Intuitive operation and pilot training when using marine azimuthing control devices

AZIPILOT

Report Title:

Deliverable 3.8:

Integrate knowledge through Advisory Committee

Contents

INTRODUCTION

This report is aimed to summarize all the meetings and workshop had with experts in the course of the AZIPILOT project.
The contents of this report will include both official workshop called by partner consortium and informal interviews and meetings had for the purpose of collecting relevant information and data for specific activities of the project.
Full text of interviews carried out in the course of the project are contained in the Appendixes.

FORCE INTERVIEW TO ACD CAPTAIN

In April 2009, FORCE partner performed an interview with an experiences instructor and Captain on ASD tugs concerning both operational and training aspects related with such manoeuvring equipments.
The full text of the interview is enclosed to this report in Appendix 1.

INTERVENTION OF ITALIAN PILOTS ASSOCIATION

In the course of the first WP4 meeting held in Rome in July 2009, there was the first intervention of an external expert with the scope to give advice and information to project partners in regards of the ACDs.
The meeting was on a WP basis, and it was addressed to orientate the activities of WP4. In particular there was discussed the issue of operational practice with ACD which need to be reviewed and analyzed in the course of task 4.2.
The vice-director of the Italian Pilots Association, who attended the meeting, gave his valuable and expert comments, also under the hat of ex-Captain onboard ships equipped with such devices.

INTERVIEW TO MASTERS OF SHIPS EQUIPPED WITH ACD DEVICES

In the course of the first part of the project, a series of interviews with experienced Masters of ships equipped with ACD devices were conducted by UKMPA, for the scopes of activities included into WP4. Inputs from such interviews were used as a basis for the contents of deliverable produced in Task 4.2.
The Masters interviewed worked onboard the following ships:

- Independence of the Seas;
- Queen Victoria;
- Norwegian Jade.

The full texts of the interviews are included in Appendix 2.

INDEPENDENCE OF THE SEAS

Partners of AZIPILOT project agreed to organize their M21 meeting onboard the "Independence of the Seas", a cruise ship sailing between Southampton and Cork. The meeting was held in August 2010.
The great relevance of such meeting is due to the possibility given in the course of the cruise to visit the main environment of the ship (bridge, control room, engine room) and to observe officers performing their duties and in particular manoeuvring with ACDs.

In particular the workshop had with the Captain and other officers of the cruise ship was a very interesting event, as it was the opportunity to have a direct feedback from people using equipments addressed by the AZIPILOT project in day-by-day operations, expressing their agreement or concerns about such systems. This interview was further used to clarify some open questions raised by the project and as a basis for forthcoming activities to be performed.
The interview was filmed by one of the partners and further used for reporting purposes and also as a basis for the discussion to be raised in the course of the workshop in Rotterdam. The full transcript of the interview is included into the Appendix 3

In the course of the cruise, partners also had the opportunity to visit the simulator used by Pilots in Cork.

ROTTERDAM WORKSHOP

At M27 of the AZIPILOT project a conference/workshop involving experts in azimuthing control devices (ACDs) was held in Rotterdam.
The workshop has been arranged in order to fulfil the obligation stated in the Description of Work of the ARIADNA project, and in particular for the scopes of task 3.8 "Integrate knowledge through Advisory Committee".
The workshop was aimed to disseminate to the audience the achievements and progresses made in the course of the AZIPILOT project and to eventually orientate the remaining activities through observations and considerations made by experts in the field of ACDs.

WORKSHOP ARRANGEMENTS

During the M24 project meeting in Duisburg, at DST premises, partners agreed to held the workshop at M27.

Location and date

It was agreed to hold the workshop at the STC conference room in Rotterdam, in the STC-Group building on February 24th, 2011.

Invitation phase

Invitations for the workshop were sent via e-mail to potential attendees and the message included the following:

- Invitation letter by the coordinator of the project;
- Invitation flyer containing all information about the organization of the workshop.

These documents are included in the Annex to this deliverable.

Potential attendees were chosen among partners networks and contacts collected during the development of a previous task, related to all fields (ACD and simulator manufacturers, simulator facilities, training facilities, shipping companies and pilot organizations) having some relevance with the ACDs.

Agenda of the workshop

In this paragraph the agenda of the conference/workshop is reported.

As you can see from the agenda below, the workshop was divided into two sessions:

- Morning session: the coordinator and representatives from all WP of the project present the main information and results achieved in the course of the project.

- Afternoon workshop: it will stimulate debate amongst all stakeholders concerned with ACD design, operation, training and use, facilitated by the project partners, and including panel contributions from some of the most respected and knowledgeable actors in those fields.

09:30 - 10:00 Registration and Coffee
10:00 - 10:20 Opening conference and introduction of AZIPILOT Project
(Michael Woodward - UNEW)
10:20 - 10:40 WP1 Hydrodynamic modelling
(Erland Wilske - SSPA)
10:40 - 11:00 WP2 Marine simulation
(Marielle Labrosse - METTLE)
11:00 - 11:20 Coffee Break
11:20 - 11:40 WP3 Maritime Training
(Jakob Pinkster - STC)
11:40 - 12:00 WP4 Operational Practice
(Gareth Rees - UKMPA)
12:00 - 12:10 Summary AZIPILOT Project to date and introduction to afternoon AZIPILOT Workshop
(Michael Woodward - UNEW)
12:10 - 13:00 Lunch
13:00 - 14:20 AZIPILOT Workshop (part I)
Forum (4-6 pers.)
14:20 - 14:40 Tea break
14:40 - 16:00 AZIPILOT Workshop (part II)
Forum (4-6 pers.)
16:00 - 16:20 Conclusions & Recommendations AZIPILOT Workshop. Possible next steps
16:20 - 17:30 Drinks

The original structure was slightly modified during the conference, in particular for the afternoon session, according to the group of attendees and to the items to be focused on.

Participants

Participants to the workshop can be divided into two groups:

- Project partners;
- External attendees.

External attendees included the following:

- 28 experienced people coming from the following companies:
  - BCL Maritime Aps.
  - Hamburg Port Services Gmbh
  - Harwich Haven Authority
  - Port of Cork
  - Australian Marine Pilot Institute
  - Gdynia Maritime School
  - FLP
  - Nautical consultant
  - Dutch Pilot Association
  - Damien Shipyard Gorinchem
  - Forth Pilot
  - Dutch Pilot Association
  - Kiel canal Pilot Association
  - University of Applied Sciences in Warnemünde (Germany)
  - EMPA (European Maritime Pilot Association)

  - Hogeschool Inholland Delft
  - Dublin Port Company
- 22 students from the Newcastle University.

Morning session

Morning session opened with the welcome to all attendees by Jakob Pinkster, who hosted the event on behalf of STC-Group. He briefly gave some information about STC-Group and about organizational aspects (coffee-breaks, lunch, visits) of the conference.

After this short introduction, the morning session officially started. As previously said, this part of the event was dedicated to the presentation of the AZIPILOT project and to the description of studies conducted and of main achievements.

The group of presentations started with the coordinator of the project, Michael Woodward, who presented in detail the aims and objectives of the project, its structure, the partner composition and competences.

Erland Wilske (SSPA), representing WP1, describes the main activities and findings concerning "Hydrodynamic modelling" in the course of the project.

For WP2 "Marine Simulation", Marielle Labrosse (Mettle) showed a presentation summarizing the achievements collected so far.

Jakob Pinkster (STC) gave detailed information in the field of "Maritime Training" (WP3), as collected in the course of the activities performed within this WP.

Last but not least, the WP4 Leader, Gareth Reese (UKMPA) discussed about the outcomes concerning "Operational practice" as come out from the work performed, highlighting feelings and considerations from users of ACD devices.

Visits to STC's simulation facilities

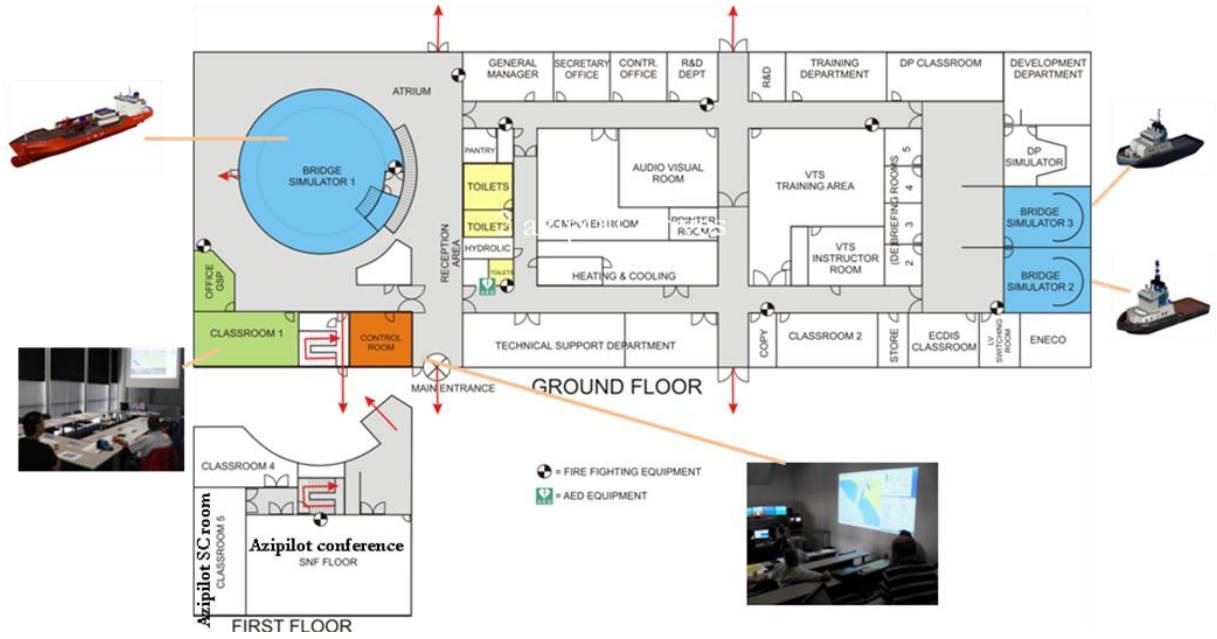
At the end of the first part of the conference, attendees enjoyed a lunch time together, discussing further about the aspects recalled in presentations.
It was the chance to visit, with the expert guide of STC instructors, the STC's simulation facilities. Audience was divided in small groups of 10-15 people and they were introduced in rooms for the simulation and in the control room where all parameters (type of ship, location, visibility, density of traffic, etc.) are set to run the simulation.
The tour included visit to the following Full Mission Bridges (FMB):

- Full mission bridge 1 (with LNG tanker/2 azipull drives);
- Full mission bridge 2 (with ASD tug boat/2 azipush drives).

At both full mission bridges it was possible for a number of Azipilot conference delegates to sail the LNG tanker and/or the ASD tug boat and thus experience the handling of an ACD device for themselves.

A number of experienced ACD pilots did so and found the models to be very good.

Following the map of the location with the identification of the simulation rooms is reported:



Afternoon session

At the end of the lunch break and once all attendees completed the tour at STC simulators, the workshop session officially started. In this phase, the intervention from the present experts was strongly required to discuss further on some of the "hot topics" detected in the course of the project.

The session was chaired by Nigel Allen, representative of the project partner UKMPA and Pilot in Southampton. He was supported by nominated experts as follow:

- Aidan Fleming: Dublin Port Company;
- Paul O'Reagan: Port of Cork;
- Leif Carlsson: Capt. in Bröstrom and also partner of the AZIPILOT project;
- Thomas Lindner: Hamburg Port Services.

The session started with the presentation of the video of an interview to Capt. Arnolf Remo made by Gareth Reese and Nigel Allen. In about 7 minutes, the Captain briefly gives description of ACD instruments and their functions, describes what he use and how for certain types of manoeuvres. In particular he highlights the situation of entrance into port with the presence of wind: in the interview he explains how he copes with the wind effect by properly using pods.

Nigel Allen presented then some slides where the most interesting and disputed typical themes concerning ACDs:

- Terminology used (usually very different according to the Company);
- Power reduction;
- Pod rotation speed;
- DP – Dynamic Positioning;
- Pod RPM blanking at various angles;
- Pod seal and bearing problems.

Nigel's presentation also contained a list of questions to be commented and discussed by experts.

1. *"How do we train Ship Masters? And pilots?"*

To support this question another video contribution is showed. Now a snatch of an interview to the Master of Independence of the Sea, Theo ?, during the AZIPILOT M21 meeting onboard the cruise ship, was projected.

