in Sydney harbour belong to them.

3.8. Day 8 – VTS and Pilotage

I was cited in Port Botany at 8 am in the morning. It was de VTS day (Vessel Traffic Services). The VTS office is in the Brotherson House building, just between DP world and Patrick's docks (Botany Bay). Its team is composed on 3 persons, 1 supervisor and 1 person in charge for each port (Botany and Sydney Harbour). In this shift this persons were Lucas, Tracey and Steve. Lucas, the supervisor has been very busy today, so first I have spent a few time with Tracey (Port Botany) and then with Steve (Sydney Harbour).

I have been lucky today that in botany have been a lot of movements, so Tracey have been able to show me her work perfectly.

They have explained me a lot of useful things, but as a curiosity of the jobs conditions, I can say that they do 4 shifts of 12 hours each, and then they have 4 days off.

It has been an interesting morning, its always good to see how from one office, it's possible to monitor and control all the traffic of a big city like Sydney.

After lunch I have had the opportunity to get on board the pilot cutter and see how 2 pilots of Port Botany got on board two different ships. The two of them were tankers (Morning Swan and ICS Allegiance). All the procedure and the fact of being next to one of these huge vessels have been a really nice experience. It has been something new for me. The pilot cutter is crewed with the master cutter, a deckhand and the pilot.

3.9. Day 9 – Marine Operations

This has been the last day in Sydney Harbour, and it has been a full boat day. Even though it was raining all the day, it hasn't been an obstacle for us. On the morning we have gone to middle harbour to check the blind points of the AIS system. We have been sailing through all the spots in the middle harbour and with a VHF device in hand, we have been on constant communication with VTS to check if the bling points which were detected weeks ago, had been fixed. This has been a useful job for me, because a part from doing the duty work, I have enjoyed the amazing landscape of the middle harbour and, of course, the 3 hours of navigation.

After lunch, we have got on board the Millers Point cutter again, and we have gone to Lane Cove River, with the same purpose of the morning. In this case, we have had to be very careful, because the waters of this river are very shallow.

3.10. Day 10 – Pilotage and Marine Operations

The last day of my work experience in the port authority of New South Wales has been in Port Botany. On the morning I have done what I liked most: pilotage. I have been invited to go in the pilot cutter to do an inbound and an outbound. The sea was pretty rough today, but the pilot cutters of the Sydney's ports are perfectly ready to hold huge waves.

Figure 35: On board the pilot cutter approaching the container vessel – Own source

Friday's in marine operations are so quiet, so on the afternoon, after lunch, the shiftmaster taught me some tips with the ropes and the most important knots. Here ends the second and last week with the PANSW, where I have learned a lot of interesting and useful things.

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Chapter 4. Comparison between the Ports of Barcelona and Sydney

This thesis is about the Port Authority of New South Wales (where Sydney is the main port) but is done and delivered in Barcelona. This fact makes important to do a comparison between these two ports, to make visible the main differences and how run this business two big ports that are far away from each other. This comparison will focus on the traffic of the ports and the rates or port charges that the Port Authority of each port applies to the vessels.

Although the PANSW owns more than the two Sydney ports (Sydney Harbour and Botany Bay), this comparison will be done only between Barcelona and Sydney (Sydney Harbour plus Botany Bay). The only reason of this is to try to offer a more exact comparison, because here is the real competitiveness, assuming from the beginning that Barcelona is bigger in terms of traffic (both cargo and passengers).

Before starting with the comparison, I think it's important to do a little introduction about the port of Barcelona. At the beginning of this project, there is a huge description about the port of Sydney (which the project is about), but to understand better the results of the comparisons below, it's necessary also to have a little knowledge about the port of Barcelona and its terminals or infrastructures, among other things.

The first difference is the geology: while Sydney has a big natural entrance of sea to the land, Barcelona is a simple lineal coast, so instead of a natural port, Barcelona has had the need to build and artificial port in front of the city.

Along all the city of Barcelona, there are three ports. Beginning from north to south, there is the recreational port Forum, the recreational port Olímpic and finally, the main port in which I will focus to do this introduction and which takes the name of the city: Port of Barcelona.

Figure 36: Port of Barcelona – Source: Port of Barcelona

This image above shows all the port of Barcelona. On the top right of the picture, there is the south part of the city, with the mountain of Montjuic next to. Then, more to the left, there are the industrial polygons of the commercial port and finally, the Llobregat River. It's important to mention this river, because it is the limit of the port. Due to this river, it's impossible for the port of Barcelona to expand to the south (apart from that at the other side of the river, there is the airport). [14]

As it can be appreciated, there are two main entrances to the port. The north entrance is called November (from the N meaning north) and the other is Sierra (meaning south).

The closer area to the city (right side of the picture) is where the recreational boats are berthed. There are a few nautical clubs with its respective fleet and some docks reserved for fishing vessels. Just next to them, there is the main building of the Port authority of Barcelona (called World Trade Centre, WTC). All the docks surrounding this building are reserved for the ferries doing the regular line of Barcelona to Balearic Islands. There is also enough space for these times when some war ship visits the port. On the left of the WTC, there is an opening bridge that connects this part of the port with the commercial side. However, the majority of the vessels going to the commercial port enter through the sierra entrance, so this bridge is almost always closed.

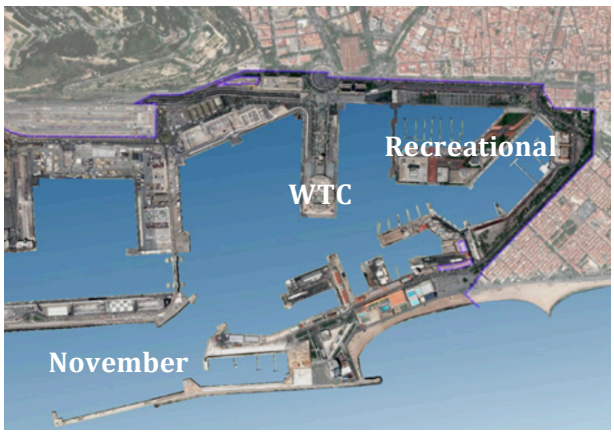

Figure 37: Recreational area and World Trade Centre – Source: Port of Barcelona

The picture below shows the right side of the commercial. I have divided it in two pictures because is more appreciable than only in one. Instead of Sydney, here there is altogether. Merchant ships and cruise ships are in the same port. It might look like is not bigger than Sydney, but it is. Although the image seems little, the distances are huge. Actually, port of Barcelona has 22.216 km of docks and berths, which is a lot.

