E-navigation Applications by Marine Pilots

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INTRODUCTION

SLIDE 1 - TITLE

Marine pilots have always supported the development and adoption of advanced navigation technology to help achieve the objective of safe and efficient navigation. The situation is not different with e-navigation.

In fact, I believe that some of the most compelling initiatives involving e-navigation around the world are currently led by pilots. As such, pilots are well-placed to assist with effectively moving e-navigation forward and to determine how it can best be integrated into pilotage practices.

Pilots are familiar with e-nav because they have already adopted electronic marine navigation and make extensive use of it, through systems such as:

- high-integrity electronic positioning systems,
- electronic navigational charts and related display systems, and
- vessel traffic monitoring capabilities.

As the member of the IMPA executive designated to follow the e-navigation file, I am certainly mindful of the fact that the IMO concept of e-navigation is much broader than any of the specific systems, I just mentioned. At the same time, I do believe there is value in taking a look with you at one of the most interesting e-nav applications currently used by pilots, that is, pilot portable units or PPUs as they are usually referred to

The purpose of my presentation here is not to advocate for something in particular but rather to share information with you and provide you with a demonstration of how pilots actually use PPUs as they discharge their duties.

WHAT IS A PILOT PORTABLE UNIT?

SLIDE 2 – PILOT PORTABLE UNIT

So, what *is* a PPU?

A PPU can be generally described as a portable, computer-based system that pilots bring onboard a vessel to use as a decision-support tool for navigating in confined waters.

Interfaced with a positioning sensor such as GPS/DGPS and using some form of electronic chart display, it shows the vessel's position and movement in real-time. In addition, PPUs can provide information about the location and movement of other vessels via an AIS interface.

Increasingly, PPUs are also being used to display other types of navigation-related information such as corrected depths from recent surveys, water levels, ice coverage, and security zones. Moreover, through the internet, it is also possible to have access to even more information.

For example, on the St. Lawrence River where I pilot, I can access port and waterway information, via a dedicated Canadian Coast Guard website. In the future, this data will be accessible in real-time through Wi-Fi coverage all along the River and will also include real-time squat information and webcams which will relay real-time visibility and ice condition updates.

A PPU is therefore one of the many tools that pilots can use to assist them with the safe navigation of vessels.

Typically, PPUs can be set up quickly on the bridge with simple deployment of the navigation antennas and connection using wireless technology to a laptop computer positioned where the pilot normally navigates.

On this slide, you can see the laptop, pilot plus and wireless interface. I also brought my own PPU and, for those interested, I'll be delighted to show it to you after the presentation.

SLIDE 3 – PILOT PLUG

Here is a photograph of a pilot plug. This is what allows the PPU to receive information from the ship's sensors. It is very reliable and sends the information either via Bluetooth or through a Wi-Fi system.

SLIDE 4 – PILOT PORTABLE UNIT (2)

Now a word about the hardware and software used by pilots in their PPUs.

Hardware

- While most pilots are allowed to choose their own equipment, of the 500 PPUs which Dr. Lee Alexander surveyed in the study he made on the use of PPUs by pilots in various jurisdictions around the world in 2007, over 50% were ruggedized notebooks. This essentially means that they are compatible for use in a tough, demanding, maritime environment.
- Most PPUs use the ship's power but also carry batteries; a screen size of 15 inches is most frequent. The PPU's weight is not a problem to climb the pilot ladder.

Software

- The software used varies widely – because of the complexity and diversity of pilots' needs in the various districts in which they operate. A one-size-fits-all approach clearly could not work and would not optimize safety!
- Most software is therefore customized to meet specific needs. In North America, pilots tend to prefer simple displays but this can vary significantly from place to place.

SLIDE 5 – FRASER RIVER (FIRST SLIDE)

For example, on the Fraser River in British Columbia, in Canada, the main concern of pilots is that the bed of the River is constantly changing. Because of this, they need a PPU system that allows them to easily integrate sounding data shortly after it is released so they can rely on real-time water level information.

SLIDE 6 – FRASER RIVER (SECOND SLIDE)

Because of their specific needs and the choices they have made, the display of their PPU looks like this.