In this video the Master strongly supports training and declares how important is to go onboard a ship, of whatever type and class, after having received appropriate and specialist training. In particular this results to be even more important for Masters/deck officers when they move from a conventionally powered ship (propeller + rudder) to a podded ship. He makes a similitude with cars: it is easier to move from a conventional ship to a podded ship than vice versa, as it is simpler to move from an old car to a new, more technological car. In addition the training needed to properly use ACDs is compared to the training necessary to drive a car in a right and expert way: at the beginning you need of a certain amount of time to adjust your seat, rear-view, etc. and you often watch at the commands while you are using them. This is to gradually acquire experience and familiarity with all instruments available. The same goes for a ship: Master/deck officer/pilot should be able to perform manoeuvres with a good command of all tools.
In order to acquire this level of skill, the interviewed Master estimates that a full week of training and practice with simulators is essential to get used to the controls, so that people can operate handles without having to keep looking down.

2. *"How can we get the industry to standardize terminology for all ACD vessels?"*

Slides presented by Nigel during the workshop clearly presented great differences from one Company to another concerning terminology used to indicate commands or manoeuvring modes. These terminologies are often source of confusion and misunderstandings. In particular when commands are passed from the central bridge to the bridge wings or vice versa.
How to explain in a safe way to another what to do in a particular situation? Attendees recognize that the most important thing is to well understand the current situation and to be confident with the right manoeuvres to make. Then, you should be able to explain what to do.
Another aspect to consider is that there is more than one way of achieving the same result when you are manoeuvring a podded ship, so there could be great difficulties for the standardization of commands.
At the moment there is not a common language used universally: often there is a language that is specific to a port. The problem is that, while pilots in a same port could understand each other due to a common terminology, ship Masters move to one port to another and so it could be hard for them to understand.
Maybe a suggestion to overcome these troubles could be to standardize the terminology at the training centres level.

3. *"Do we need controls with feedback, if we attempt something (operationally) undesirable?"*

One possible option is to transmit a vibration to the operator, through the handles, when the system recognizes that it's doing something potentially dangerous. This solution is not seen as adequate for experts as the vibration is felt only by the operator and not by the entire bridge team. In case an alert would be present, it should be visual and available to all the bridge team.
It should be well integrated to other alarms present on the bridge, without incurring in the situation of just adding another one, consequently increasing the possibility of distraction.
Some of the experts present guess that the presence of an alarm is unnecessary if the operator is well trained, as in this case he is able to feel intuitively what is going on, having a great command on the equipments.

4. *"Are verbal commands for pods (especially multi-pods) just too complicated?"*

Experts agree in considering that an appropriate practical training can allow a simplification of manoeuvres and therefore of needed commands for them. Above all the good knowledge of those commands is recognized to be essential.

5. *"Do ACD vessels require specialist certificated training, as for DP?"*

Pilots so need some form of training just as he/she would need for a conventional vessel but it need not to be to the same standard as the Captain/Chief Officer. Training for the Captain and Chief Officer is not always suitable for Pilots. These vessels are pushing the limits so some form of training is needed, not necessarily certification. Pilots would not swing a 340m long conventional propelled vessel in a 360m circle but we would swing a 340m long ACD vessel in a 360m circle so clearly some form of training is necessary.

6. *"How can a Master know that a Pilot is competent in handling ACDs?"*

This is the reason why the certification is necessary for them.

7. *"How can a Pilot know that a Master is competent in handling ACDs?"*

STCW recommends training on vessels with unusual handling characteristics. Jakob Pinkster reported that STC have noticed that Companies often call up to arrange training for all crews after the occurrence of expensive incidents. So, there is currently still a "disaster-driven industry"!

8. *"What makes ACD vessels different?"*

High manoeuvrability with large amounts of power can cause problems for Ports infrastructure and as Cruise liners do not generate a lot on income for the Port Authority then capital spending on new facilities will not generate a high return. However they do generate income for the surrounding areas and business so they cannot be turned away. Adequate mooring systems need to be in place to take into account the high windage of large cruise vessels. Ports cannot afford to turn away business.

9. *"Do ACD vessels require a different safe operating envelope and, if so, what criteria/parameters would determine this envelope ?"*

The capability of the Master would determine when it is safe to enter/depart from the berth.

10. *"How do Port Authorities control the movement of ACD vessels in extreme weather?"*

The Port Authority should look at the whole Port and ACD vessels should not be treated any differently from other vessels. Masters are under commercial pressures which may influence his decision making. Wind force is a critical factor and Pilots should be involved in the discussion/decision making.

11. *"How does an ACD vessel undertake a crash stop from high speed?"*

If on full sea speed (e.g. 24 knots), switching to manoeuvring mode will reduce the power to 50%. When in this mode the pods can be desynchronised and then slowly turn them through 180° while maintaining positive thrust (the Pod Way).

APPENDIX 1

The following interview was made in Lyngby by FORCE with an experienced instructor and Captain on ASD tugs.

I: I will start the interview now. I will start by asking you about your age.

B: I am 50 years old.

I: Your education – you are a master mariner, correct?

B: That is correct, yes

I: Have you been doing something else before starting your education and career as a mariner?

B: No, I started directly at the Sea Training School. I was hired by the company A.P. Moller as an apprentice.

I: What vessels have you been sailing?

B: After I finished my education as a master mariner I have been sailing on tanker vessels, mostly LPG, until I was hired by the company Svitzer. I was hired by Svitzer 20 years ago and have been sailing tugs ever since.

I: So in total – how many companies have you been employed in?

B: I have been employed in Maersk (A.P. Moller) and in Svitzer, That's it.

I: You mentioned the ship types before as well…. LPG?

B: Yes LPG, Liquefied Petroleum Gasses. That is gasses that are less volatile than the natural gasses. It is mainly butane and propane and gasses like that we can contain under low pressure, were the LNG have much higher pressure and much lower ?) temperature.

I: So all the vessels you have been on before you were employed in Svitzer had traditional propulsion systems?

B: Yes they had. One propeller, one rudder and fixed propeller – stop and start with air pressure when going from ahead to astern and so on.

I: Then at Svitzer, the first time you started sailing with azimuth –

B: Yes azimuth is the propulsion system fitted on Svitzer`s tugs. The abbreviation is ASD - tug. Azimuth Stern Drive Tug. This means that two azimuths are positioned at the aft end of the tug. That is different from azipods which are used primarily on the larger vessels. It is different from ship type to ship type on the larger vessels how the system is made up. Often they have one fixed propeller and one or more azipods that enhances their manoeuvrability considerably. In stead of fitting bow and stern thrusters it makes good sense to fit these propellers and make use of them when sailing ahead as well.

I: The controllers – the handles for controlling the azimuths you have been using on the Svitzer tugs are made by Rolls Royce and exactly the same as the one we are standing next to here in the simulator, correct?

B: Yes they are from Aquamaster and are the one I have been using.

I: And Aquamaster – they are from Rolls Royce?

B: Yes, Rolls Royce is in charge of that.

I: There are no differences from these handles fitted in the simulator and the ones you have on Svitzers tugs? Have they changed during the last years? Are there different models? And what about the design?

B: The design when you just look at them is exactly the same in all the tugs Svitzer owns. But it is as if the ones we got in the beginning were of considerably better quality than the ones we got for the last tugs. Therefore as the controllers we stand next to here in the simulator they are of lower quality.

I: When you say lower quality what exactly do you mean?

B: It means that they seem very plastic like in the hands and then the notches at 0 degrees and 90 degrees are very difficult to feel. And the notches in the lever for revolutions and pitch are very difficult to feel as well. And when the controllers are used a lot and get worn this problem gets worse and worse. It is plastic like all the way trough. But I know that Aquamaster make one of another quality which is more expensive of course but where you get the sensation of quality when you handle them.

I: So different models are available that have the same functions but are made of different materials?

B: Yes. They also make some where there is a button in the handle for switching on the VHF radio. This is a smart solution as operating the radio can often be a problem when you are handling the tug. Both of your hands are busy handling the controllers so it comes in very handy if you have a talk switch for the radio.

I: This possible function is something you have heard other captains and officers express a demand for?

B: I know of many colleagues that would like to have this function built into their controllers – yes. But of course – it costs extra and is often not installed in order to save money.

I: This switch, if installed, where will it typically be sitting? – on the starboard controller?

B: I should think it most practical to fit it on the starboard controller as most of us are right handed.

I: I will now jump to talk about the equipment and set up we have in our simulators and especially in this bridge (H-bridge). If you look at this simulator critically how do you then think it works for education and use regarding training and handling of azimuth tugs?

B: This setup is made in cooperation with Svitzer and as a copy of one of their latest tug models. It has been made to come as close as possible to their M-class tugs. And it has been the goal from the beginning that it should be a replica. Therefore the setup is the same as on the real tugs. This is clever. Whether this setup is the best in the real world is another issue, but as for the simulator it resembles the real world the officer will find on the bridge. There are some differences visually though since the surroundings are shown on a number of widescreens. But as for the manoeuvrability it is exactly the same and all taken into consideration I find it very very good.

I: If you have to prioritize how important it is that the setup is exactly the same in the simulator as in reality thinking of training… how important is it?

B: If we focus on training now for a specific vessel then I think it is a clear advantage that it resembles the specific vessel. Especially if the crew have already been on that specific vessel before and comes to our facilities and are able to recognize it. That is what makes it possible to almost jump pass the first day in the course where the familiarization is normally done.

I: It will in that case not be necessary to spend time on familiarization?

B: No, at least not to the same degree as one would normally do.

I: What do you think there is generally the biggest marked for? As in Svitzer where the crew after they have been employed first are mustered on the vessels for some weeks and then comes to the simulator to train or that crew comes here to train before they are embarking the vessels?

B: It depend on what crew you have or what crew is available in the areas where the vessels are supposed to operate. We had some from South Africa that did not have any knowledge of ASD tugs whatsoever and they were to handle newly delivered ASD tugs. But they did not have any crew that could handle them at all. Seen from that perspective it is a really good idea that they come to us first. But then we just have to realize that what they are here for is to learn the absolute basic handling of the tug. That is to learn how to sail back and forth and turn.

I: But such knowledge and practice the crew that come here from Svitzer will already have?

B: Most often that would be the case, yes. You can easily spend two days with the basic stuff before people start to think in vectors in their heads and hands. That can be skipped if they have had the opportunity to try this in the real world first. And then a four day course will be 4 effective days of where you can train the actual purpose. We are able to deliver both services both it is a question of what the purpose of the course is. If the purpose is to push, tow and assist other vessels with the tug, then the better trained they are in the general handling when then come to the simulator the more time can be spend on the more difficult manouevers and operations.

I: Are there anything in this simulator that you would characterize as design flaws?

B: No I can think of any direct flaws.

I: If we focus on being able to deliver state of the art training in the future with a simulator like this one, and let us focus on the customer being Svitzer. If we try to think of what could be even better in the future in order for us to be a step forward of the second best what would you then say was necessary to do? That could be about extension, physical movement of the bridge platform, enhanced sound quality etc.

B: In that case I think the physical movement have been considered from time to time but I think it is totally unnecessary. When you look through the door to the simulator and see the people on the bridge leaning to the side almost falling it is obvious that the degree of realism from the visual feedback alone is enough. So I do not think physical movement is needed. At least not physical heel. But what could be an advantage is when we go alongside another vessel it would be useful with some kind of bumping feedback. That sensation is not offered for the operator in the simulator when he hits, actually physically hits, the vessel.

I: Some kind of realistic haptic feedback?

B: Yes. Something that could give at small push of some kind that indicate for the operator that now I hit it.

I: Could that be some kind of vibration or….?

B: Yes. I do not think it has to be very large. Maybe something like what you know from the joysticks used for flight simulator computer games where there is some kind of feedback in the joystick alone. That gives a completely different experience of…

I: What about vibrations and sounds? From the engines – regarding the revolutions of the engines? Our experience (as human factor specialists) is that it is not something you think of but something that still can play in important role in the perceived realism anyway. Because one instinctively can get an impression of what effect the engines are supplying.

B: Like old cars where you drive as much with your ears as you do with you with your eyes? Yeah – the effect could be turned up a bit, but we do have the sounds of the engine but we have turned them down because of the people working on in the offices on top of the simulator. But I think it is really good as it is. Something you could wish for that is a realistic stress factor is that combined with the engines power increases some kind of rattling sound on the bridge if you understand what I mean. Something in the vessel and on the bridge that starts vibrating when running at high revolutions on the engines and when the propellers are turned cross ways. Something that you maybe can not feel but is delivered as an input to the operator through sounds from the speakers.

I: Indicating some stress on the tug?

B: Yes – exactly.

I: Maybe indicating possible cavitation and so on?

B: Yes.

I: Do you have anything more to add to our discussion of the setup of the simulator?