Figure 38: Barcelona container Terminal and Cruise Terminal – Source: Port of Barcelona

There are plenty of docks, for Ro-Ro vessels, for container vessels and cruise ships. In the image there is only indicated some of them, the most important, but it doesn't mean there are no others. Only the cruise terminal, can berth more than three big cruise ships at the same time, while Sydney can hold only a big one in the OPT (others smaller in White Bay). The Barcelona Container Terminal (TCB, in catalan) is in front of the cruise terminal and is also huge. Moreover, it is not the only container terminal. There is the BEST (Barcelona Europe South Terminal) in the left limit of the port (next picture), which is bigger than TCB, and between them, can berth a big number of container vessels.

The other part of commercial port (as shown in the image below) is, if possible, larger than the other. Next to the cruise and TCB terminals, there is the bulk terminal, where are berthed all this vessels that transport bulk cargo, including gas and petroleum.

Finally, on the left of the Sierra entrance, is the already mentioned BEST terminal. The last terminal that was built in the port, so it is very modernized. BEST is able to host the biggest container vessels in the world.

That's why the Sierra entrance was built; to permit big vessels enter to the port in an easier way. In fact, sierra entrance is 370 metres width and a draft of 16 m. while the November entrance is 145 metres width and has a draft of 11,5 m.

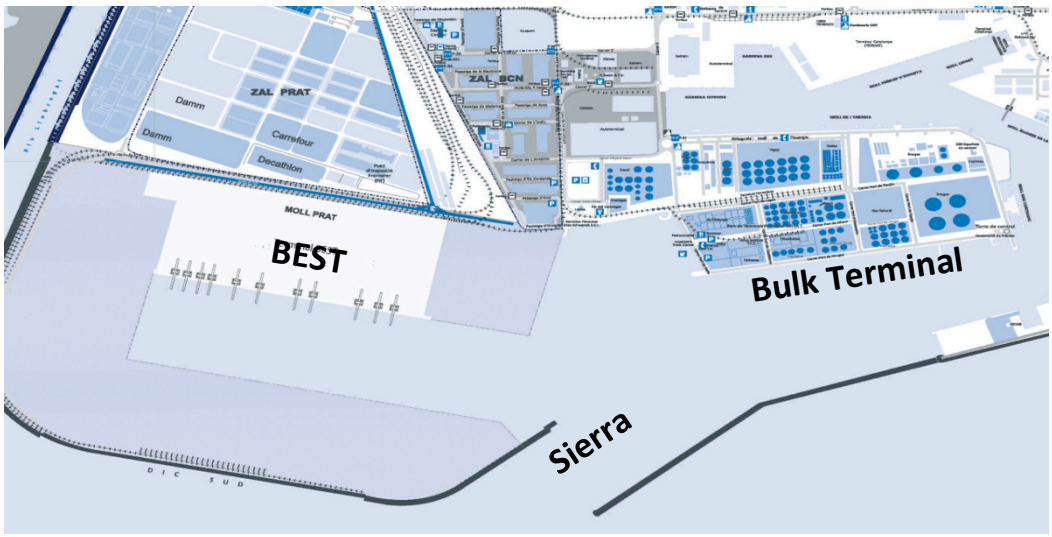

Figure 39: BEST Terminal and Bulk Terminal – Source: Port of Barcelona

Apart from all this docks and berths I have mentioned, there are a lot more. So, basing in what we have seen since now, port of Barcelona is bigger than Sydney, in terms of port dimensions. But what really matters in this business is the traffic that receives each port. Let's see if the difference between traffic is equivalent to the dimensions of each port.

4.1. Traffic comparison

The tables below present the total traffic in both ports during the 12 months season of 2016. There are 3 different comparisons, beginning for the total vessel visits, and then separating them in trade vessels and cruise vessels. [5][15]

	Barcelona	Sydney	
		Sydney Harbour	Botany Bay
Vessel visits	8.728	1.169	1.700
TOTAL	8.728	2.869	

Table 18: Total traffic comparison – Source: PANSW and Port of Barcelona

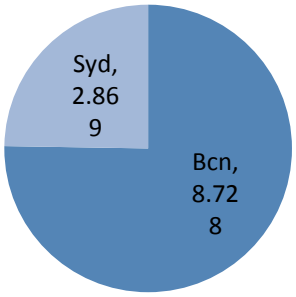

Figure 40: Graphic of total traffic

	Barcelona	Sydney	
		Sydney Harbour	Botany Bay
Trade vessels	7.970	858	1.700
TOTAL	7.970	2.558	

Table 19: Trade vessels traffic comparison – Source: PANSW and Port of Barcelona

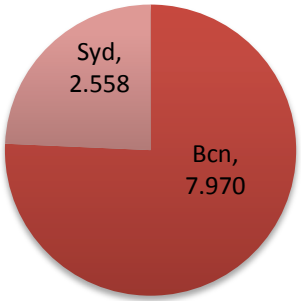

Figure 41: Graphic of trade vessels traffic

	Barcelona	Sydney	
		Sydney Harbour	Botany Bay
Cruise ships	758	311	0
TOTAL	758	311	

Table 20: Passenger ships traffic comparison – Source: PANSW and Port of Barcelona

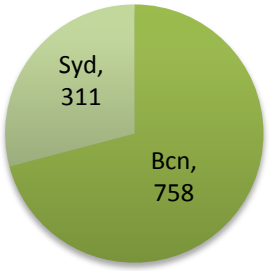

Figure 42: Graphic of passenger ships traffic

As we can see in those comparisons, there is a similar pattern followed by the three tables. It doesn't matter if we segregate the traffic by trade or cruise ships; the proportion is always the same. Port of Barcelona has about 75% more traffic than the city of Sydney.

The main difference may be the situation of the port. Barcelona is in the heart of South Europe, just inside the Mediterranean Sea. Is a strategic stop for those vessels that come from the Middle East and want to go to North Europe, because it is near the Gibraltar Strait. Moreover, in terms of cruise ships, Barcelona is more than consolidated as one of the biggest ports in the Mediterranean and the world. The situation and facilities of this port have caught the attention of the main cruise lines and they use Barcelona as a homeport for their vessels.

In terms of passengers, the thing doesn't change very much. Barcelona continues to have more passenger traffic than Sydney, for the same reasons as mentioned before. Moreover, if the cruise ship's traffic is bigger, so it's the passenger traffic. It is proportional (depending a little bit of the ship's size). Here we have some statistics about passenger traffic in Sydney Harbour (there is no passenger terminals in Botany Bay) and Barcelona, and then a comparison between them, month by month during the season 2015-2016. Due to the fact that they are in different hemispheres , the summer of Barcelona is in

different months that the Sydney one, so it will be big differences depending on the month. It is needless to say that the summer is when the passenger traffic is bigger, due to the warm weather.

