

A Case Study on the Creation and Use of a Bridge Simulator

Sub-Lieutenant Donald Figol

This is a case study of how a commercial-grade ship's bridge simulator was developed at very modest cost and has acted as a catalyst to enhanced training experiences for both Primary Reserve personnel and Sea Cadets. In this article I will begin with a brief overview of the bridge simulator's physical set-up and capabilities. Next I will discuss how this project evolved, developing a positive feedback loop between our Sea Cadet unit and our host Primary Reserve unit, HMCS *Tecumseh*. Finally, for those who are interested, I have set out the technical details of constructing the bridge simulator.

By way of background, I am a Cadet Instructor Cadre (CIC) Canadian Armed Forces (CAF) Sub-Lieutenant assigned to work with Royal Canadian Sea Cadet Corps *Undaunted* in Calgary. Sea Cadets is a program jointly sponsored by the Department of National Defence (DND) and the Navy League of Canada. The aims of the Sea Cadet program are to promote citizenship, leadership and physical fitness to stimulate an interest in both the sea and the RCN for individuals age 12 to 18. Given the 1,000-kilometre distance from Calgary to saltwater, this latter aim is something of a challenge.

The Sea Cadet program has units across the country and is staffed with CIC officers (who are members of the CAF Reserve Subcomponent Cadet Organization Administration and Training Service), along with civilian instructors and volunteers. Funding comes from both DND and fundraising by local Navy League branches. The Sea Cadet program involves a diverse range of activities, some mandatory and some optional, including sailing, band, drill, marksmanship, biathlon and seamanship training. In my experience, the program is excellent at developing leadership skills and confidence in youth.

The VSTEP Bridge Simulator

With the support of the Calgary Navy League Branch, individual donors and a terrific vendor, we have created a bridge simulator with the following attributes:

- a set of three external view screens which give an approximate 120-degree forward-facing view;
- an overhead engine and rudder order panel, along with two 'binocular monitors' controlled by handheld controllers that can view 360 degrees and zoom in on targets;
- fully functional MARIS radar and Electronic Chart Display and Information System (ECDIS) display;



*RCN sailors operate the bridge simulator set up in a building co-located with HMCS *Tecumseh*.*

- a helm console featuring an engine and rudder display, along with real engine order telegraphs and helm controls; and
- a gyro repeater, mounted on a stand, with an accompanying pelorus.

A key element of any simulator is that it must be immersive, the trainees must suspend their disbelief in order to act (and therefore learn) as if they were on a ship's bridge. In this aspect, and as will be discussed in greater detail below, the software is critical. The VSTEP NAUTIS software platform is exquisite in the detail and realism of its external views.¹ By way of example, if you zoom in on a building with the binoculars you will often be greeted by curtains and flowerpots in windows.

The NAUTIS software provides five different locales: San Francisco Bay and its approaches; New York and its approaches; the Bosphorus Strait (connecting the Mediterranean, via the Sea of Marmara, to the Black Sea through Turkey); the English Channel; and Hong Kong. Additionally, an open ocean scenario can be simulated.

Any sea state, weather (rain, thunder, snow, etc.) and time of day can be simulated, either in the simulation set-up or at the press of a button. VSTEP provides a large number of target ships which follow a programmed route (route followers) and trainee ships which can be operated (a Damen

4207 patrol craft is used as a stand-in for an *Orca*-class patrol vessel). The physics of each ship replicates the actual vessel. The programming of each simulation is done separately and is very easy and intuitive. Important details, such as speed and a ship's light state, can be programmed for each route follower.

Mutual Challenges and Mutual Solutions

Once we created the initial bridge simulator set-up, the first challenge was my own lack of training on RCN ship-handling procedures. One of the rules we established for the simulator is that it would always be operated using RCN procedures. An early solution came in the form of a fellow CIC officer who had completed the CIC Tender Officer in Charge course. That and background reading materials got our cadets working on the simulator, primarily for three hours each Saturday morning as part of a newly created Boatswain Mate Training Program (BM-TP). Broken into port and starboard watches, one watch is on the bridge simulator while the other conducts other boatswain-related activities (shipboard firefighting, ropework, etc.).