B: No as long as the setup is as it is and we want to use it for training for a specific tug then it is perfect. You could imagine other tugs – if other types of tugs was modelled to fit this simulator and it was necessary to have both a for and aft bridge – if we can do that visually alone... that is a good question.

I: I have personally been thinking about what kind of effect it has on the operators perception visually if the window bars are indicated by the edges of the flat screens as they are now or if they are made up by an exact visual model of the actual view though the windows on the bridge. Do you think that has an effect? Do you look for something through the windows and monitor that you cannot monitor in the same way because the view is a little different – or things and objects you would like to monitor along the side of the tug that we cannot see here?

B: Yes, there actually is. When we go alongside another vessel it is quite difficult to determine the distance to them. In the real world we can see more to the sides and downwards. We have actually discussed that the left and right bottom screens forward, could be replaced by still photos, and the screens moved to show a lower view at the sides. That would help a lot.

B: I suppose it is a question of money. Likewise it could also be beneficial – especially when we talk about tug escort training – you could wish for more screens upward. In the real world there are small slanting windows upward to the sides. When the tug is escorting it is so close to the other vessel is has problems seeing where it is positioned.

I: Is it an issue when the tug is below the bow of the big vessels where you have to make sure your mast does not come to close?

B: Well – under those circumstances the tug will be 60 to 70 meters form the bow – or the tug will be even further away – so that is not a problem.

I: The tug is not supposed to be so close to the bow at all?

B: No, not at all.

I: The operator station for this particular simulator is situated right behind the screens here (behind the screen providing the visual effects for the captain manoeuvring on the simulator bridge). How does that work compared to what you are used to and think is optimal?

B: I must say that sometimes you could wish for the possibility for the operator to sit beside the captain manoeuvring – maybe with a laptop for the control of the simulator. When you sit inside the simulator – and especially when the totally inexperienced navigators are training you need to support them a lot in the beginning.

I: So in these situations the operator is supplying "standing next to – education"?

B: Yes. There are situations where you cannot leave them for 10 seconds before it goes wrong. And that is often in the situation where they need to take the line from the other vessel, and therefore also the situation where the operator needs to set the line between the tug and other vessel from the desktop controlling the simulation programme. In these situations you as the operator have to leave the room. You could therefore benefit from having just some of the critical functions available for the operator within the simulator for instance to establish a towing line.

I: How about the sound and sound insulation – for instance if you call the simulator on the vhf radio from the operators station? Can it then be heard both on the radio and from behind the screens?

B: Yes it can. But it is generally not a problem.

I: But I think that when larger scenarios are played in the simulator and possibly with another type of vessel or towing/assisting operation it could be a distracting factor that the radio calls comes from different locations (analogical and digital) at the same time?

B: Yes in such scenarios it could be an advantage to have the operator control desktop further away – yes. But we do have the possibility of controlling the simulator on almost all of the other simulator bridges and control it from there.

I: What kind of podded vessels do you think can be realistically reproduced on a simulator bridge like this one?

B: Roughly any type of ASD tug. The tractor tugs with the propulsion positioned further toward the bow of the vessel I do not have very much experience with regarding how the manoeuvre and how the operating station should be for those vessels. But I will say – roughly all ASD tugs can be sailed on this bridge. But some of the realism of the setup disappears….

I: In order to realistically simulate another kind of tug do you think that the setup needs to be changed?

B: Not necessarily. It is possible to ignore the difference from a "wrong" setup and play along thinking the tug we are operating today is an imaginary one. How realistic the setup has to be for the simulator to work properly for training is a matter of discussion. In this simulator the setup was planned this way from the beginning because it is a direct agreement with the company who wanted this simulator facility (Svitzer M- class ASD tugs).

I: The most important instruments for controlling the azimuths in prioritized order – can you start going through them here?

B: The handles themselves where both pitch and revolutions are controlled. They are combined here. In principle there are two different ways of controlling pitch and revolutions. Given the Tug has pitch propellers of course. Normally when you are doing your manoeuvres and go to port and are assisting the vessels then we use towing – or combined mode. Where a predetermined proportion of pitch and revolutions is programmed. This is done in order to get the maximum effect of the engines. The way pitch and revolutions are combined when you increase power on your handle is pre-programmed. It is all in one lever. The same goes for turning. But if you are sailing solo and longer distances the fuel economy is better if you lock the propellers in full pitch and adjust the revolutions on another controller. And that is possible here.

I: Is that what you would call and automated function?

B: No. In real life this would just be called to operate in separate mode. It has more to do with economy.

I: The next important instrument is perhaps the feedback instruments?

B: Yes – correct. They are deeply connected. And the ones we have here are very good. And they are placed just right – they are clearly visible and you do not have to move your eyes much to read them. They are exactly where they should be and are placed in a way that even though you experience bright sunlight they are visible and easy to read.

I: What is this scale? (-pointing to the feedback instrument)

B: That is the load on one of the main engines. And that will vary as the controllers are handled. In these ships we have to differentiate between where the load is. Is it on the line we assist with or is it the load on our engines? Imagine if we turn the engines against each other and order full power. That would give 100 percent load on the engines and 0 percent on the line we assist with. You cannot get more than 100 percent out of your engines but you can maybe get more out of your line. The next instrument is the rev counter for the main engines. An the next is the azimuth indicator and it gives an indication of the angle the azimuth propeller is momentarily positioned in. You have to imagine that the line you see going from the propeller is the shaft or your rudder stick. That means that the way it is now positioned it will push the water astern and the tug will move forward.

I: And then there is an indicator up here…

B: Yes. That is an analogue indicator of the load on the engines or of how many revs you run your engine at. In the simulator here there is no coupling between the engine and the propeller. That means that what you see here is how many percent of your maximal revs on the propeller or you can change it to show how much pitch you are running with at this present

time. And the digital readout on top of the scale that is now 0,0 and goes all the way up to approximately 26 degrees and the analogue simply shows where you are on the scale.

I: That is because you do not have any other indication of pitch in your controller or elsewhere since you are running in a combined mode?

B: No – correct. So that is actually the indicator of force – the read out of force. And next to that instrument – I must start the exercise to show you that (starts the exercise). Now the controllers are adjusted so that the propellers are pointed sideways and the pitch is zero. If we then turn it – you see on the indicator – and that is of course controlled directly from the Aquamaster unit itself – so it shows how it is positioned. And not what your order for its position is. If there is some lag. So it is very important that when training in the simulator – navigators have to learn that they must always look at their feedback azimuth indicators because they are showing the real picture of what I going on with the azimuths at a given time while the controller is the medium through which you tell the engines what you want. An as it is showing here it is showing about 45 degrees to port. That means that if we put on some power the tug will start to turn to port. Now we can see that the pitch is increasing to 13 to 14 degrees which on a normal vessel will be approximately the same as hard port rudder.

I: Other instruments which are very important on this bridge?

B: Yes – now we have discussed propulsion – but we can also take a quick look on our bow thruster. It is a good example of a choice made (by Svitzer) the company that have had wishes for this simulation bridge. The cheapest solution has been chosen regarding the control of the thruster. They have bought what we call a non follow up system for rudder – emergency steering of the rudder. And that means that if we want to thrust to starboard and keep an eye of how much it increases to starboard and when we release it continues to run at – say 50 percent – where we left it. That means that when we try to use it you have to focus all your attention on this instrument and you have to watch all the time you adjust it back to zero again. And hold it with one of your hands while adjusting it. And when the instrument shows 0 again you can release the tiller.

I: What are the reasons for choosing such a system – it seems totally foolish to install something considerably worse than what you have on many leisure crafts?

B: Absolutely – I think the only reason is money and cost price.

I: I think it can have something to do with the way the guy ordering the equipment for the bridge on the tug thinks; now we are ordering a tug with two azimuth propellers so the thruster is just installed for looks and is basically superfluous.

B: That is also correct under many circumstances. What is the matter is that in Danish waters where we often have jobs in floating docks and precisely these types of tugs where you do not have winches on the aft deck, this means that you always have to tug over the bow and if the tug is lying in very narrow areas and only has a line it can be very difficult… And the bow thruster is the only force you can work with…

I: If you want to keep the tug in a certain position…

B: Yes – in the middle of a dock for instance and… you have to assist another vessel by holding it in the middle of the dock.

I: You mean that when you manoeuvre with the tug there is always a pivot point… and when your propellers are aft and you pull there will always be some swinging of the bow?

B: That is correct – yes. In open waters we do not need the thrusters that is true and that is also what we see – almost nobody used the thruster under such conditions. They even use it less than they actually want because they find out how much attention you need to focus on it in order to operate it. You simple choose not to use it. But if you had another controller for the thruster looking more like the "normal" where you can adjust it to 25 (percent) and leave it there or move it back to zero and you do not even need to look at it when you know the notches.

B: The next thing we have that is important is the operation panel for the towing winch.

I: We don't need to come closer to that subject. We will now talk about training and education – but first I need to ask you how many years you have sailed on tugs?

B: Twenty years on tugs and fifteen on ASD tugs. And twelve years as a captain.

I: Education and training. If you look from the outside at that training you give the officers here at this facility, and imagine that you are a captain on the tug in the real world what would you think is the most important the officers learn?

B: We need to distinguish officers from captains. We have also to differentiate between those with ASD experience and those without. Do they come here first or have they already been onboard and had the chance of being taught the standard harbour manoeuvres to and from quay etc. Sail straight ahead and so on. If they already have that kind of experience then the most important is of course to begin to learn them to do the most basic tugging. Setting lines aft and fore… And do repetitions of this until they can do this and avoid to make too difficult and too demanding. You can easily make it so difficult that they have a change to…. So the most basic tugging tasks and if they can…

I: That was the officers…

B: That was for the mates yes – and if you desire that these mates must come here before they go on the tug, then we will start from scratch where they first have to learn to think in vectors, then in and out of port and to and from quay. And much more general manoeuvring. Where the focus is on simply learning the positioning of your vessel, getting a feel for the tug and how it moves when you give different orders to the azimuths.

I: Is it your impression that it is an advantage to learn some basic theory beforehand about azimuth forces and vectors by manoeuvring this way or is it better to have practical knowledge first and learn the theory later on? Will you be able to detect differences in the ways people sail and manoeuvre?

B: That a highly individual question. Some people are enormously practical. They come here on the bridge and can almost feel what they have to do almost immediately. And we as instructors can feel that as well when we get people like that in the simulator. But it is not often. These people just "feel" the vectors in their body without thinking about it. And other people need thousands of explanations and some has to think and calculate all the time in their heads before they can do anything. Knowledge based…. There is a lot of difference in how people work. Some are good and some are not that good. Some will learn it and some will never learn it at all.

I: Will you say that there – thinking about a learning curve – can be a difference regarding how fast you become super good – Can it have an effect for your pupils if they are able to combine your experience with the theoretical knowledge both for the more practical and theoretical "personalities".

B: Yes absolutely. If you can add some physics to the practical experience at hand – that will be an obvious advantage.

I: Have you had some pupils with theoretical forehand knowledge that was as good as those who did not have any and they both had the same amount of practical experience – and when you see them in a critical situation here – have you then seen any differences in performance?

B: No – not directly. Of course there are differences in peoples capabilities but if we have two equally… then you would probably not see any big difference. Maybe one of them will think more about it and be better at explaining what he is doing while the other cannot. He just does it. And that, I guess, is just as good? I really cannot decide that but some are able to explain what they do and others cannot.

I: Does operation of azimuths require a certain personality? Or said in another way – are there any personality characteristics that are an advantage when operating azimuths?

B: No – I won´t say that. I will say though that is important to be able to multitask to a certain degree. When handling azimuths you are controlling two engines with a lot of power you must be able to work independently and in combination at once while operating winch, talk on the radio and so on…. So you need to have a talent for a high degree of multitasking. And you need to be able to keep calm in stressful situations because the forces and the speed of what thing happens with you must be able to keep your awareness level up– if you cannot you are bound to make mistakes and there is a high risk of incidents and accidents. A peaceful mind is an advantage together with the capability to do several things at once.

I: When you say multitasking – do you think that training specifically focussed on training the ability to multitask could be an advantage? In line with the thought or assumption that people who are used to do several things at the same time will have an advantage when it comes to azimuth operation?

B: I would think that is possible yes.

I: Short questions next. What is the duration/length (how many days) of the ideal course – again differentiating those with pre – course practice and those without? The best course you can think of you can deliver – given all your experience and releasing all the potential of the programme and the simulator - how many days?

B: OK – if we start with those without knowledge of ASG tugs: I would then prefer to divide in three courses at different levels, where the first is a four days basic training course, and then again a four day – I believe strongly in the four days duration of a course because it gives enough space for a slow start, a reasonable ending and have two full days where they really get action.