Sydney	2015/2016
July	38.213
August	22.260
September	62.467
October	111.746
November	141.263
December	170.459
January	189.889
February	172.696
March	149.117
April	126.771
May	63.192
June	61.250
TOTAL	1.309.323

Table 21: Number of passengers in Sydney by month – Source: PANSW

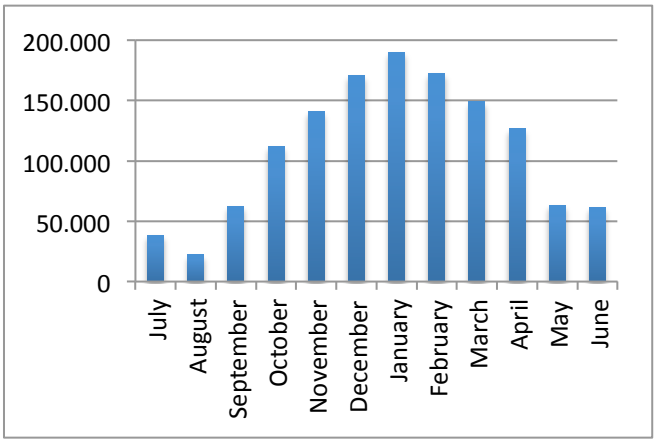

Figure 43: Graphic of number of passengers in Sydney by month

As we can see in the graphics, there is a huge difference between months of cold and months of summer. There is no explanation but the weather. Tourist prefer doing their holidays in cruise ships in summer, where they can relax in the beaches of the cruise destinations or in the pool of the ship. We will se the same pattern in Barcelona, but with more passengers and in the opposite months, for the reason explained above.

Barcelona	2015/2016
July	466.426
August	621.491
September	406.398
October	404.355
November	242.314

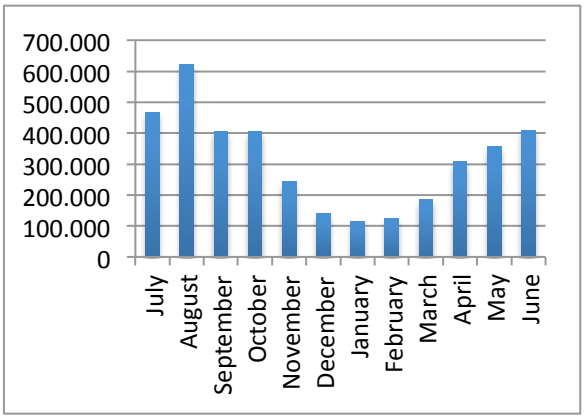

Figure 44: Graphic of number of passengers in Barcelona by month

December	139.956
January	113.882
February	123.516
March	183.999
April	307.260
May	355.504
June	410.075
TOTAL	3.775.176

Table 22: Number of passengers in Barcelona by month – Source: Port of Barcelona

2015/2016	Barcelona	Sydney
July	466.426	38.213
August	621.491	22.260
September	406.398	62.467
October	404.355	111.746
November	242.314	141.263
December	139.956	170.459
January	113.882	189.889
February	123.516	172.696
March	183.999	149.117
April	307.260	126.771
May	355.504	63.192
June	410.075	61.250
TOTAL	3.775.176	1.309.323

Table 23: Comparison between number of passengers – Source: PANSW and Port of Barcelona

Here it is. The same idea with more volume of passengers. Traffic during winter months decreases. Although the weather in this two destinations isn't hard in winter, people prefers doing it in summer. Moreover, it usually matches that people have work holidays in summer months.

If we put together the statistics of these two cities, we will see better the differences of traffic.

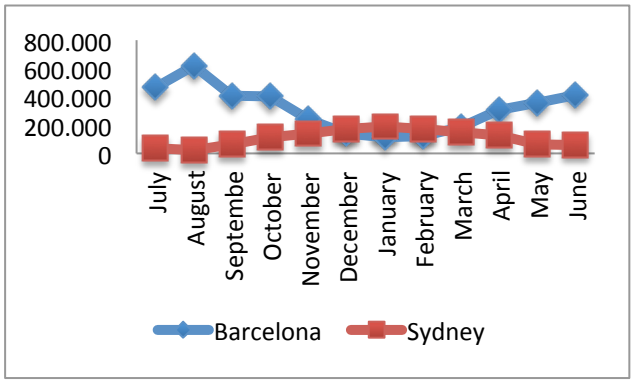

Figure 45: Comparison of number of passengers between Sydney and Barcelona

As we can see, the busiest months of each one are completely the opposite. And a fact that makes significant the difference of traffic is that the lowest months in terms of passengers in Barcelona are almost the same as the busiest months in Sydney.

Here there is an important difference that should be mentioned. Barcelona, for the characteristics of its geography, has a lot of ferry traffic, which passengers are included in this statistics. I am talking

about ferries that connect the city with the Balearic Islands and other destinations like Italy. This means a huge traffic that Sydney doesn't have. In Australia (apart from the inexistence of islands in front of Sydney) the distances are higher than Barcelona, so there is not a ferry service like Barcelona. If we take off the passengers of this regular ferry lines, and compare only cruise ships, the statistics would be like this:

2015/2016	Barcelona	Sydney
July	287.694	38.213
August	336.470	22.260
September	289.169	62.467
October	340.224	111.746
November	198.155	141.263
December	89.738	170.459
January	69.769	189.889
February	84.764	172.696
March	102.284	149.117
April	222.867	126.771
May	270.155	63.192
June	266.406	61.250
TOTAL	2.557.695	1.309.323

Table 24: Comparison between number of cruise passengers in Sydney and Barcelona, by month – Source: PANSW and Port of Barcelona

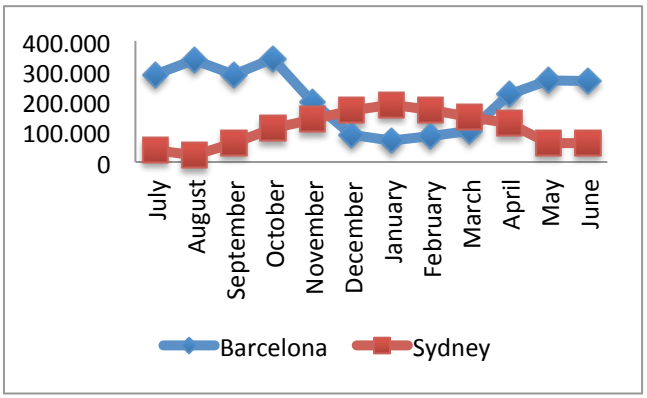

Figure 46: Comparison of number of cruise passengers between Sydney and Barcelona

Here, the difference has reduced notably. Sydney continues to be a little bit under Barcelona but now is justifiable that Sydney is also an important cruise port in the world.