SLIDE 7 – COLUMBIA RIVER (FIRST SLIDE)

On the other hand, the needs of the pilots operating on the Columbia River in the United States are more focused on knowing the location and movement of other vessels.

Accordingly, the display of information on their PPUs puts in evidence other elements of information and looks like this:

SLIDE 8 – COLUMBIA RIVER (SECOND SLIDE)

Here, the use of AIS is crucial and the PPU actually computes "meeting points".

SLIDE 9 – HALIFAX (FIRST SLIDE – PHOTOGRAPH OF THE BRIDGE)

In Halifax, Nova Scotia, marine pilots had to face the challenge of bringing 48 metres-high vessels under two suspension bridges where the clearance at high water is 46.9 metres. This sounds incredible and, in many ways it is!

SLIDE 10 – HALIFAX (SECOND SLIDE – TEXT)

Working in close collaboration with the Bridge Commission, pilots found a way to provide for the safe passage of such vessels by relying on DGPS receivers installed at strategic locations on the bridges.

Using real-time information regarding the motion of the bridges – whose exact height changes as the temperature changes – in combination with real-time water and tidal level information, pilots are able to obtain very precise air draught measurements and, as a result, plan for the optimal time to allow for the passage of the vessels.

SLIDE 11 – HALIFAX (THIRD SLIDE – DISPLAY)

Here is what Halifax pilots see on their PPUs.

I could cite many other examples (Antwerp, Tampa Bay etc…) of the work pilots do with electronic navigation applications, and I'm sure you would find each of them fascinating in their own way, but let's come back to the main features of PPUs, so as to complete the picture of what they are.

Electronic Chart Data:

- Most PPUs use S-57 ENC or RNC data provided by a hydrographic office but they also rely on much larger-scale data provided by other government agencies.
- Some even make an innovative use of other geo-spatial information such as *Google Earth*.

GPS/DGPS

- Most pilots use the ship's GPS/DGPS position as provided by the pilot plug.
- However, many also carry their own GPS/DGPS units and will deploy them as appropriate. This allows pilots to compare information from two different sources which can certainly prove very helpful – as we will see in an example in a few moments.
- It is also worth noting that European pilots tend to use RTK GPS for precise docking.

Heading

- Heading information is usually obtained via the pilot plug.
- Some pilots now use special dual-antenna DGPS for heading.
- And some European docking pilots use rate-of-turn sensors.

AIS

- All pilots access this information via the pilot plug.

HOW DO PILOTS USE PPUs?

So, armed with all this information, how exactly do pilots use their PPUs in the real life?

SLIDE 12 – PILOTS TRAIN WITH THEIR PPU

First, it is worth underlining that pilots typically receive extensive training in the use of their PPUs and that this training – as in everything they do – is specifically designed to enable them to make the most of this tool in the specific waterway for which they have been licensed.

It is the combination of pilots' expert local knowledge and the specialized training they receive that really allows them to make the most of this tool.

Often, this training will take place in state-of-the-art simulation facilities – as we can see on this slide – where pilots will be able to use their PPUs in exactly the same way that they use it when piloting vessels.

At the same time, it is also important to emphasize that PPUs and other e-nav applications – as good as they are – are really just other tools that pilots have at their disposal to inform their decisions and that they never ever can be used as the sole basis for decision-making.

As I often say, looking out the window remains essential! Actually, I'm not the only one to say this, as it is also what IMPA believes.

SLIDE 13 – IMPA POSITION STATEMENT ON E-NAVIGATION

This is why, earlier this year, IMPA adopted a Position Statement on e-navigation that will guide our participation in the work that continues in respect of e-nav.

The Position Statement sets out three basic principles that IMPA believes must remain at the centre of the implementation of e-navigation.

1. Predominance of the Human Element

E-navigation must reflect the fact that mariners are the most critical factor in safe navigation. This means that the expert human element **on the bridge** must be at the centre of decision-making.

2. Meeting the Needs of the Bridge Team and the Pilot

E-Navigation must – first and foremost – give priority to responding to the needs of the bridge team and the pilot, and facilitate the tasks they perform.

3. Looking Out the Window Remains Essential

E-navigation must recognize the value of information obtained through **other** means. To ensure safe navigation, e-navigation data must be complemented and validated through all the other traditional methods available to pilots.