I: And four days instead of for instance 5 – any particular reason for that?

B: Yes if the start day is slow and the ending day the same – then three days with intensive training that will probably be too much for most people. Then I think the learning curve will turn downwards.

I: Is it realistic to get the companies to pay for such courses and with that structure and setup?

B: Yes I think so. If the world economy is not all bad I think they would. The ship owning - and ship operating companies focus more and more on safety and larger demands are made for the operating crew regarding education. I am convinced this is the case – yes.

I: At our facility and in this one special tug simulator what is the ideal number of people attending the courses?

B: If we are just to run at the one simulator and then a bridge from where you can control the bigger vessel the tug is supposed to assist then maximum 4. We can have more attending the course but they will then experience considerable more waste time and watching which is not necessarily very good.

I: What is the ideal number of instructors for such a 4 person course. Ideally – what do you think?

B: Yes – I will think that one instructor to 4 pupils – that would be a good setting. The instructor does not necessarily have to be physically the same person all through the four days and for the practical and the theoretical part. But I think it will be an advantage though if the instructor is the same throughout the course. When I started working here I was not very much into the human factor part of the theory so I had a more experienced colleague teach to do that part of the course. That is no problem.

I: How big a part does human factors play in the course?

B: Well – that part takes up approximately 1,5 to 2 hours on one of the days – that's all. I must say that I have actually changed something along the courses. Situations occur naturally in the exercises and that makes it relevant an important to work with it… Especially when we talk about the SRK model then we can see clearly in some runs that you move from one area to another. And instead of boring theory on the Thursday of the week of the course. Then it may be better to take it as it shows up naturally and discuss it then.

I: I am thinking that if you like to sail the tug and love to do the practical side of the job then maybe you are even more hypersensitive to theory and power point slides?

B: I think you have a point there. It must be thoroughly considered what theoretical material you present on the courses and when. And it must be compressed a little. But often you adjust, divide and fit it into the exercises. The part of the theory that fits with the next exercise you are about to run and so on…

I: Can you think of a way to obtain or gather data for each of the pupils that can give some kind of objective measure of how good they are – or have become?

B: It is more my judgement. I see how much they sweat and shake and if they can actually do the manoeuvres. The time factors of course also plays a role here. Some of it is actually possible take time on.

I: Can you say – sail to this position, this way – and then you as instructor can monitor how long it takes for them and how safe the manoeuvre was?

B: Yes – we do have a small exercise we do from time to time. We call it tug race and the pupils are racing each other. They have to compete in time. They do not get any punishment if they hid something on the way to this particular defined destination. It gives us a quick picture of their understanding of the vectors and how the tug is basically operated. We cannot use for much more than for themselves to decide who should by the first round in the evening! This

exercise can be seen as a socialising event as well... Of course it would to some degree be possible to set criteria and exercises where the people could be objectively measured.

I: How do you measure – I know you use the Delphi method for evaluation where we get feedback – but how do you personally as an instructor measure the effect of their learning compared to what they could do when they came at first? – do you look for any particular markers or cues?

B: It is difficult to say. What I do is that I make some test runs with them individually – the go back and forth and get a feeling of what level there at. And if they are on equal level or close it is an advantage. We can then proceed faster.

I: You do this as the first part of the course?

B: Yes it is a part of the course. It is the first exercises we do. It is part of the familiarization we do. We go back and forth following a track – back and forth – looking aft – looking forward. That quickly gives me an impression of if they have the feeling for the vectors and what part of the tug they can actually control. And that gives a clear impression of their abilities and if they need more training on the cubicle bridges in specific issues before they can proceed in the programme.

I: Is there any difference of age and ability to learn to operate the azimuths? Is there any difference in age of starting point for operating azimuths and how easy it is for them to learn?

B: That would be a guess from my side…

I: But if you think of your own experience regarding this issue…

B: Well – generally – the older the people the more experience they normally have. No matter what kind of experience they have beforehand some of it will be relevant and transferable to this way of manoeuvring. I would say that if you take experience and how fast they learn the older will probably learn a little slower but have more experience while the younger would learn a little faster but have less experience from earlier resulting in approximately the same total learning during the course. It is hard for me to say. But experience is an important factor. Yes – the younger probably learn a little faster.

I: I think maybe some of the experience could be that you should be a little more cautious. The more experienced might not "jump forward" without first being sure they know exactly what they are doing?

B: Yes – and the older are maybe a little to slow reacting sometimes in stressful situations. With this kind of tug you sometimes have to react swiftly and give full throttle to safely handle a situation. You can say that the older are a little more afraid to use the power at hand.

I: You should think it is important… we have been discussing this a lot… A part of this project is also to consider different types of crash stop situations.. There is also being held interviews with pilots… and questionnaires are being forwarded to pilot associations. British and Danish in order to get some kind of measurement of just how good the pilots are at manoeuvring azimuth - like propulsion systems. Many pilots actually have not trained and cannot manoeuvre these systems and one of the issues is that there are many different ways to stop the vessel and to turn the vessel. And maybe some of them are better than others in certain critical situations.

B: What is needed in order to use the tools at hand with a propulsion system like this one if firstly knowledge. My experience is that in order to get better and get better using the

experience you already have is to eliminate some of your old habits and beliefs first. If we get people in this simulator that are used to handle two fixed propeller vessels then we would actually benefit from a psychologist that is waiting for them just before they enter the door to our facilities at their first entrance who can "reset" them before we start the course from scratch. We typically see that they do not know have to take advantage of all they can make use of. They think; backing or forward…

I: I have tried sailing vessels with water-jets myself and the first time I wanted to try this azimuth system here in the simulator I instinctively turned the azimuths to what I believed was toward each other but in reality the opposite happened. Then I started to mentally "rotate" my knowledge of the consequences of moving the handles which slowed my manoeuvres a lot. What was the most difficult for you to learn when you started sailing on ASD tugs?

B: The most difficult or maybe I should say what surprised me the most that was not exactly difficult as such – but positive – that was that you suddenly had 100 percent use of your forces and not just in forward or backward direction. It took some time to adjust to the reality that you had these forces at your disposal.

I: Can you say that you had to build up a repertoire of different manoeuvre possibilities?

B: That is totally correct. You suddenly have to get used to the fact that you are potentially much more capable as to manoeuvring than before. But you also had to be more cautious with your forces because they are so powerful, work 100 percent and immediately.

I: Was there anything contra intuitive when you started to use this propulsion system. Something that you thought was difficult… where you continued to do it the wrong way even though you knew it was wrong…where you kept thinking: this is strange how this works…? I know when I tried these Aquamaster controllers I was told to think about them as to outboard engines… which helped me immediately… But anyway – if I had to do a fast manoeuvre I fell back and handled the controllers as if they it was Kamewa jets I was operating. You came from vessels with traditional propulsion - was there anything you thought was contra intuitive?

B: I do not think so. But sometimes I was as I said surprised about the sheer force and swiftness of how the forces was applied but besides from that I think the use of the system is in my head is intuitive.

I: What about the controllers themselves. You have through many years gotten used to using these controllers. But if you try to look at them objectively as if you did not know them; if I asked you to do an analysis of what your vessels should be able to do and how the controllers (azimuth system) should be able to work ideally. And you where allowed to draw the handle from scratch – imagining that you did not already know what the controllers normally looks like – that this I a good model – what can you then think of regarding size and ergonomics for instance?

B: I think they are good and feels good in the hand. I supposed the edges could be rounded a bit.

I: So that it fits the breadth of the palm of the hand better?

B: Yes – and if it was possible to get a better grip "underneath" the handle. It is like a square. You could imagine….?

I: Do you need to be able to hold on to the controller when the tug rolls or moves I rough weather? Does the tug roll that much at all?

B: That happens form time to time, yes. There are situations where you need to hold on to the handle.

I: Can they stand to be used in that way?

B: To this date yes. But I think – it is difficult for me to think how the controllers could be different from this model. But I am of course affected by the amount of experience I have with this type of controllers.

I: If it was me I would think that when the revolutions indicated on the handle are showed on this scale on top – it is hard to see the indications. And if I look at the controller I think it is thought from the producer that you would hold on to it in the top leaver and not at the base where I see most people hold on? If you held on to the leaver you could adjust the revs at once. But if you hold on to it as most people do you have to move your entire hand – change grip – and push the leaver for revs.

B: Some might have thought you were going to hold it like that – but you do not use it that way. You do hold it this way. Maybe you could imagine some kind of shape of this controller that was more natural considering its purpose. And maybe the other controllers on the other bridges are preferred by some people who has not – as I – sailed on this kind of ASD tug for many years.

L: You mean the small Lillås controllers? – or may be even Kamewa?

B: Yes Lillås – but not Kamewa. There are too clumsy and when you are sweating during stressful conditions your hands almost start to hurt. They are too broad. But maybe a combination of them – and they radiate considerable more quality than these from Aquamaster does. Clearly marked zero indicators and so on…

B: But surely they must not be too small. It should always be possible to feel what you have in your hands.

I: And there should be a certain feedback resistance?

B: Yes – there has to be that.

I: Would it be interesting to have other notches so that the operator can feel the angles the controller is positioned in… abeam and..?

B: There are some. But they are not clearly felt.

I: Could more of these notches be an advantage – more than abeam and aft as is the case now?

B: Yes maybe – it would be alright if there was a notch for 45 degrees as well. There are certain situations where you have angles where you are not supposed to operate your azimuths in and that could be a help. Obviously – the less you have to look at it the better. You must be able to feel where you are.

I: Could you imagine – there are some angles you should not put your azimuths in because of cavitations….

B: Yes it is basically about how the vessel acts …. It has of course something to do with the shape of the hull under water. It has for that reason nothing to do with the controller itself but is more vessel-specific. On these vessels - if you are pulling something you have the angle

from forward to 45 degrees inward toward the hull where you are not supposed to operate the azimuths because the water from the propeller is sent directly onto the hull and the skeg) that is there. So you must pass 45 degrees in order to get the planned effect. Otherwise something unforeseen happens.

I: Could it be of an advantage to have some sort of feedback tactically in the controller when operating certain revs and at certain angles?

B: Yes. But that would only be correct if this particular situation. This is some of the things you simply just have to learn. This has something to do with knowledge of your vessel. It will be slightly different from vessel to vessel where this unfortunate area is.

I: Do you have any idea of how Aquamaster get information about their equipment and controllers from users? You have never had any contact with them?

B: No.

I: I don't think we have the time for discussing all the Aquamaster panels. But they seem difficult for me to understand…

B: I would like to say something about these Aquamaster switch panels anyway. They are very difficult to understand and get an overview of. And they have chosen to make all the buttons the same size and shape. Some of them are push buttons and others are indicator buttons and it is not possible to see the difference.

I: What do they mean then – these buttons (pointing to the panel)?

B: These ones here are perhaps the most easy to understand. They indicate if the Aquamaster unit is clutched in or not. And this one is the indicator for clutched in. So it is not all that easy! And this one here clutched out and this is clutched in and this is the indicator lamp. When this button is not lit the clutch is out. Here they could have had two buttons only. One for clutched out and one for clutched in.

I: I can see the point in that. What are the rest?

B: The one beneath indicate that we are in command mode here at the controller. That this controller is the one in command. The others are emergency steering indicators when they are emergency operated. You operate it by holding it down.

I: How do you see what way you are operating the azimuth then?

B: I was wrong just before. This is not for the angle adjustment but for adjusting the pitch. This way is increasing pitch and the other is decreasing pitch. Here you increase the pitch and here you decrease the pitch. And the same with the emergency steering of the azimuth angle. Here you turn. When you push to port side the azimuth turns to port and so on.

I: So the vessel then turns to port?

B: No, only the azimuth. And you then have to control the vessel…It is rather difficult but possible.

I: Okay. Here there are more?

B: Yes this is where you switch between the different modes; when it is in towing mode you have the optimized possibility of adjusting rev and angle of the propeller blades the pitch

giving maximum amount of power. The other when you switch to free run that is when it is only pitch you are adjusting by the control. And the revs are set on the forward panel here. The last thing is the mode you use when you have fire pumps clutched in on the main engine. Then there are some area of revolutions you need to be within. That is then the only thing you can adjust. Still, on these – you can still manoeuvre your vessel.

B: But if you are fighting a fire and pumps water onto a large vessel this will be the way it works. We do have this fire fighting mode on the real ship as well. That makes it possible to manoeuvre the vessel but you do not have much force at your disposal of course. The pumps take their share – a quite big share.

I: Very interesting. The last thing I have to ask you is about automation. It is a difficult term – it is described in the project description and I do not know completely know what they mean. But I think what they mean is systems which can help in certain critical situations. For instance when a pilot has to do a crash stop – if he had a possible of using some kind of automated system that could control the azimuths in combination or some other way to give the must efficient stopping manoeuver under the current situations. Do you know of such automated systems?