As we can see in the table next to, the total amount of passengers in cruise ship in Barcelona is 2.557.695, so it means that the ferries carried a total of 1.217.481 passengers in the season 2015/2016. The ferries in Barcelona carry almost the same passengers as the cruise ships in Sydney.

This competitiveness is relative, because they don't share passengers. The fact of being in the other part of the world is that the passengers of one are not the clients of the other (in the majority of cases). So the real important point here is the growth they have year by year. This is what is useful for them (Port Authorities). If they have growth means that they have been doing good things. On the other hand, a decrease of traffic should cause a headache and then they would try to fix this for the next year. Fortunately, cruise industry is growing year by year since a few years ago, and this two cities have

noticed that. The two cities in question have had an important growth, and as an example, there is a comparison between season 2014/2015 and 2015/2016.

	Barcelona			Sydney		
	2014/2015	2015/2016	Growth	2014/2015	2015/2016	Growth
July	414.666	466.426	12,48%	25.774	38.213	48,26%
August	583.988	621.491	6,42%	40.483	22.260	-45,01%
September	401.145	406.398	1,31%	63.197	62.467	-1,16%
October	362.522	404.355	11,54%	114.226	111.746	-2,17%
November	202.780	242.314	19,50%	126.190	141.263	11,94%
December	121.974	139.956	14,74%	170.577	170.459	-0,07%
January	120.462	113.882	-5,46%	173.713	189.889	9,31%
February	99.425	123.516	24,23%	142.626	172.696	21,08%
March	155.717	183.999	18,16%	148.440	149.117	0,46%
April	286.068	307.260	7,41%	76.572	126.771	65,56%
May	373.121	355.504	-4,72%	20.529	63.192	207,81%
June	393.437	410.075	4,23%	48.791	61.250	25,54%
TOTAL	3.515.305	3.775.176	**7,39%**	1.151.158	1.309.323	**13,74%**

Table 25: Comparison growth of number of passengers between Sydney and Barcelona –

Source: PANSW and Port of Barcelona

As is shown in the table above, the two cities have had a big growth between this two seasons. There are some unstable months with negative growth, but the overall is clearly a positive growth. Moreover, as Sydney has less volume of passenger, the differences between years can be more significant. That's the reason why Sydney has a growth two times bigger than Barcelona.

The forecast, as I have explained in previous chapter, is that the cruise industry will continue growing, so these cities will have more passengers year after year. It is unknown the year that this will stop growing, but it is obvious that the moment will arrive. Things always tend to stabilize.

4.2. Port charges comparison

Both Port Authorities apply port charges to all merchant and passenger vessels that enter in their ports, each one on its way. There are different port charges, such as navigational service, pilotage, site occupation, vessel tax, etc. Each port calls them in different way, and maybe one include two of them in the same charge, but in the end, the two companies apply charges for the same services. What can be different, is the final price of the charges depending on which port are applied, so in this chapter there will be a comparison between charges applied by the Port Authority of Barcelona and the PANSW. First of all, there will be explained the charges of Barcelona and then the Sydney ones. Finally, there will be a real and detailed example of a vessel and we will be able to see the difference between the charges in these two cities, in terms of costs. [16][17]

In Barcelona, the charges that are applied are the following:

- Navigational aids tax
- Vessel tax
- Passenger tax (only for passenger ships)
- Reception and treatment service of waste generated by ships
- Mooring service
- Tug service
- Pilotage service charge

In case of Sydney, the charges would be:

- Navigational service charge (which include navigational aids, mooring service, tug service)
- Site occupation (which include vessel tax and passenger tax in case of passenger vessels)
- Pilotage service charge

It is important to mention that both Port authorities apply (plus all the charges above) another charge depending on the kind of cargo that vessels carry. This charge depends on each vessel and is different for all vessels. So it is not stipulated. In each case, the port authority asks to the vessel managers all the cargo they will charge or discharge to the terminal and with an internal program, they conclude the price of this tax. I am talking, as an example, of vessels carrying containers, ro-ro cargo, bulk, etc. Each cargo has its own charge depending also on the volume of it. This charge is applied because all this cargo will need a berth infrastructure, trade facilitation, land service, etc. which belongs to the Port Authorities.

4.2.1. Navigational aids tax (Barcelona)

As the title says, this tax is applied to cover the costs of those navigational aids installed in the port to make safer the navigation of the vessels through it. There are different rates depending on the type of vessels, but we will focus on the rate of merchant vessels (which include also the passenger vessels). Other rates are for fishing vessels or recreational boats.

This tax for merchant vessels is applied only the first 3 calls of the same ship. Then, it becomes free.

It depends on the volume of the vessel, so it is necessary to know the gross tonnage. It is not the same price for a small merchant vessel than for a large one. So, this rate is configured by the product of the following formula: 0,0200 * number of GT (minimum 100 GT).

4.2.2. Vessel tax (Barcelona)

Maybe is the most sophisticated charge in Barcelona. It is the tax applied for the berth occupation of the vessels or the space that they are occupying. There are different factors depending on the way that vessel is berthed, the size (GT) and the total of hours that the vessel is on berth.

The formula used is: basic rate * variable factor * GT/100 * hours of stay

The basic rate is 1,20€ for short sea shipping and 1,43€ for long distance maritime service. The GT's and hours of stay depend on every case. And the variable factor comes from a table, which are all the possibilities of a berthed vessel. There are from simple vessels that are on a normal berth only a few hours to abandoned vessels or ships under construction, among others. In the next paragraph there are this variable factors, but I have deleted those weird cases (which are probable but are not of our interest in this chapter). There are only the normal cases of vessels berthed a few hours to do their charges and discharges before going to the next port.

- Berthing not granted in concession or authorization
  - Alongside berth: 1,00
  - Berthed on the bow, broadened, berth on a buoy or anchored: 0,80
- Berthing granted in concession or authorization
  - Berthed or anchored with enough water space
    a) Alongside berth: 0,60
    b) Berthed on the bow, broadened, berth on a buoy or anchored: 0,50
  - Berthed or anchored without water space
    a) Alongside berth: 0,70

b) Berthed on the bow, broadened, berth on a buoy or anchored: 0,60

- Berth only for repair (maximum 48 hours): 0,25
- Cruise ships standard: 0,70
- Homeport cruise ships: 0,56
- Cruise ship of a local company (minimum 12 calls per year): 0,50

Moreover, this charge has a bonus for those vessels that do more than 12 calls per year. This bonus is applied after the product between the basic rate and the variable factor (before entering the whole formula) as follows:

From (calls)	To (calls)	Maritime service bonus	Regular maritime service bonus
1	12	1,00	0,95
13	26	0,95	0,90
27	52	0,85	0,80
53	104	0,75	0,70
105	156	0,65	0,60
157	312	0,55	0,50
313	365	0,45	0,40
366	-	0,35	0,30

Table 26: Bonus applied in case of more than 12 calls per year – Source: Port of Barcelona

4.2.3. Passenger tax for passenger ships (Barcelona)

This charge is for passenger that makes a movement in port. We understand as movement a boarding, disembarking or only transit. In other words, all the passengers of a passenger ship that goes in/out of the vessel, or simply goes to visit the city in transit mode, have to pay this charge. It is payed by the vessel, but the company of the vessel includes these costs in the total amount that they charge to the clients as a transport ticket or holidays in case of cruise ships. So, depending on the movement that the passengers do, the tax price will be different. Each variable of movement is written on the following points, where there are the factors that have to be multiplied in the formula. The final formula would be: 3,23 (basic rate) * factor * nº of passengers.