The BMTP quickly established a dedicated group of 15 to 20 participants among our cadets. It has proven to be an excellent platform for developing confidence, teamwork and leadership. At first intimidated by the sophisticated technology of the bridge simulator, I have found that our cadets quickly mastered the required skills. Hooking and reporting a radar contact, recommending a course change

from the ECDIS to stay on track and taking helm and engine order telegraph orders are all learned. With these skills has come a growing confidence among the cadets and, along with this confidence, comes the realization that only when working as a cohesive team can the ship be safely conned.

Building on those skills, cadets grow to take on the role of Officer of the Watch. This involves receiving reports from lookouts, radar and ECDIS, taking fixes with the pelorus, doing block reports to the 'captain,' and giving helm commands. One cadet, following his first time having the conn, looked at me with wide eyes and said very seriously and quietly, 'the power,' in reference to his leadership role on the bridge. Nelson could not have said it better.

Like all of us, cadets have a variety of personalities from the quiet to the effusive. The bridge simulator (which has simulated engine noise generated by the NAUTIS software) encourages the quiet cadets to speak up and assert themselves. Similarly, the need to gain the Officer of the Watch's attention, at an appropriate moment, guides other cadets to control their enthusiasm. Both are very useful life skills.

The bridge simulator came to the attention of *Tecumseh's* Commanding Officer who immediately saw the potential for his Junior Officers Under Training (JOUTs). *Tecumseh* has an innovative practice of having its JOUTs trained by two exceptional volunteer retired RCN officers: Commander Gary Whitehead and Lieutenant-Commander



Credit: Timothy Choi

The grounds of HMCS Tecumseh, September 2011.



An RCN sailor peers through the pelorus on the bridge simulator.

(LCdr) Nancy Olmstead. After Commander Whitehead, LCdr Olmstead and I met, a highly productive partnership was formed wherein *Tecumseh* obtained the use of our simulator and I (and therefore our cadets) obtained superb training on RCN ship-handling procedures.

We quickly developed a routine. Early in the week LCdr Olmstead provides me with the specifications for one or more simulations that she wants. I prepare those prior to attending the JOUT training at *Tecumseh* each Wednesday. By participation in the JOUT training I have learned things such as Officer of the Watch manoeuvres. On Saturday mornings I train our BMTP cadets on a modified version of the training I received on the Wednesday. Approximately once each month, following the Saturday morning BMTP training, the JOUTs will also use the bridge simulator.

Through this cycle a virtuous feedback loop has established itself. The JOUT training will demonstrate some additional capability from which the simulator could benefit. I will take that away and, not burdened by any procurement procedures, will create the required capability. This has varied from the minor, a clock on the bridge, to the more significant, two overhead monitors for the binoculars (in the form of two \$100 32" LED TVs), to the complex, most recently demonstrated by the addition of a gyro repeater stand and a pelorus. The foregoing plays to

strengths of each organization; the JOUT directing staff can identify hardware gaps which we have proven to be able to address rapidly.

None of this should be seen as a criticism of the RCN – our bridge simulator is an added capability to an existing training infrastructure. Where the bridge simulator and the BMTP will, I believe, really benefit the RCN is in the interest it is stimulating among cadets in careers in the navy.

My experience with cadets is that they are reluctant to venture into the new and unknown. This is a perfectly rational worldview, but it has (in my opinion) acted as a barrier to cadets choosing to consider a naval career. What our BMTP program has done is draw back the curtain, if only a little, on the mystery of what being in the RCN involves. I believe going forward this will translate into more cadets, as they age out from the cadet program, considering a part- or full-time career in the RCN. To be clear, we do not promote a future in the RCN to our cadets, that is not the role of the CIC, but rather the cadets themselves, having found out what is actually involved in a naval career, appear to be seeking out opportunities in the RCN.

Hardware and Software

For those interested, the following is a brief description of how we utilize the VSTEP NAUTIS software, along with the hardware we assembled, to create the bridge simulator.



An RCN sailor operates the helm console of the bridge simulator. The console was built from scratch using MDF boards based on dimensions of those for the Orca-class training craft.