B: I think that they mean joystick. Some systems have what you call a micropilot as they call it from Aquamaster – installed. You can with this system control it in different modes; if you are sailing back or forth and turn or sidestep. But we have had mechanics coming to adjust it all the time everyday and several days! And my experience is that a captain with just one year of experience is a lot better at handling the vessel than the aquapilot. As of yet anyway. I can also tell you that some come to us and say that they already have ASD experience because that is the propulsion system they have on their vessel. But as the ones we just had this week from Lisbon it turns out that they sail using the joystick and therefore they do not have the same control of their vessel at all.

I: What were the officers you just had on course this week?

B: Two of them were tug boat captains from Lisbon. They had been operating their azimuth tugs. But they do not have the individual control of each of the azimuths. They have a joystick and some kind of combined system which means that they cannot set the azimuths to each side. The system automatically reduces the revolutions when the azimuths are turned. This means that the very efficient method we use in transverse arrest where we put the propellers to each side 90 degrees from the moving direction cannot be used on a tug like that. This way of stopping means that with a tug like this with 60 tonnes of bollard pull static. But if we make a transverse arrest we can come above 100 tonnes of brake power.

I: So that is very efficient in some situations when tugging?’

B: Absolutely. I have done that a lot.

I: When we talk about safety devices which could be some kind of combined use of the azimuths. If you think about something that could be of an advantage regarding safe operation of azimuths what do you think of?

B: Well I think training is the one thing that can do the most for the safety. That is the most important. The next is the quick release mechanism on the winch where we can let go the line. And the other is the release hook after if we have something made fast aft. These are the two most important things.

I: Is it possible to imagine some combination of an automatic mechanism regarding the manoeuvre of the tug or adjustment of the controllers (some optimization)?

B: No – not really. What we must keep in mind is that we often have to give the maximum pull on the line that we possibly can. You can in fact say this is the criteria for success. Something that would release it at a certain force that would be completely opposite to what tug operation is all about. Much of the safety is build into the line you choose to fit on your tug. This line is calibrated to fit the effect of the tug and so on. If you are at the limit where the tug is in danger then the line must break. So the dimensions of the line is tailored to the limits of the tug. That may be from an economical perspective but it is some sort of a safety measure. It is generally very important in the tug business that you follow the procedures that exists. That you ensure water-tightness and so on. So that the vessel actually can stand lying on its side – as it is supposed to be able to withstand and come back up again. Building in of any automatic measures is hard to imagine because the kind of work you have to do with the tug is about operating on the "crazy" side of what many would consider right. But that is what tugs are for.

APPENDIX 2

Interview n°1

Interview made by UKMPA to the Master of the 'Independence of the Seas'

Q: Thank you very much for agreeing to help us in this project. Perhaps we could begin by asking your age and your back ground?

A: I am 59 in four days time and I having been working for Royal Caribbean for the last thirty three years, the last ten years have been on podded ships. Prior to that I was working in the oil industry.

Q: Did you come to sea straight from school?

A: I was in the Norwegian Navy, so I have only worked for two companies

Q: Are you familiar with the term ACD – azimuth control devices?

A: I have heard it but we never use it.

Q: Can we go back to the period before RCCL used azipods and talk us through how you became involved in azipods, to where we are today?

A: About 12 years ago I was sitting in an office and at RCCL we knew how difficult it was to manoeuvre large ships the old way. A ship like this in bad weather has difficulty berthing and unberthing, so that was the main reason the Company started looking at azipods, especially Mr Kulivar, a Naval Architect who was a Senior Vice President in charge on new buildings at the time, he saw how difficult it was to manoeuvre large passenger vessels and he was convinced we should go for pods. There are two systems used by RCCL the ABB azipod and the Rolls Royce Mermaid. We have the Mermaid on what we call the Liberty ships but there have been problems with them. We saw things happening so we changed our operating procedures, how to operate them, how to increase and reduce speed. We have instruments now, a boroscope, so we can see what is happening in the pods. This shows us the metal in the lubricating oil in the pod, when you put 28000 hp on the pod something is going to give after a while and one of the first things we saw because the pod was breaking. We saw this on two of the early ships fitted with pods the Voyager and the Explorer. We have a fixed pod in the middle and two azimuthing pods outside. This is the same on all our ships with the exception of the new ship the Oasis of the Seas that has three azimuthing pods.

Q: What was the thinking behind having three pods one fixed and two azimuthing?

A: I do not know the thinking behind having a fixed pod but I know the thinking behind having three azimuthing, as I was Task Captain for Oasis. This was brought about by entering Ports like Miami that have a 7 knot speed limit passing the Coastguard station yet many times when you have a NE wind and a 3 ½ knot side current you need speed on the way in, maybe 14 knots, yet there is only ½ a mile to the Coastguard station we need to get the speed and we realised that by putting the fixed pod astern you put tremendous pressure on that pod which created damage to the three bearings. Moving ahead and you start going astern we realised we had a problem. Now that is why we always turn the pods around, so they are always going ahead. On this class of ship we have two pods and if we turn the pods around this also gives us very good control of the ship when going astern particularly when using the bow thruster.

Q: Was this trialled on a simulator?

A: Yes, in Helsinki.

Q: Was that at ABB?

A: No it was a Finn Company. I was there for three days doing tests.

Q: The Oasis has three azimuthing pods, so you have moved away from a fixed pod what brought that about?

A: Increasing the manoeuvrability.

Q: The centre pod is that going to be further forward?

A: I don't know, I would have to look at the drawing.

Q: Do you have a skeg on this ship? (Independence of the Seas)

A: Yes we do and we know if we put the propeller towards the skeg we are reducing the pods efficiency down to about 65%, because you are not able to draw enough water into the propeller.

Q: So you are conscious about how you are moving the water around?

A: Yes because of the loss of efficiency.

Q: Depending upon the prevailing conditions when berthing, do you have a preference for approaching the berth in any particular way, for example stern first?

A: Exactly the same way as you would do a normal ship. Its still a ship, so I approach the berth if it was a conventional ship, why go sideways, you are using a lot of power and energy which costs money. When you are approaching the berth I usually look to have the outboard pod at about 48˚ ready to counter the bow should it start to swing out - this gives the best effect - and the inboard pod at 90˚ ready to stop the stern swinging into the berth but of course you can put the pods at any direction you want.

Q: On a twin screw ship, I tend to use my shoulders to mimic the turn of the ship do you have anything like that on here?

A: Yes, we call it handlebars.

Q: Do you have anything on the controls that indicate you are not getting 100% from the pod?

A: No, you need to be aware of it.

Q: Would it be useful to have any audible warning to indicate that you were not getting maximum efficiency from the pod?

A: You need to train the people.

Q: On the matter of training could you explain how the training over the last 10 years has evolved?

A: We have the Star Centre in Miami and every ship had its own PC Rembrandt at which 2nd and 3rd officers could sit and practice.

Q: From what we have learnt so far from other interviews they seem to have started off with pods just using them in a T bone configuration before moving onto vectoring them, was that the same here?

A: Yes, but if you are heading in towards the quay and you put the pods 90˚ inboard it helps to reduce the speed an economical way by using the pod as a spoiler. It will reduce the speed quite effectively.

Q: What is the full rating of each pod on sea speed?

A: 14 mw on each pod.

Q: And in manouvering mode?

A: 10 mw on each pod.

Q: In practice, are you likely to use that amount of power when manoeuvring?

A: No, probably 2 or 3 mw only.

Q: In the early days of using pods you had the idea of the pod either being ahead or astern, so was it feedback on the bearing problems that lead you to trying to keep positive thrust on at all times?

A: Yes.

Q: Do you actually stop the pods or are you happy to keep them turning all the time so one is working against the other?

A: No, I stop the pods it takes only seconds to stop. When you are 10 or 15 metres off the dock and you are approaching at ½ knot, I start the pods at maybe 20 rpm, so I know I have them ready and it only needs 30 or 40 rpm to see the sideways speed drop.

Q: Are most of the docks you go to fixed walls or are some piles and open where the water has somewhere to go?

A: It is not so effective if you have open quay, here in Southampton (fixed wall) moving the first 10m is quite slow then she will start to move a lot quicker.

Q: Have any Port Authorities complained at the amount of power you generate?

A: We try and lift with the outside pod.

Q: The practice of putting the pods inboard 90˚ must put a lot of pressure on the pod if you have headway on the vessel?

A: You should not do it above 15 knots, you can if you want to but I have not heard anything about damage caused by this but I try and wait until we are below 6 knots.

Q: What about in an uncontrolled situation and you loose control of one of the pods do you have procedures for that?

A: That is something I have not experienced but of course we have two pumps on each pod. You would need to reduce speed and come out of track mode because in track mode the

autopilot will try and bring you back on track and at 20 knots you do not want to have rates of turn in excess of 3˚ a minute or else you will have stability problems.

Q: Do you have an Operations or Procedure manual?

A: Yes, we do and we train the Bridge Team on a weekly basis onboard the ship.

Q: Do you allow the Staff Captain to do any manoeuvring?

A: Yes, of course.

Q: Just the Staff Captain or do you allow anyone else?

A: It depends on how much time we have and how tight we are for the schedule when the average speed is not so high. You need to let them make mistakes, so you can learn from them and we don't always have the time to let them make mistakes.

Q: In terms of training, what is the single most important point you want to get across to the trainee?

A: There are so many things hanging together and unfortunately the new breed of Officer learns from a computer and that what the computer tells them is correct. Seamanship does not appear so important, if you do not have seamanship and do not understand how regular ships behave, then I can see that they will have problems, that is the biggest challenge and it is hard to explain how the pods work.

Q: When you are manoeuvring are you thinking about the pivot point at all?

A: A little bit, particularly doing a 180˚ turn I always try to have the ship moving when doing a turn and approaching the berth.

Q: I just wondered if having so much power there is a tendency to forget about basic ship handling principles?

A: As I said before, you still need to manoeuvre a ship like a ship and take account of all the factors.

Q: I do not know how it works in Norway but are you aware of M Notices or Marine Guidance Notes?

A: No.

Q: As this ship is registered in the Bahamas, I wondered if they have anything like that?

A: Not that I am aware of.

Q: When the ship was built, were you involved in any of the sea trials?

A: Yes.

Q: Did the trials data produced come from the data collected during those trials or have they come from a computer programme?

A: The shipyard gave us the ship and we did what we wanted.

Q: So the information on the Manoeuvring Poster in the wheelhouse is real data?

A: Oh yes, all the data we have is from real trials.

Q: Are you familiar with a Manoeuvring booklet?

A: What do you mean?

Q: There is supposed to be three pieces of information onboard, the Pilot Card, The Wheelhouse Poster and the Manoeuvring Booklet which no doubt is onboard somewhere?

A: We have so many manuals on the Bridge and so many graphs showing wind forces but none of it is correct, the real life is totally different.

Q: Do you think that handling azimuths require a different type of person, be it an younger or older mind?

A: I have seen a lot of good seaman who can operate normal ships but have difficulty with the pods. I have been with them and tried to teach them but they cannot grasp it.

Q: How do you indentify who can and who cannot adapt to it?

A: Some people have no problem but others, no matter how much training you provide, they just cannot do it.

Q: Are you familiar with manned model training with scale models as opposed to simulators?

A: No, not really.

Q: All the training RCCL do is at the Star Centre?

A: Yes and we have developed our own training courses for Officers.

Q: What we are discovering is that the terminology varies from Company to Company which is confusing for us as Pilots?

A: Yes, most probably you do because we have our own.

Q: So, if you are handling the ship how do you communicate to others in the Bridge Team what you are doing?

A: When manoeuvring everyone has their role to play and the man in the cockpit is monitoring what is happening and operating the instruments and has an overview, so if something happens he has to deal with it because it is only from that station that you can for example start another bow thruster. Standing on the bridge wing we rely on him and he has to revert back to us and close the loop. So, we have one back up officer and he starts completing the check list a long time before the Pilot comes onboard

Q: What is your experience of Pilots coming onboard these type of vessels and how do they fit in?

A: We do not have any problems. Some Pilots are quite comfortable with the technology while others are not.

Q: More often the Captain does the manoeuvring, so is that letting the Pilot off the hook? If he (the Captain) were to drop over, is the Pilot going to be able to contribute something, I suspect not?

A: That's true but on here we integrate the Pilot into the Bridge Team and give him the con and monitor him.

Q: How does a Pilot contribute to a Bridge Team on a podded ship?

A: By giving me advice and using his local knowledge, during the manoeuvring it is difficult to tell him what I am doing or to explain what I am doing.