- Passenger in transport mode boarding or disembarking in traffics between Shengen countries: 0,75
- Passenger in transport mode boarding or disembarking in traffics between no Shengen countries: 1
- Passenger of cruise ship in the start or final port of the holidays: 1,2
- Passenger of cruise ship in transit: 0,75
- Motorcycles or 2 wheels vehicles in passenger regime: 1,3
- Cars with or without towing with a total length lower than 5 m: 2,9
- Cars with or without towing with a total length higher than 5 m: 5,8
- Coach or any other collective transport: 15,6

Apart from this factor, those maritime services that are regulars, will have a bonus or reduction tax, multiplying the total amount by 0,8.

4.2.4. Reception and treatment service of waste generated by ships (Barcelona)

This charge is only applied in Barcelona. Sydney includes it in another charge. All ships calling in Barcelona must pay this tax, no matter if the ship uses this service or not. This charge is calculated as follows:

L7 = (R1 * TB) + (R2 * passengers on board)[1]

R1: basic rate. For passenger ships (ferries, Ro-Pax and cruise) is 75. For the rest of vessels is 80.

TB: resulting of the formulas of this table.

Ship's GT	Formula
Between 0-2.500 GT	1,5
Between 2.501 and 25.000 GT	6 * 0,0001 * GT
Between 25.001 and 100.000 GT	(1,2 * 0,0001 * GT) + 12
More than 100.000 GT	24

Table 27: Formulas depending on vessel's GT – Source: Port of Barcelona

[1] Only for passenger vessels: (R2 = 0,25)

0,25 * passengers on board

If the service is done on the sea (instead of berth) the fee will have a surcharge of 25%.

There are some exemptions such us war ships, port authority boats that are working in port, fishing vessels, recreational boats with a maximum of 12 passengers on board, or vessels under construction. All this cases are exempts of this charge.

4.2.5. Mooring service (Barcelona)

This charge is simple. The amount that vessels has to pay, is written in the following table:

Gross Tonnage	Charge (€)
Up to 7.000	92,02
7.001 – 120.000	0,013147 * GT
More than 120.000	1.577,61

Table 28: Mooring service charge depending on vessel's GT – Source: Port of Barcelona

Every movement that vessel do, must pay the amount above. It is for mooring and unmooring, so it is counted as 2 movements. For the mooring or unmooring operations in inflammable docks, there will be a surcharge of 80%.

4.2.6. Tug service (Barcelona)

The tug service charge is similar as the other ones. The total amount is counted with a formula, depending on the GT of the vessel. The charge is for tug and manoeuvre. So, if in one manoeuvre is used more than one tug, the final charge will be the sum of the two tugs.

There are more rates in case the tug is for other uses. For example, fire fighting, tug in case of emergency, water supply for intervention teams, maritime rescue operations, etc. But we will focus only in the tug charge of manoeuvres, which is exactly what we are looking for.

If the gross tonnage of the vessel is lower than 70.000, the charge is: 0,0665 * GT + 302,94 per tug.

If the gross tonnage of the vessel is higher than 70.000, the charge is: 4.957,94 € per tug.

There is also a variable rate in case the vessel is carrying Liquid Natural Gas (LNG) in special docks:

T = 0,5330 * GT in case GT < 100.000

T = 53.302,5 € in case GT is between 100.000 and 130.000

T= 63.963 € in case GT > 130.000

4.2.7. Pilotage service charge (Barcelona)

The pilotage service in port of Barcelona is mandatory for all vessels, except for:

- Vessels with less than 500 GT.
- Movements that doesn't need to unmoor and the use of any tug.
- Those vessels that have the certificate of pilotage exemption.

As the majority of the charges we have seen, this one is fixed also with the gross tonnage of the vessels in question.

If GT is lower or equal to 7.000: T = 227,97 €

If GT is between 7.000 and 25.000: T = (0,0157943 * GT) + 117,41

If GT is between 25.000 and 100.000: T = (0,013960 * GT) + 163,267

If GT is higher than 100.000: T = 1.559, 267 €

Like the tug service charge, in this case there is also a particular rate for Liquid Natural Gas vessels berthing in special docks:

If GT is lower or equal to 7.000: T = 455,9 €

If GT is between 7.000 and 25.000: T = (0,031586 * GT) + 234,79

If GT is between 25.000 and 100.000: T = (0,027918 * GT) + 326,49

If GT is higher than 100.000: T = 3.118,29 €

Those rates above (normal vessels and LNG) are for arrivals or departures manoeuvres. In case of a movement inside the port (for example, a change of berth), the charge will be: 1,25 * T.

In case that the movement is for going to the dry dock, there will be a surcharge of the 80% of the rate.

In case that the movement is with the vessel not under command, the surcharge will be of the 100% plus other charges that may be.

4.2.8. Navigational service charge (Sydney)

This charge (applied in Sydney Harbour and Botany Bay) is used to ensure safe navigation of vessels through the two ports and for the provision of various services such as: Navigation aids, emergency response and port operations, among others. So, as I said before, this charge in Sydney includes the navigational aids charge, tug service charge and mooring service charge of Barcelona. It is applied every

port entry, with no discount or bonus for a lot of port entries during a year. So the total amount that gives the next table is for every port entry.

This table shows that different rates are applied depending on the type of vessel. Moreover, there is an environmental service charge, which is applied to those vessels transporting noxious substances in liquid, gas or oil form.

There are 3 rates for each type of vessel: GST exclusive, GST and GST inclusive. GST is a state fee (like IVA in Spain) that must be paid. In the table there are the 3 amounts. The rate fixed by the PANSW, the GST and the total amount with the sum between GST and the rate. It is shown like this because allows people see what is the real price fixed by the PANSW, but for doing the calculations, it's better to take the GST inclusive rate, because in the end, is the price that vessels will have to pay. This rate has to be multiplied by the vessel's GT to have the total charge amount.