Merchant ships are operated very differently from the practices used by the RCN. For example, a merchant ship's bridge will often be staffed with far fewer mariners than an RCN warship operating in the same pilotage waters. This minimal approach to manning in merchant marine ships is often replicated in simulator set-ups; frequently the set-up will be for one person in front of six desktop screens.

Accordingly, one of the first modifications to our bridge simulator was a helm console. A visit to an Orca-class patrol vessel and an online review of naval console dimensions gave me the sizing for our console. The console is made out of inexpensive MDF cut to size and painted ship-side grey. We deliberately made the console, and

everything else with the simulator, movable so that it can be stowed in about 100 square feet when not in use (the external screens are mounted on 20 feet of wall space and fold out to provide the 120-degree forward-facing view. The bridge simulator itself is located in a building adjoining *Tecumseh* owned by the Naval Museum of Alberta Society.

The external view screens are TVs purchased at Walmart. The radar and ECDIS also use LED TVs, somewhat larger than what you would have aboard ship, but very useful in their size for training purposes.

An engine order telegraph and helm control bare hardware (no circuitry) were obtained inexpensively online. The helm was a 'follow up' helm where the turns were effected by closing or opening a series of switches. I replaced this set up with a potentiometer to closely replicate the movement of a helm. The potentiometers in the engine order telegraph and the helm each feed into a Leo Bodnar BU0836-LC Load Cell Joystick Controller.² The Leo Bodnar unit converts the potentiometer electrical output into a USB output that feeds into the NAUTIS software.

The gyro repeater proved to be the most complex addition to date. The gyro repeater is a Sperry Marine DBR 600, an early digital bearing repeater which utilizes the National Marine Electronics Association (NMEA) 0183 data format. NAUTIS can transmit data in the NMEA 0183 format and it feeds a heading signal into the bearing repeater. The gyro repeater is mounted on an aluminum gimbal created by a local welding shop for about \$100.

At this point I should mention that VSTEP's support has been exceptional in integrating all of the hardware.



An RCN sailor operates the radar and electronic chart system of the bridge simulator.



Credit: Sergeant-Major Bozys MABPAC Imaging Services

A trio of Orca-class Patrol Craft-Training (PCT) moor at North Vancouver during the 2023 Fleet Week, 8 May 2023.

VSTEP effortlessly connected and calibrated all of the hardware into the NAUTIS software. All of the aforementioned hardware and software collectively cost approximately \$30,000.

Going Forward

Begun as an effort to provide greater maritime experience for Sea Cadets, the bridge simulator has generated the following benefits for our cadets and the CAF:

- It has provided a realistic, rigorous training platform for JOUTs which is continually enhanced via rapid modification.
- It demonstrates how partnerships within the naval community, available in most major Canadian cities, can build on respective strengths to address each other's challenges.
- It is an excellent venue within which to develop teamwork, leadership and confidence in a controlled environment.
- It is creating interest in young people to join the RCN by overcoming what I believe is the greatest obstacle to recruitment – fear of not knowing what they are getting themselves into.

The opportunity created by the bridge simulator and our relationship with *Tecumseh* should, in whole or in part, be something other units should consider replicating. A

modestly-sized space can be transformed relatively inexpensively into a bridge simulator, utilized seven to 10 hours a week. In this process a Naval Reserve unit gets a well-maintained simulator customized to its needs and Sea Cadets learn both useful life skills and more about what it actually means to serve in the RCN.

Our next step is to add an instructor console to the bridge simulator; currently all simulations are pre-set and run autonomously. An instructor console will allow dynamic simulations with the actions of target vessels being modified in real time, a useful capability for training in potential collision situations (among other scenarios). There is a material cost to this enhancement which will be met by the generosity of numerous donors.³ 🇨🇦

Notes

1. For more information on the NAUTIS simulator, see the VSTEP website at <https://www.vstepsimulation.com/nautis-simulator/>.
2. See Leo Bodnar Electronics, at <https://www.leobodnar.com/shop/>.
3. If you would or your organization would like to join these donors in supporting this capability, please feel free make a donation to the Navy League Canada Calgary Branch, information for which is available on their website at <https://nlccalgary.ca/>.

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