Q: How might that be improved?

A: By training of Pilots, perhaps to the Star Centre and do the same courses as we do.

Q: Have you ever had any Pilots on Courses with you?

A: When we go with my Bridge Team there are eight people and we have two ships so that is 16 people, that is a lot of people.

Q: How regularly do you go the Star Centre?

A: The last time I was there was 2001.

Q: That's a weeks Course?

A: It was 14 days.

Q: For people with no pod training, 14 days would be a good start?

A: That included DP training and other Courses such as Bridge Team training, so only 3 or 4 days with pods.

Q: What ratio of trainers do you have with students or do you become the trainer?

A: In the Star Centre we have one trainer, the Captain, but there are other Star Centre people around.

Q: What would be the ultimate propulsion system to have on the ship?

A: The best system I have used so far is this system because I have so much control.

Q: Do you think that it should be mandatory for anyone working on a podded ship to have attended a pod training course?

A: In RCCL, it is a Company recommendation. A 2nd Officer would be sent on the Course. Someone is normally 2nd Officer for one or two years, so we have that window in which to train him on pods.

Q: That's an internal requirement?

A: Yes, it's a Ship Management responsibility and we are responsible to schedule that into his training and if someone does not have it, we have to send him off for 5 days to do the Course.

I think probably the rest of the questions we have can be answered on the Bridge and we can film what is happening. Thank you.

Interview n°2

Interview made by UKMPA to the Master of the Norwegian Jade.

Q How old are you?

A I am 37 years old

Q What is your background?

A Started at 16 yrs old onboard fishing boats as a deckhand for two years then went into Norwegian Navy for 12 months then back to fishing boats for a while until going to college to gain qualifications. Went to sea as junior officer on small ships before going back to college again

Q. These vessels were normal propulsion with conventional propeller and rudder?

A. Yes that's right. I Returned to college to gain Masters qualification before sailing on tankers worldwide then transferred to North Sea Shuttle tankers for about two years. In 1997 I joined Norwegian Cruise Lines as 1st Officer

Q. Intially at that time they didn't have any podded ships did they?

A. Yes that's right they had twin screw with high lift rudders and bow thrusters. I was on a ship called Norwegian Majesty. I became Staff Captain in 2002 that's when I actually got more hands on manoeuvring onboard the Norwegian Wind and Norwegian Sky. From there I went to the Norwegian Star in 2003/2004/2005. She was our first podded vessel very similar to the Norwegian Jade in many respects with regard to the pods and control systems. That was my first experience with azipods I was there for 2½ years and did a lot of manoeuvring. The Star was the first ship we had with azipods she came out in 2001, the Dawn came later. At the time we had little nautical knowledge of pods so probably did not use it the most optimum way with positive rpm, negative rpm, angle of pods etc back them it was more conventional use including t - boning. Later on we started experimenting and did some internal training and slowly but surely found the most efficient way to operate the azipods which is the way we use them today. Nothing like experience but a big impact was that these particular azipods had some technical problems in the beginning with the bearings.

Q. Who is the manufacturer?

A.ABB - they are all ABB particularly this size the 19.5 MW. We had thrust bearing problems and came a recommendation to avoid negative rpm and use only a positive direction when you do that you have to turn the pod and use the angle, you quickly realise it is also a more efficient way to operate it and you get into the habit to do it. Since then we always do it but we have been told we can use negative rpm at any time if we have to - safety or whatever as it is faster then turning the pod around if you are getting close to the berth, safety is the most important thing.

Q. When did you get command?

A: My first command was in 2007

Q. How many companies have you worked for?

A: Four Part of my background which you may be interested to know In 2005 I was sent to German to the shipyard where they built this ship and the two sister ships. So I was involved in all the sea trials.

Q:Did you have any influence in the design for example the bridge layout?

A:This is exactly a replica of the Norwegian Star, the first ship and the feedback was so good from that ship we are very happy with this layout, minor adjustments we did. I was on the sea trials and sailed for three months before going back to the next one. On the sea trials I actually got to see all extremes of operation including the crash stops, different ways to do a crash stop, the azipod way and the conventional way from full ahead to full astern, the hard over turns, to see it live was very useful.

Q: So there is data around from those sea trials is there

A: Yes it's all on the poster.

Q:In the project because we are dealing just with podded ships but with all azimuthing, we called then ACD, is that a term you are familiar with?

A:We call them azipods, I understand what you are talking about but we don't really call them that

Q:Azipod is a copyright name of ABB so if I start talking about azipods with Rolls Royce that is not really correct and of course some ships, small tankers, have 2 shottels and are azimuthing but nothing like the pods with electric motors under water, they are mechanical drive systems and of course the tug boats have the same. So in terms of training how has that progressed during your time with NCL with pods, have you been on any courses or has it been a self learning regime

A:Well it is combination of both, the first ships the Norwegian Star and Norwegian Dawn the Captains and Staff Captains had training with ABB on azipods and that was followed by simulator training at FORCE Technology. When the Norwegian Jewel the first one of this class we had simulator training at Force. But as we sent captains to the shipyard those captains had already been on this class of ship so they already knew, the knowledge was already there, the need for simulator training was not necessary. What we do now is the majority of the fleet have azipods you get the knowledge as first officer and chief office so by the time you get to Staff Captain you have already practised and been taught by other Captains what to do. For myself I had training by ABB at the shipyard in Germany who came down to the yard and we discussed manoeuvring with azipods and I have also been to the Star Cruises simulator in Malaysia in cooperation with Force and all the deck officers went there and we are now sending deck officers to the simulator in Amsterdam and we have signed a contract with them and we are going to utilise their facilities with officers going every five years for a combination of azipod training and BRM Courses

Q:If you look back from where we are today what do you think is the most important thing officers need to learn about azipods

A:They need to learn the limitations and understand the system, it is two completely independent units and if something goes wrong what is important is to know what to do if the steering start to go wrong, they need to know what to do. They are very powerful units and if they go out of control bad things can happen it is not like a rudder which goes only to certain angle.

Q:How did you do to understand and train for that, does that happen in reality, do you have problems like that on a regular basis

A:No, there have been incidents with steering failures which are more to do with hydraulic problems rarely it happens but it happens. We have built in redundancy with two pumps available for each azipod and if one fails we switch over to the other one immediately but in port or in narrow channels we have two pumps on all the time.

Q:Do you think the operation of azipods require a certain personality or certain type of person to operate them

A:No - I wouldn't say that. You need to understand but that is the same with any ship-handling

Q:Aslong as it is explained properly and you get the right training it is not a problem

A:No I don't think so, you need to understand it is a completely different way of thinking to the rudder and propeller shafts.

Q:What training do you think is necessary for Captains and officers, do you think that what you have described is all that is necessary , good advice from an experienced Captain.. With your experience what do you think would be the ideal approach.

A:I would put it this way, a good qualified Captain who has proven knowledge of regular ship-handling he can quite easily adapt to azipods it is not that complicated but I think a lot of my knowledge has been gained with 6 years on this class of ship I have seen what can go wrong with the steering, I have seen through the sea trails the limitations I think a lot of my knowledge which I take for granted has come from watching other Captains

Q:Do you think everyone should have some basic training to understand the limitations while additional knowledge can be gained with experience

A: Probably a good idea

Q:Accidents that have happened to ships you have been or other ships you have heard about has any of that influenced how you operate today

A:Absolutely

Q:Which ones stand out

A:It has to be the steering at high speed, during manoeuvring we haven't had any incidents caused by the way you operate the azipods at high speeds for example we have wave avoidance trying to stay away from big waves it can be too much for the azipods so if you see something it may be necessary to switch to the tiller but we have a specific Company procedure for that. Also there is a steering failure and that has been a topic of lengthy discussion for a number of years. If you are at full speed and you lose the steering from azipods what should you do. Everyone has agreed you need to do something and the first thing you should do is come out of autopilot into manual steering and then take the load off the pod that has failed but in which order do you do it. Do you go from auto to the tiller and reduce the load manually or do you go auto to aziman manoeuvring mode. It is still under discussion and it depends very much on what has caused the steering failure.

Q: Is it immediately obvious what has caused the steering failure

A: The problem is that there are so many things that can go wrong. If you full speed 25 knots and you get big angle on the pods she can get a big list. If you lose the gyro and the ships starts to wander you probably come out of autopilot into manual and steady up using the horizon or the magnetic compass. That would probably be the best and most direct way to do it but if you

have full ahead and something happens to the mechanics if you then go onto tiller or hand steering the pods will not still be synchronised because you still have a problem with the pod so then you have to try and synchronise it but that does not work so you lose some load but if you go directly from auto pilot to aziman two things happen, first of all you have independent control so although you do not have control of one of the units you can try and match it with the other or put the pod in the opposite way to try and compensate. The second thing which is even more important as soon as you press the azimuth function you go from 70 megawatt to manoeuvring mode which is 10 megawatt so straight away you have reduced the problem. If you have a mechanical error you cannot control the pod, if it is a gyro error it is probably an extreme step to go to aziman because to go to manoeuvring mode and start independent operation at 25knts is not safe either. So my answer is really to determine the nature of the problem but in the middle of the night and if you have officers on watch who do not have the basic knowledge that is why we try to have only one procedure so that everyone does the same. Even though that may not be the best and you should have different procedures for different events there is room for discussion within the industry and within the company . We have one standard procedure and we say okay go to tiller/hand steering at least you take it out of auto pilot.

Q: For Junior officers how do they get trained in that procedure if they are new to the ship.

A: It is part of the familiarisation process we have onboard and every officer has an overlap before they can take over the watch particularly if they have never been on an azipod ship I try and sit down with them. This is the bible for deck officers we have in the cockpit, normal procedures and emergency procedures and basically includes gyro failure, loss of steering etc. If this happens they should not be opening the book to read it they should know what to do because if it happens they should react instinctively.

Q: Has this been put together by the experienced Captains or has some one in the office done it.

A: I did it for the whole fleet

Q: A lot of hard work?

A: It was a project, we had manuals and check lists, it was to comprehensive, and available electronically the manuals were so thick and complicated that it was left on the shelf, maybe 50 check lists so I actually put this all together in one binder so everything is here, procedures and check lists. This was done this year and now runs right through the fleet.

Q: Have you had feedback from other ships

A: Yes, first of all I drafted a proposal and sent to the Office to my Manager, a previous Captain who had worked on the sister ships, who was happy with it and it was sent to the other ships after that there have been minor revisions but it is based on the procedure we had but much simplified.

Q: I have been on this ship before I know you operate the Pilot/Co Pilot system, that sort of thinking is encompassed in this manual?

A: Absolutely, it tells you how to do that

Q: Did you develop that with SAS or some other Company

A: The Pilot/Co Pilot system was I think we got it in Norwegian Cruise Lines from Star Cruises when they bought the Company and they got it very much from their ferries who did not take Pilots.

Q: Is there any possibility of having a copy of this manual or is it private information

A: I would have to ask the Company

Q: This manual contains your knowledge gained over a number of years in a condensed form and that is what we are trying to achieve in the project.

A: Exactly, you see the procedures and check list contain a number in our case JA which is ship specific so that was time consuming how to make ship specific for every ship in the fleet.

Q: You must be quite proud of that work looking at it

A: Yes, it took a lot of time but I had secretarial support.

Q: Coming back to that basic training for an officer, you have the handover onboard but if you went on simple course how long would you envisage that to be, one day or four days what would you anticipate that basic course to be.

A: If you are just talking about azipods then it depends what you put into it. At least one day to understand the basic mechanics of the system, how the steering works and if one failed for example. Then one full day to talk about the azipods and how to operate them to optimal effect then perhaps a third day to have some practice so three days should be good.

Q: I know the shipping industry responds slowly to these things but would you eventually see that as a compulsory IMO course for people coming onto azipod ships. You have certificates for tanker endorsement do you think we need to go that far

A: It is hard to say maybe I would not say yes because it is a new technology at the same time there is other technology, fairly complex new rudders and more thrusters for example I would say maybe it should be under IMO, maybe an IMO approved training course. I wouldn't say you need to go to shore side facilities.

Q: At the end of this project we need to make recommendations and those recommendations may be made to Classification Societies or IMO

A: I would say there needs to be a minimum training requirement perhaps audited by Port State

Q; How big a part does human factors have in this area, for example in following procedures

A: Human factors has a big part there are more things that can go wrong with azipods particularly in emergency situations and if you start playing around with azimuths, with angles etc they are very powerful and things can get very bad, for example if you loose the steering and do not know what to do.

Q: So presumable there is a fine balance between understanding them and not being afraid of them

A: Exactly yes

Q: As people progress and get more experience with azipods how can you assess whether they are competent with them. Do you get to appoint that as an individual you can say for example my Staff Captain knows what he is doing now or do you have objective methods.