Rate per GT, per port entry			
Navigational type charge	**GST exclusive**	**GST**	**GST inclusive**
Standard navigation	$0,5635	$0,0564	0,6199
Bulk liquids & gas vessels	$0,6247	$0,0625	0,6872
Passenger vessels	$0,3801	$0,0380	0,4181
Environmental services charge	$0,2170	$0,0217	0,2387

Table 29: Navigational service rate per GT per port entry – Source: PANSW

4.2.9. Site occupation (Sydney)

The site occupation charge (applied only in Sydney Harbour) has two variants, for passenger vessels and for non-passenger vessels. The first one includes the vessel tax and passenger tax of Barcelona, and the second is only like the vessel tax.

Passenger vessels

This charge is levied in reference to both the number of incoming passengers arriving on the cruise vessel at any of the dedicated or non-dedicated passenger berths, and the amount of time for which the site was reserved or occupied by such vessel. The calculation of this charge is done in two different ways. In the passenger berths (OPT, White Bay Central Terminal and White Bay 4) the calculation is: rate

per passenger per slot. In the case of non-passenger berths (Glebe Island 1, 2, 7 & 8 and White Bay 3) the calculation is done by hourly rate, not per passenger.

In other words, in the first one, the charge depends on the number of incoming passengers, and in the second depends on the time that vessel is at berth. Due to the lack of terminal infrastructure in the non-passenger berths, the charge is much cheaper than the OPT, for example. So, the calculations explained, are done with the rates following in the next tables:

Rate per passenger, per slot			
Site occupancy type charge	**GST exclusive**	**GST**	**GST inclusive**
At dedicated passenger berths (OPT, WBCT)	$35,00	$3,50	$38,50
At non-dedicated passenger berths (WB4)	$17,50	$1,75	$19,25

Table 30: Site occupation rate for passenger berths – Source: PANSW

Hourly rate			
Site occupancy type charge	**GST exclusive**	**GST**	**GST inclusive**
At non-passenger berths (Glebe Island 1, 2, 7 & 8; White Bay 3)	$126,02	$12,60	$138,62
Lay-Up	$37,80	$3,78	$41,58

Table 31: Site occupation rate for non-passenger berths – Source: PANSW

A Lay-Up rate only applies in unforeseen circumstances where a vessel needs to undergo emergency maintenance or cannot otherwise carry out normal cargo transfer operations due to an unexpected event.

The site occupation charge for passenger vessels is also based on a minimum of 1.200 passengers per cruise vessel, except for the vessels with a stated passenger capacity of less than 200 passengers.

Moreover, passenger vessels also incur miscellaneous charges, as per appropriate usage, as follows:

Miscellaneous charges	GST exclusive	GST	GST inclusive
Cleaning (OPT)	$560,68	$56,07	$616,75
Furniture hire (Standard)	$1.345,62	$134,56	$1.480,18
Furniture hire (Non-Standard)	$1.682,03	$168,20	$1.850,23
Hose handling fee	$560,68	$56,07	$616,75
Gangway hire - additional hours (hourly rate)	$156,99	$15,70	$172,69
Berthing facility insurance	$336,41	$33,64	$370,05

Table 32: Miscellaneous charges for passenger vessels – Source: PANSW

Non-Passenger Vessels

This fee levied for the use of Sydney's Harbour common user, lease and passenger berths. The fee applies to vessels occupying all or part of a berth, discharging/debarking and loading/embarking cargoes, or for any other planned and approved activity at the berth. The calculation is simple. Hourly rate per hours at berth, as follows:

Rate per hour			
Site occupancy type charge	**GST exclusive**	**GST**	**GST inclusive**
Glebe Island 1, 2, 7 & 8	$126,02	$12,60	$138,62
White Bay 3 & 4	$126,02	$12,60	$138,62
Dedicated passenger berths (OPT, WBCT)	$126,02	$12,60	$138,62
Lay-Up	$37,80	$3,78	$41,58

Table 33: Site occupation rate for non-passenger vessels – Source: PANSW

4.2.10. Pilotage Service Charge (Sydney)

The pilotage charge is levied for all piloted movements, both in and out of Sydney Harbour and Botany Bay. It is mandatory for all commercial vessels, unless those who have on possession the pilotage exemption certificate.

The pilotage charge is calculated in a similar way as the other ones. There is a rate per vessels gross tonnage, plus a boarding fee, which is fix.

There are two separate charges, depending on the type of vessel. Non-passenger vessels or passenger vessels.

The boarding fee for non-passenger vessel, no matter the GT's of the vessel, will be always: $1.088,80 (GST exclusive) + 108,88 (GST) = 1.197,68 (GST inclusive).

Non-passenger vessels			
Variable GT charge	**GST exclusive**	**GST**	**GST inclusive**
Pilotage in/out – Tier I (1 to 4.000 GT)	$0,00	$0,00	$0,00
Pilotage in/out – Tier II (4.001 to 30.000 GT)	$0,1281	$0,0128	$0,1409
Pilotage in/out – Tier III (30.001 to 55.000 GT)	$0,0218	$0,0022	$0,0240
Pilotage in/out – Tier IV (>55.000 GT)	$0,0072	$0,0007	$0,0079

Table 34: Pilotage service rate for non-passenger vessels – Source: PANSW

The boarding fee for passenger vessels, no matter the GT's of the vessel, will be always: $1.528,93 (GST exclusive) + 152,89 (GST) = 1.681,82 (GST inclusive).

Passenger vessels			
Variable GT charge	**GST exclusive**	**GST**	**GST inclusive**
Pilotage in/out – Tier I (1 to 4.000 GT)	$0,00	$0,00	$0,00
Pilotage in/out – Tier II (4.001 to 30.000 GT)	$0,1200	$0,0120	$0,1320
Pilotage in/out – Tier III (30.001 to 55.000 GT)	$0,0205	$0,0021	$0,0226
Pilotage in/out – Tier IV (>55.000 GT)	$0,0068	$0,0007	$0,0075

Table 35: Pilotage service rate for passenger vessels – Source: PANSW

What is a little different than the other charges is the price methodology. For example, if a passenger vessel has 15.000 GT, it's not as easy as multiply the 15.000 per rate in the table plus the boarding fee. It is necessary to divide it by tiers. In this case, it would be:

The first 4.000 (following the table above) are free.