Now, let's move on to the more dynamic part of the presentation! I have a few examples here for you that illustrate the type of information that we get with our PPUs, and which give a sense of how useful they can be.

SLIDE 14 – OOCL MONTREAL PLAYBACK

This recording – which was obtained from the PPU that I use in my pilotage district, on the Lower St. Lawrence – shows how this information can be very useful for many important reasons (description of playback, as it unfolds):

a) collision avoidance

- traffic report (situational awareness)
- vessel ID (from AIS targets)
- vessel heading (gyro heading provided via AIS from other ship)

b) grounding avoidance

- under-keel clearance (from tide gage; provided every 3 minutes)
- distance to navigation features

c) route planning/monitoring (ownship)

- Position relative to navigational corridor
- Time to go/time-to-turn
- Distance to go/distance to turn

d) customized information

- As mentioned, the PPU really is a pilot's own navigational tool, used to display only the information that he really needs based on the situation he is facing. The tool is flexible and can easily be customized, as a result of changing circumstances.

SLIDE 15 – HAI BAO PLAYBACK

SEGMENT 1 – UNBERTHING

- Here is an example of erroneous information provided by the ship's GPS. While the information provided by my PPU was not recorded, it was very useful when it was displayed during the assignment as it allowed me to have much better situational awareness. This type of information will be recorded in the future.

SEGMENT 2 – NEARING A SHOAL

- Demonstration of how a PPU can integrate valuable information (i.e., regarding the presence of shoals) that is NOT available to the ship.

SLIDE 16 – GPS OFFSET ERROR OR INCORRECT DATUM (BALSA)

- Here's another example of what pilots sometimes face when all they have at their disposal is the information provided by the vessel they pilot.
- In this example, a vessel is shown to be outside the navigation channel while, for its part, the pilot's PPU shows it is in the channel.
- Clearly, if the pilot did not have a PPU, then he would not have the right electronic information.

SLIDE 17 – INCORRECT AIS GPS POSITION (BROTHER GLORY)

- Again, in this example, the information provided by the ship's sensors suggested that the vessel was outside the channel when it actually was inside the channel – as shown by the pilot's PPU.

CONCLUSION

I think it is clear that PPUs are valuable tools that support the decision-making process of pilots.

One of the messages I want to leave with you is that the development of this tool has really been driven by the specific needs of each pilot group. In that sense, the development of PPUs has really been user-driven and has been facilitated by the freedom pilots had to experiment and to innovate, in accordance

with their own requirements. At this stage, pilots don't need more information as much as they need it quicker and better.

SLIDE 18 – STANDARDIZATION V. CUSTOMIZATION

PPUs are now not only commonly used virtually everywhere but the flexibility pilots have in their respect means that they have not finished innovating and that many further developments should still be expected.

It is important that PPUs remain easily open to improvement and change, based on the latest technology available, so as to give their full value. As a pilot, I am concerned that any effort to standardize PPUs would actually have the very detrimental effect of stifling innovation.

As every pilotage district is intrinsically different, no single PPU is capable of meeting all needs. And so, in many ways, the development of PPUs has been very much in line with the IMO's Resolution A960 which recognizes that each pilotage district, by nature, requires specific approaches.

Pilots know what information is needed, and how to obtain and use it. PPUs are a good example of how pilots can be both practical and innovative and – in collaboration with all stakeholders – of how they can help overcome gaps in the functional capabilities of existing shipboard equipment and systems.

At the same time, with the increasing use of PPUs worldwide, IMPA considered it would be useful for its members to establish a few general points of reference on the design and use of this tool and which pilots could consider as they develop the solutions that fit their needs.

IMPA's guidelines – which were developed last year with the technical input of CIRM, the International Association for Marine Electronics Companies – are not intended to be used as detailed specifications for PPUs.

However, they will ensure that PPUs are used in a manner that meets IMO requirements (i.e., SOLAS, Chapter V, Regulation 17 and Resolutions A694, A813 and A830) (compass safe distance and electromagnetic compatibility) and that does not interfere in any way with the existing bridge navigation equipment or procedures.

In concluding, I would like to thank Capt. Singhotta for his kind invitation to present today and am available for your questions.