A: It is my duty to train the Staff Captain and the Chief Officer because eventually he will be a Staff Captain. The Staff Captain here has been on the sister ships and is a very good ship handler he has no problems. When I came here the Chief Officer was operating the azipods in a different way to me, it is not a wrong way, but a different way so we had a discussion about it and he now does it the way I do it. Only certain officers do ship handling, there are going to be times when you have a soft landing and days when it does not go so well.

Q: Do you find any relationship between age and ability, do younger people adapt to it quicker than older people or are more experienced people better at it or does it not really matter

A: I would say that I have seen older Captains who are really good at it but one of the biggest problems have is that these are big ships but highly manoeuvrable and people get overconfident. These ships are very forgiving if you come to fast you can stop them quickly so you need to be a little bit careful not to get out of the comfort zone.

Q: We have done a survey of Pilots around the world and it is very apparent that very few Pilots have had any training on azipods at all and most have little idea how they work, how does that work for you.

A: That would be obvious. Pilots in some places around the world are happy not to do any ship-handling.

Q: If we split the voyage into two parts, the passage part and the ship handling do you find for example how Pilots cope with track system.

A: Arriving in Southampton we know the turns and the current we are usually on track pilot but this morning your Colleague told me he had never used the autopilot before
So right at the beginning he wanted to use hand steering. When using azipods in hand steering they behave very much like a high lift rudder.

Q: What would be your thoughts about improving the situation with Pilots then

A: I think where the Pilot is most uncomfortable and gets confused is when they start manoeuvring and the pods are at all different angles they do not know what they are doing.

Q: If you take a conventional ship where the Pilot is giving traditional orders these are orders we use are ones we easily understand, giving verbal orders on an azipod ship does not really work. Do you between yourselves do things on a verbal basis or is it one guy with the azipods in his hands and he gets the feel of what he is doing.

A: The guy who is manoeuvring does it himself, some Pilots like to be very much involved during the docking, an a example I can think about in the Port of Miami the Pilot like to turn the vessel in the turning basin and the Captain docks the ship. I think in Miami though they have had training at the Star Centre

Q: Would you say you have built up a repertoire of possible manoeuvring possibilities.

A:Yes I would say so

Q:So when you are training other then do you break it down into those different manoeuvres, some being emergency and some being routine

A:Yes I would say so

Q: When you started using azipods was there anything counter intuitive, that is to say it was doing the opposite to what you thought it was going to do

A: When I first learned about the azipods the thing that was most surprising was that it was pulling pod rather than pushing so we had to change the mind set to actually turn to starboard the propeller goes to port but once you got over that its okay

Q:Most of the equipment you have sailed with has been the same being ABB

A:Yes

Q: They have all been twin podded, you don't have any single pods

A:No we don't have any of those.

Q: Is there anything you want to add about procedures and manuals

A: Not really but like I said you need to know these by heart.

Q:Do any of these procedures and manuals apply to the Pilot

A: Not really. There is nothing that applies directly to the Pilot.

Q: The Pilot has to dovetail into your bridge team quite quickly do you have any thoughts on this may happen

A: You should always include the Pilot in the team, its suppose to be one team although it varies from Country to Country and from Port to Port

Q: As younger Pilots progress through their career they have to trip onboard various types of ships but at the moment there is no requirement, particularly here in Southampton, for them to do that on azipod ships

A: I think that it is a good idea, every ship is unique.

Q: Going back to the manuals, one of the things we have noticed in reading accident reports a lot of them occur during the transfer of control from the central console to the bridge wing or vice versa. Do you have a set procedure for transfer of control

A: That cannot happen here, if I move from the centre to the bridge wing I can take control regardless of the position on the centre console, I can override it. We have the Pilot/Co- Pilot System onboard, the OOW is the Pilot and the person doing the manoeuvring is the Co-Pilot they sit in the cockpit together. When you approach the dock the Co-Pilot moves to the bridge wing and control remain in the centre console. When the Co- Pilot gets everything set up at the bridge wing controls as he wants it he makes it very clear that he is taking control, takes the thrusters and azipods by pressing the buttons at the wing console then you have control.

Q: Some ships buttons are pressed at the centre console and everyone runs over to the wing and hopes control has been transferred so it is quite different here

A:Yes, if something should go wrong the Pilot has remained at the centre

Q: In terms of the controls you have are you happy with the design of them and how they feel, are there any notches to give you any indication when you have gone through 90º

A: No, they work very well but then I am use to them, the only comment I would make is that they are very small and it is not a clear notch when you go to zero so you might actually be at +1 or -1

Q: When you have the controls in your hands does your brain know instinctively what is happening or do you have to keep looking at the screen to see what power or direction you have

A: I know what is happening

Q: Its instinctive

A :Yes

Q: What is your personal strategy on using vectors in your head when you have one pod pointing in a certain direction and you want the ship to go a certain way, can you describe what your brain is trying to do

A: Yes, when we are doing an approach to the berth we transfer control to the bridge wing we have less than a mile, maybe ½ mile to go approaching the berth, the bridge wing is set up and the first thing I normally do is take control of the bow thrusters then the azipods then I will turn them inwards, like a transverse arrest, this is ready to take the speed off, as the speed comes off if she starts to turn into the wind or is affected by current I do not have to turn the pods around ready to lift the stern. On the final approach I adjust the angles slightly to control the speed if necessary. The pods turn quickly, we have four different speeds, during manoeuvring we always have two pumps on each pod at all times and the pod turns quite quickly, if it becomes critical then we can go to fast op that will increase the oil pressure and double the speed the pod turns.

Q: In your personnel opinion what was the most difficult thing about manoeuvring with pods while you were learning

A: It's hard to say, from the beginning we used the t bone which is like using the pod as a stern thruster, I did this for maybe a year then we started to play with angles, the only reason we started to play with angles was because of the problems with thrust bearings and the need to use only positive rpm so that was the beginning and since then many people are using the pods more. Some people use them in the opposite direction, that is outboard, using the pod outboard has risks, putting water onto the other pod or on to the skeg, having them inboard you will always have clean water flow and positive rpm.

Q: So it is not what the ship is doing it is what the water is doing

A: Exactly, when I was Staff Captain one Captain was insisting that I used them outboard he was convinced that was the way to do it, I did it because he told me too but I found out afterwards that operating them inboard was much more efficient.

Q: In terms of the instruments can you explain how they work for you

A: Here we have the conning speed in the docking mode, we have different views depending on which bridge wing we are on with the bow facing forward. You have the vectors showing the bow and stern movement, for manoeuvring we can have different vector lengths, I prefer 90 sec, this becomes more useful as you approach the berth as it gives you an idea of the trend and you can make sure you are going in the right direction and of course you have the additional radar vector.

Q: While you have information from this screen do you look much as the dials showing the pods are doing

A: Yes, when I go into aziman I have independent control.

Q: In your head are you using numbers for example so much pitch ahead to slow down

A: Yes I think that's the part that takes the longest time to learn the speed and propeller match takes time to learn. In some ports you have to stop the ship in a shorter distance and use more power but it is no problem because the ship stops quickly. If you are doing 4 or 5knts ahead and put the pods astern to 2 or 3 the ship will stop in one ships length, sometimes you stop too quickly and you have to start again.

Q. Do you find that some of the Ports you go into that room is very tight, and does this create problems for you.

A: Yes, the Ports are the same but the ships are getting bigger with more power so ship handling today is different. Ships were underpowered and you would have used the wind and current and you had more space because the ships were smaller but today the Ports are very small it is more about precision and position.

Q: This equipment is laid out for the ship going ahead but what happens when you have to back a long way to the berth.

A: That's why I stand side on to overcome that problem so I can look both ways.

Q: There are obviously limitations about what you can do with the pods and the problems of cavitation, do you know when these limitations are being reached by vibration or would it be better if there was some other form of warning to you.

A: I don't know, it's a good point but we have alarms.

Q:In the operating guidelines the power curves show 100% but this does not always happen and I wonder if there should be some feedback to warn you when you are not getting the best out of the system

A: I think you have to learn it.

Q: Perhaps to finish of with we can talk about automation. You have a joystick here how do you use that.

A: We never use the joystick, I don't think any Captain uses the joystick to dock the ship. We use the DP system instead of anchoring. The joystick I don't find very good, it uses too much power I think it is softer, more gentle to do it by hand.

Q: Have you ever had to use tugs anywhere

A: Since I came to this ship no - we have never used tugs but I have used tugs.

Q: How did that work.

A: That is work for the Pilot . But then again it is a big ship so a small tug at the back does not really do much for you when you have so much power.

Q: Are you familiar about the terminology pivot points

A: Yes, it part of our simulator training at College and very much in my thinking and I teach my Officers, particularly about use of bow thrust when you have headway not being very effective yet a short kick on the pods will do a lot for you.

Q: We have three documents onboard we are interested in, the Pilot Card which I already have a copy of, the Bridge Poster and the Manouvering Booklet. Your Bridge Poster do you find this a good way of displaying the information compared with a conventional ship or do you think it should be displayed differently about your ship.

A: It gives you the information you need but some of this information I have in the Manual, like the crash stop. The Bridge Poster is not something we use every day.

Q: Do you find many Pilots take much interest in this poster

A: No they don't, maybe only the squat when entering shallow water.

Q: Looking at your Pilot Card the bit I am really interested in the part under the water, I cannot see, if I can visualise the position of the pods, the type of stern you have, maybe a skeg I can better understand. Sometimes a photograph of the ship in dry dock would help.

A: I have these pictures to show.

Q: The Manoeuvring Booklet is down in your office somewhere.

A: The Manoeuvring Booklet, what's that

Q: Most ships have a Manoeuvring Booklet which contains trials information

A: I am not sure if we have that I would have to look for it

Q: Is there anything you think we have missed

A: No I think we have covered everything

Interview n°3

Interview made by UKMPA with the Master of the 'Queen Victoria'

Q: Thanks for having us along on what we know is a busy day for you. The Queen Victoria has 2 pods and three bow thrusters of with a total of 8800hp. Perhaps we could start by asking your age?

A: I am 55.

Q: Perhaps you could give us a run through of your career to date?

A: I started as a BP Tanker Company as a deck cadet. I then moved to Bibby Line as third officer mainly on LPG tankers, then I went to work on coastal ships for 10 years with Hullgate Shipping of Grimsby. In 1997 I moved to Cunard as second officer, being promoted through the ranks and becoming Master of the Queen Elizabeth II until her retirement, then I moved here to Queen Victoria.

Q: I don't know if you are familiar with the term ACD – Azimuth Control Devices – but that appears to be the adopted phrase to describe not just podded ships but also tugs and some coasters that have a z drive, so during your time on coasters I suspect you did some ship handling?

A: Yes but they were all either conventional fixed pitch single propeller or maybe cpp with single propeller and rudder, very conventional.

Q: Prior to coming to the Queen Victoria this was the first time you had come across azimuthing devices?

A: Yes that's right.

Q: The Term ACD is that one you have come across before?

A: Only on tugs really, from our side of the industry everyone calls them podded ships.

Q: ABB have cornered the term 'azipod' as their patent but on the QM2 for example with Rolls Royce do they still call them azipods?

A: Yes but Mermaid azipods.

Q: Let's move onto the training now. Could you perhaps explain where you are with azipod training?

A: Before I joined Queen Victoria for the first time, I went to the simulator at FORCE Technology in Lyngby and having done the normal Bridge Team Management Course that Carnival arrange, that was followed up by 1½ days of pure azipod training on the simulator. When I joined the ship I had a run from Hong Kong to Singapore with the Master onboard at the time. This amounted to about 10 days of onboard training from him and manoeuvring with him supervising.

Q: What do you think was the most important thing you picked up from the training?

A: I think the thing that we learnt in Lyngby was some of the theory of how a pod works because it is something completely different. I think the thing we had to understand first and foremost was that the pod was pulling you through the water and not pushing you through the

water. On this ship we have restrictions on the pods in that we are not allowed to reverse the motors and we are not allowed to operate the motors with anything less than 25rpm because the Company and the manufacturer are concerned about the bearings more than anything else. I know that is a completely different way to how, for example, RCCL operate their pods. I am not sure how NCL use their pods but on here you are restricted to a minimum number of revolutions and they do not want you to reverse the motor in the pod unless it is an emergency, so we do lot of azimuthing the pod itself to get the direction and control that we need.

Q: Have you found that intuitive in how you do that?

A: No, you have got to think, you have got to think an awful lot. If you talk to RCCL Officers when they are manoeuvring they put their pods at outboard 30º with the pod facing ahead and they will quite happily reverse the motor, while on here we have to turn the pod, so you are thinking about two things rather than one thing. You are thinking about the revolutions to control momentum and the pod direction to achieve the desires direction.