15.000 – 4.000 = 11.000 → 11.000 * 0,1320 (rate per GT in tier II) = 1.452 $

1.452 + 1.681,82 (boarding fee) = 3.133,82 $

Apart from the basic pilotage charge, there are other miscellaneous charges that can be applied in pilotage charge. I am talking about movements that vessel may do inside port, like anchorage, harbour removal, deferral inward or other miscellaneous charges. The prices are in the next tables:

Anchorage	GST exclusive	GST	GST inclusive
Anchorage in/out – Tier I (1 to 7.990 GT)	$0,00	$0,00	$0,00
Anchorage in/out – Tier II (7.991 to 29.223 GT)	$0,0641	$0,0064	$0,0705
Anchorage in/out – MAX charge (>29.223 GT)	$1.361,04	$136,10	$1.497,14

Table 36: Anchorage rate depending on vessel's GT – Source: PANSW

Harbour removal	GST exclusive	GST	GST inclusive
Harbour removal – Tier I (1 to 7.990 GT)	$0,00	$0,00	$0,00
Harbour removal – Tier II (7.991 to 29.223 GT)	$0,0641	$0,0064	$0,0705
Harbour removal – MAX charge (>29.223 GT)	$1.361,04	$136,10	$1.497,14

Table 37: Harbour removal charge depending on vessel's GT – Source: PANSW

Deferral Inward	GST exclusive	GST	GST inclusive
Deferral In – Tier I MIN charge (1 to 15.981 GT)	$509,79	$50,98	$560,77
Deferral In – Tier II (15.982 to 29.223 GT)	$0,0319	$0,0032	$0,0351
Deferral In – MAX charge (>29,223 GT)	$932,21	$93,22	$1.025,43

Table 38: Deferral inward charge depending on vessel's GT – Source: PANSW

Other Miscellaneous	GST exclusive	GST	GST inclusive
Deferral outward (Flat Rate)	$212,14	$21,21	$233,35
Assisting Pilot on board (Hourly Rate)	$139,00	$13,90	$152,90
Master audit in/out (per movement)	$1.463,10	$146,31	$1.609,41
Pilot stays on board (al Master's/Port Authority Request – Hourly Rate)	$139,00	$13,90	$152,90

Table 39: Other miscellaneous charges – Source: PANSW

4.2.11. Example of charges applied in a same vessel at Sydney and Barcelona

In this chapter there will be a charge comparison with real numbers of Barcelona and Sydney. In other words, we will see the total amount that one vessel would have to pay if she visited the ports of Sydney and Barcelona. This will give us a good view on how equivalents are the charges of these ports, or if they are decompensated.

For doing this example, I will use one passenger vessel that, as I explained during the project, I was lucky to visit while she was at Overseas Passenger Terminal in Sydney. The cruise ship in question is Carnival Legend and here there is some important information about the vessel.

Length Over All → 293 m

Beam → 40 m

Built in 2002

Gross Tonnage → 88.500 GT

Flag → Malta

Passenger capacity → 2124

Figure 47: Aft of Carnival Legend – Own source

Figure 48: Bow of Carnival Legend – Own source

Before starting with the calculations of the charges, it's important to mention the conditions of the entry of the vessel to be able to choose the correct factors later. If it is not specified, it means is the same in both ports. It is important to do the comparison with the same variables, if not, it would be useless.

The Carnival legend will stay 10 hours at berth (from 8 am to 6 pm). In Sydney it will be at the OPT and in Barcelona, in the cruise terminal (Berth not granted in concession or authorization). Both will be alongside berth. It is a long distance maritime service and is the first call of the year.

The cruise ship is full, with 2124 passenger on board. Sydney and Barcelona is the start and final point of the trip. As Carnival Legend has a good engine system, it is not necessary the use of tug boats.

In the OPT, the Carnival Legend will incur the next miscellaneous charges: cleaning, standard furniture hire, hose handling fee and berthing facility insurance.

First, I will do the calculation of the charges of Barcelona, and then in Sydney. Finally, I will compare the final results.

Charges of Barcelona

Navigational aids tax: 0,02 * 88.500 = 1.770 €

TOTAL: 1.770 €

Vessel tax: 1,43 * 1 * 88.500/100 * 10 = 12.655,5 €

Basic rate: 1,43 (long distance maritime service)

Variable factor: 1,00 (alongside berth in a berth not granted in concession or authorization)

TOTAL: 12.655,5 €

Passenger tax: 3,23 * 1,2 * 2124 = 8.232,62 €

Basic rate: 3,23

Factor: 1,2 (Passenger in the start or final port of the holidays)

TOTAL = 8.232,62 €

Reception and treatment service of waste generated by ships: (75 * 22,62) + (0,25 * 2124) = 2.227,5 €

Basic rate (R1): 75

TB: (1,2 * 0,0001 * 88.500) + 12 = 22,62

R2: 0,25

TOTAL = 2.227,5 €

Mooring service: 0,013147 * 88.500 = 1.163,51 €

There are two movements of mooring (arrival and departure): 1.163,51 * 2 = 2.327,02 €

TOTAL = 2.327,02 €

Pilotage service charge: (0,01396 * 88500) + 326,49 = 1.561,95 €

Two movements of pilotage (arrival and departure): 1.561,95 * 2 = 3.123,9 €

TOTAL = 3.123,9 €

Charges of Sydney

Navigational service charge: 0,4181 * 88500 = 37.001,81 $

TOTAL = 37.001,81 $

Site occupation: 38,50 * 2124 = 81.774 $

Miscellaneous charges of cleaning, standard furniture hire, hose handling fee and berthing facility insurance: 616,75 + 1.480,18 + 616,75 + 370,05 = 3.080,73 $

81.774 + 3.080,73 = 84.857,73 $

TOTAL = 84.857,73 $

Pilotage service charge: 1.681,82 + 3.432 + 565 + 251,25 = 5.930,07 $

Boarding fee: 1.681,82 $

First 4.000 GT: 0 $

(30.000 – 4.000) * 0,1320 = 3.432

(55.000 – 30.000) * 0,0226 = 565

(88.500 – 55.000) * 0,0075 = 251,25

There are two movements of pilotage (arrival and departure) = 5.930,07 * 2 = 11.860,14 $

TOTAL = 11.860,14 $

All this dollars are Australian dollars, so the conversion with Euros is: 1 AUD = 0,6266

<table>
<tr><th colspan="2">Barcelona</th><th colspan="2">Sydney</th></tr>
<tr><td>Navigational aid tax</td><td>1.770 €</td><td rowspan="3">Navigational service</td><td rowspan="3">37.001,81 $</td></tr>
<tr><td>Mooring service</td><td>2.327,02 €</td></tr>
<tr><td>Reception and treatment service of waste generated by ships</td><td>2.227,5 €</td></tr>
</table>

Vessel tax	12.655,5 €	**Site occupation**	84.857,73 $
Passenger tax	8.232,62 €		
Pilotage service	3.123,9 €	**Pilotage service**	11.860,14 $
TOTAL	30.336,54 €	**TOTAL**	133.719,68 $
			83.788,75 €

Table 40: Comparison example of charges between Barcelona and Sydney – Own source

As we can see in the table above, there is a huge price difference between the charges in Barcelona and Sydney. It's obvious that each Port Authority decide the prices of the charges, so there is no need to be similar prices, apart from that this two cities are in the opposite parts of the world, so they don't share anything. Clients, shipping business, etc. they don't have competence between them.