Q: With the engineering restriction you have on reversing the pod and the problems that might cause what is the reason for the minimum 25rpm?

A: It is to avoid the shock load on the bearing ring; it is an engineering problem and is referred to in an independent report prepared for the Company and to reduce the likelihood of bearing failure caused by loss of or contaminated oil on the bearing. In the pod room there is a unit that continuously filters the oil before it goes to the bearing. So by not reversing the motor or dropping the rpm to zero you are reducing the chance of shock loading the bearing.

Q: In a marine environment that is quite a tall order?

A: It is, it is a lot to think about. You are always worried about the mechanics of the bearing at the stern unless there is an emergency of course and then you will do what is necessary.

Q: Returning to the training do you think what you had was sufficient or if you had to do it again you would do anything different?

A: The Centre in Lyngby was very good and the Instructor was very good. He had a copy of the restrictions we have in place, so it could be made very realistic to what you were going to experience onboard the ship but 1½ days is not a lot of time in a simulator to get your head around a completely new way of handling a ship. It is not enough and although the Instructor was good there were only two of us on the Course and he basically asked us what we wanted to do. What we wanted to learn to do was to get the ship in and out of Ports, to put the ship alongside and lift off and to turn in tight areas. That's what you want to do and that's what we did taking it turn about for 1½ days so there was little time for theory or planning exercises.

Q: If the Course had been a bit longer, say 5 days, that would have sufficed?

A: Yes, I think the five day Course arriving on the Monday morning and finish on the Friday afternoon would have made it a little more relaxed and less intense and give time to plan exercises to discuss and to talk and to go over things you have done wrong and give you time to correct them before moving onto the next exercise.

Q: An important part of the week is that everyone is in the same hotel talking to each other over a meal and comparing notes?

A; Yes that's right, but that is not going to happen in one night.

Q: Are you aware that there are two manned model Centres in Europe that operate podded models?

A: No I didn't, sounds very interesting.

Q: Have you come across the terms 'positive and negative thrust' because if you have to keep 25rpm and turn the pod it would imply that at some time you would have negative thrust?

A: I am not aware of those terms but we have what we call neutral effect by turning both pods inboard 90º at 30rpm so they are both facing each other. Different terminology. We will be attending Carnivals simulator training unit in Amsterdam were we will be doing our Bridge control and command courses and I would expect azipod training to be in there.

Q: What training have other members of the Bridge team had with azipods?

A: Nothing. The other Master Capt. Wright, was on the start up team for QM2 so he, along with all the Officers went to the Star Centre in Miami and had a full five day course.

Q: There is an M Notice - M1015 entitled Training for Masters and Chief Mates of large ships and ships with unusual manoeuvring characteristics. I would have thought that applied to podded ships?

A: Yes, it is a complete change of life style and I had to be persistent in getting on the simulator at Lyngby. Pods are not easy and it is a completely different mind-set. Yes, it gives you more control but if you do not understand them properly your expectations of what you can do can run away with you. The technology is amazing but the amount of power you have available is limited and there are definite limitations in what you can safely do and it is difficult to get personnel in Company Offices to understand those limitations. For example, they perhaps think that because you have pods then there will never be a need to have tugs.

Q: Going back to the training. It would appear there are perhaps two areas to focus on. Firstly the operational side of how to use the equipment and what restrictions there are from an engineering point of view and how to control them from the bridge of the ship. Secondly, there is actually using them which is a new concept even for an experienced mariner?

A: Yes and of course and that does not come in 1½ days.

Q: The Marine Industry still seems to learn by its mistakes. Are you aware of other problems with podded ships which may have altered the way you do things onboard here? I understand this ship had an incident in Valetta, what came out of that?

A: That was a problem to do with the lack of synchronisation between the centre and wing console when moving out to the bridge wing. On here the control handles are not synchronised so when you move from one control position to another you have to be very careful on what is set before pressing the takeover button. It has to be the same because whatever you have set will be what the pods will go to very quickly. The problem in Valetta was that when the Captain moved from centre console to wing consol not only where the control levers not synchronised but the actual change over process was not carried out properly, so when the Captain thought he was manoeuvring the vessel he wasn't and the Officer at the centre console who was looking at the controls did not fully understand what was happening and was reticent in speaking up. We now have a strict protocol to follow when changing over control position and everyone is aware that this protocol must be followed. I understand that when Queen Elizabeth arrives changes have been made to make sure all the control levers are synchronised.

Q: What is the protocol now?

A: I am in the middle with the Pilot with the navigator. When we are ready to move to the bridge wing the Staff Captain will move over to the wing console. We will say 'synchronise' and he will move the controls of the pods and the bow thruster, if necessary, to the same alignment as that at the centre of the ship. When he is ready he will say he is ready to take control and I say 'Take Control' on the bridge wing. The Staff Captain will press the button and give a positive report that he has control and we move over to the bridge wing. We of course have to choose an appropriate time when to do that so we do not do that at a critical part of the manoeuvre. There are two lessons learnt there, how to change control and when to change control.

Q: Staying with the training, do you think it is best to do the training before you arrive onboard and see the technology or do you think you see the technology and then go and do training?

A: You should do the training first. It is such a different way of driving a ship from the conventional ship. If you had no training whatsoever you could be overwhelmed by what you find.

Q: Is it realistic to get Companies to fund such training or perhaps training should be mandatory rather than left to the individual company?

A: The M Notice is pointing you in the right direction but it is not mandatory. If you consider the risks of what could go wrong, pollution, damage to the port infrastructure or the ship itself and any liability that would attach then commonsense would suggest
training is necessary but sadly our industry only does things when it is mandatory.

Q: When you went to Lyngby where you content on going on your own or should your bridge team have been with you?

A: Ideally you want to go with your Bridge Team but on here all the Officers have been onboard for a year, I was the newcomer so that time on my own was very good. No one should be embarrassed about making mistakes and nobody should be embarrassed about putting their hands up to admit they do not understand what is happening. We have a good team here and nobody is afraid to say you have got the pod pointing the wrong way. That couple of days for someone in my position on my own was invaluable.

Q: So two students and one instructor was a good ratio?

A: Yes, for what we were doing definitely.

Q: What part do you think human factors have to play in operating pods?

A: There are a lot more procedures to follow because the technology is more complicated and with these complications there have to be more involved procedures, to ensure you are using the technology and operating the equipment correctly, because if you do get a pod failure on here it can be catastrophic. If you lose a pod it is not a quick fix, so you have to very precise with your procedures.

Q: Most seafarers are not good at sitting in classrooms for hours on end listening to theory. Do you think the Course in Lyngby was balanced between the theory and the practical?

A: The Instructor was very aware he had a very short time period to teach us so the theory was less than one hour. I think there is more room to talk about how the pod works, what it can do and what it cannot do and to discuss how to approach things and why you approach it in that manner. He did a very good job in the time available.

Q: The Course itself had some set objectives, do you think these where achieved?

A: There was no examination, no pass or fail. What should have been achieved was me being competent to come here. Now I understand the pods, I understand the theory from being in the simulator and having a few days hand over. This was not achieved by the Course alone, it was too short, so when you do come here after a short course you have a reasonable idea of what is going on but there is still a lot to learn during the handover. Fortunately the other Master and I know each other very well, so there is no embarrassment in asking questions. This might not have been the case with a different Captain and a lot of knowledge might have been missed during the handover.

Q: One of the things we found from NCL Masters was that because they have been operating podded ships for a number of years the way they operate pods has evolved, so what was best practice in 2002 has been superseded. While the training that you have had may be sufficient or it may be that there are better ways of doing things; how do you think the training may reflect that?

A: There is a need within the industry and in particular within the cruise industry for knowledge to be passed around between Companies. In the Carnival group alone we have Carnival ships themselves with azipods, the Holland America Line with their Vista Class ships, P&O's Arcadia and at the moment there is no way of sharing experience, which is wrong really with so many ships going to the same places with the same problems with turning circles, docks, Pilots etc..

Q: In terms of adapting to the technology, do you think age and ability presents any barriers?

A: No I do not think so, that is down to personnel attitude. The way our industry has changed you have to adapt to new technology, if you do not you become a dinosaur very quickly.

Q: Looking at it more from a Pilots perspective we are aware that very few Pilots have had any training at all, yet coming onboard different ships operated by different Companies, we have to fit into the Bridge Team and we find that the terminology used varies a great deal for what is effectively the same thing?

A: One of the points we have raised at our Bridge Team Courses is that Pilots should be involved, particularly here in Southampton where we have our dedicated Pilots.

Q: Presumably then Pilots do not do the berthing, just the channel transit?

A: Yes but the day comes when everybody needs and extra pair of hands, an extra set of eyes or expertise. We both need to fully understand what the limits and capability of the ships is and the only way you are going to get that is by training on the simulator and onboard the ship together.

Q: If you go to an obscure Port how does the Pilot integrate into the Bridge team, when he comes across technology that he has not seen before?

A: Very difficult. Our Bridge course goes through the whole briefing process and how the Pilot should be involved. Pilot abilities vary greatly and consequently the way you deal with them varies but that comes down to your own experience.

Q: Do you feel that you have built up a methodology of handling ships depending on the port you are going into or are you doing something different each time?

A: Each Port presents its own problems. This next cruise sees us visiting very different Ports and once again it is down to experience, getting the approach right. We do tend to go to the same Ports each year so this helps gaining that necessary experience.

Q: We see the increase in ship size yet the Port remains the same. Do you find yourself expected to do more critical manoeuvring with this ship than you do with a conventional ship?

A: Yes. Marketing are always looking for new Ports and a lot of pressure to put ships into places that 20 years ago you would not have envisaged going to.

Q: With the modern aids ships have onboard, electronic displays and enhanced manoeuvring, we see ships turning in places they would not have done in the past. The new aids we have seem to be increasing the risks that we are taking, which is fine if all goes well?

A: Yes we are doing things now we did not do years ago, there is more pressure on you to perform and perform under quite stressful situations.

Q: Was there anything that is counter intuitive when you started using the pods, anything mistakes you kept making, you knew it was wrong but you kept doing it?

A: No not really, it all came together.

Q: What indicators do you use to make the ship do what you want it to do?

A: On here it is quite easy, you point the pod in the direction you want the stern to go. We do not reverse the pod. You have to be careful not to send wash from one pod on to the other so that needs thinking about.

Q: Which do you generally find easier, backing into the berth using the bow thruster to steer or going in bow first and then using the pods to steer?

A: Backing in is quite nice on here because of the propulsion configuration, so in a lot of places we prefer to swing and back in so that we are head out.

Q: On the simulator, did you train on the same equipment that you have here?

A: No, it's not 'NACOS' Equipment. The simulator in Amsterdam has this equipment for us to train on, including the bridge wing console.

Q: So you did not have the opportunity to try different configurations and if you move to the QM2 you would want to have training on her equipment?

A; Yes, as she is completely different to this.

Q: Where are you with documentation?

A: The documentation onboard tends to be telling us what not to do, rather than what to do. We have our own notes that we write out which is only for the Bridge team. We write what we did at each port and this remains on the bridge. The makers manuals are very large.

Q: What happens then when a new officer arrives onboard, what training would he/she receive?

A: They would not be on their own. They would have at least one week as an extra. The manuals and procedures for the Bridge Team are quite comprehensive so he/she would not come in completely new and be left on watch on their own.

Q: Perhaps you can talk us through how the Bridge team operate?

A: In the middle the navigator sits in the starboard chair and the co-navigator sits in the port chair. The Pilot sits over here and has this radar unit, while I stand in the middle where I can oversee what everyone is doing. When approaching the berth we come out of 'manoeuvring direct' mode, which takes steering away from the helmsman and then we can start reducing speed. At about 500m before we start swinging; the pods will be set to normally inboard 90º with 30 rpm on each, we switch to 'Aziman', the bow thrusters are already on line so we can now steer the ship by a combination of pods and bow thrusters. We can use the pods with 30 rpm and changing their direction to slow the ship down and stop her in the swinging circle. Once we are ready to start turning we put the pods to inboard 90º. Its now time to change to the bridge wing and we go through the protocol described earlier. With the pods inboard 90º and in a neutral position it is a safe time to change control position.

Q: You are quite confident that the change-over will work?

A: It's two buttons and there is an audible alarm and a visual change in the colour of the buttons to confirm the change-over has taken place. The Staff Captain is already here and confirms to me the position of the pods and bow thruster, and then stands aside. I will always operate the pod controls, I never let the Pilot operate them. The amount of information right in front of you includes the visual displays with the Doppler showing the bow and stern movements and the position and revolutions on each pod.