However, I think there are a few facts that may influence in this cost difference. First of all, the life in this two countries are quite different. Living in Sydney (Australia) is more expensive that living in Barcelona. Salaries are higher and daily life is more expensive there. So it's normal that in Sydney the charges are higher. Moreover, there is another fact, which I think is the most important: the competence. Barcelona (as I said before) is in a strategic point of the Mediterranean, where a lot of vessels need to call some port before going to Gibraltar strait. But Barcelona is not the unique port in the surroundings. There are plenty of them, some bigger than Barcelona. Marsella, Algeciras, Valencia, Palma, etc. The big vessels have a lot of ports to choose, so the competence is high. These ports need to do a business plan that catches the attention of vessels. And one of these things are the charges. The port with lower charges will be probably the one who has more vessel visits. Meanwhile, Sydney is in a different situation. Apart from that is the biggest city in Australia, there is no big cruise ports in the surroundings. Vessels who want to go to Sydney, don't have any alternative if they don't want to sail long distances. The Port Authority of New South Wales knows that and takes advantage of this situation. Doesn't matter the price they put, if the vessel wants to call Sydney, she must pay the charge.

Finally, I think the situation of the cruise terminal also makes the difference. This is only for cruise ships, but it's logical that the OPT (just in the heart of Sydney city) must be more expensive than the cruise terminal of Barcelona. That's why site occupation charge of Sydney is so expensive. They know it is an attraction for tourist, and they rise the price charge, which is much more expensive than Barcelona's one.

Conclusions

Running a business such a Sydney Port and suburbs is not an easy job. That's why the Port Authority of New South Wales (the company in charge of running it) needs a huge organization through its departments to cover efficiently all the needs of the business.

Having the visits of the bigger ships in the world (cruise and trade ships) makes the PANSW rise to the challenge and offer a competent treatment to them. During the project we have seen that the PANSW have plenty of this good treatment. The professionalism of its departments and human team makes it a referent in the world.

An example of this is shown in chapter 3 during my diary of the working experience. They received a foreign student (in this case it was me) and introduced him to their teams as if he was a new member of the company. They work always with professionalism, doesn't matter if they have to show the business to a foreign student or they have to fight against a real emergency. This is what makes them a unique team. They are always ready for any situation.

The economic impact of the ships calling in Sydney deserves a special mention. It is obvious that the visit of ships in a city produces an economic impact. But what is not so obvious is the magnitude that it has in Sydney and Australia. Sydney is in the middle of a bay, and like the majority of sea cities, it lives for the sea. There is a big sea culture that makes people love all things related on it. All connections they receive from the foreign countries (apart from air connections) are through the sea, so they need brand new infrastructures and good treatment to all the ship visits. For making this real, a huge human team is required, so a lot of jobs are offered in this sector to achieve a competent business. Apart from that, the big passenger ships traffic that the city receives, makes the tourist consume in the city, which contribute to the local economy. Sydney without the maritime economic impact wouldn't be the same.

Since the last years, the PANSW have tried to improve thing to make even bigger the business. These things are for example the new booking system or the double stacking system, which I think is a great idea to offer more slots in the Overseas Passenger Terminal. More slots means more vessels, more

people and more economic impact. In a city that can't grow on cruise terminals, it is crucial to optimize those that it has. And the OPT is a clear example. For situation, berth and facilities is a great terminal and it's a pity that there are hours without cruise ships. With the double stacking system, this would be different.

In case of Barcelona, this problem doesn't exist. That's why it is important to do a comparison, to see the differences between two ports and how they solve their problems. We have seen that Barcelona has the privilege to have a big cruise terminal that can host more than 3 cruise ships at the same time, instead of Sydney, where there is only the OPT and White Bay Terminal (limited by Harbour Bridge). The two ports try to optimize their facilities in the best way they can. For example, Sydney establish the double stacking to receive more visits of cruise ships while Barcelona (where the problem is the competitiveness between Mediterranean ports, not the slots) reduce the price charges to catch the attention of cruise lines. These are two different ways two run the business, but the goals are the same. Saving the differences of traffic (for reasons mentioned in the last chapter) is undeniable that these cities are two referents in the world in terms of cruise ships.

As a personal view, I can conclude that this project has been very useful for me. I have learned a lot, not only about maritime aspects, but also in terms of doing a project. Collect information first and develop it later, it is a job that needs time and dedication, and that's just what I have tried to do. Moreover, writing it in a non mother tongue (English) has supposed me an extra effort, but I'm sure it has been very useful for me, to improve with this language. The experience I lived in Sydney made me grow in a lot of aspects, and being able to do the thesis of my degree about it, is a privilege of which I will always be grateful.

References

[1] Port Authority of New South Wales. *Quality Management Manual.* Sydney, 15 July 2016.

[2] Port Authority of New South Wales. https://www.portauthoritynsw.com.au Consulted during the entire thesis.

[3] Port Authority of New South Wales. *Newcastle & Yamba.* Sydney, 21 March 2017.

[4] Port Authority of New South Wales. *Kembla & Eden.* Sydney, 21 March 2017.

[5] Port Authority of New South Wales. *Annual Report (2015/2016).* Sydney.

[6] Port Authority of New South Wales. *Pilotage safety management system (Sydney Harbour and Botany Bay).* Sydney, 31 October 2014.

[7] Port Authority of New South Wales. *Sydney.* Sydney, 21 March 2017.

[8] Port Authority of New South Wales. *Cruise into Sydney and New South Wales.*

[9] Holliday, Phil and Mckenna, John (Port Authority of New South Wales). *Cruise, our story of success.*

[10] Cruise Lines International Association. *Cruise industry outlook.* December 2016.

[11] Cruise Lines International Association (Australasia). *Cruise tourism's contribution to the Australian economy (2015/2016).*

[12] Port Authority of New South Wales. *New booking system for cruise terminals.* Sydney, 1 July 2017.

[13] Port Authority of New South Wales. *Harbour Master's Directions (Sydney Harbour and Botany Bay).* Sydney, July 2016.

[14] Port of Barcelona. http://www.portdebarcelona.cat Consulted on 16 March 2018.

[15] Port of Barcelona (statistics). http://www.portdebarcelona.cat/ca/web/autoritat-portuaria/estadisticas Consulted on 20 March 2018.

[16] Port of Barcelona (charges). http://www.portdebarcelona.cat/ca/web/Port-dels-Negocis/taxes1 Consulted on 23 March 2018.

[17] Port Authority of New South Wales. *Schedule of Port Charges.* Sydney, 1 July 2017.