SHIPBOARD TACTICAL DATA SYSTEMS
A PERSONAL HISTORY

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I was asked to speak on my personal experiences with shipboard tactical data systems, which ran from the first digital combat data system through development of the SHINPADS concept.

The session has to do with science & technology. I would love to describe the technical details however nothing happens unless you can find the money and convince others to use the technology. That will be my focus this morning.

THINGS HAPPEN

I always try to look ahead and like to think that I take everything into account. That seems to work pretty well with technology however in real life stuff just seems to happen. Looking back at key decisions in my life two key decisions were: to join the Navy and to be an engineer.

I did not choose the Navy or Royal Roads. Growing up in Drumheller, AB I am not even sure I knew there was a Navy and I certainly hadn't heard about Roads – I just needed a free education. When I failed high school [French] I couldn't go to the University of Alberta as planned but could attend a CSC because of equivalency to Ontario which did not require French. Turned out to be the best decision I didn't make.

Any toy lasted a few days until I took it apart. At the start of my second year at Roads the Dean suggested with my arts marks, and no doubt with an eye on my math marks, I should be taking Arts. Apart from the feeling that someone just told me I was stupid, being of Scottish descent I felt you couldn't do anything for a living that was enjoyable – so I took engineering.

HOW TO BE UNQUALIFIED TO DO ANYTHING

Of my total career only the first few months followed 'the path' set out by the Navy. After eight months on HMCS Gatineau for first sea phase I had my upper deck Watchkeeping ticket. During almost 22 years in the Navy that would be the only qualification I would ever receive as I left 'the path' and became what would later be called a CSE. [1]

As a first step I was sent to the US to learn about the ASROC system. Less than two years out of RMC I was in NDHQ to learn as I worked on the prototype SQS-505 sonar and contribute to the ASROC/AWDS development system which I would then follow to the coast and install in HMCS Terra Nova. The ASWDS used the new UYK-501 which was our first digital shipboard computer – this historic device now resides in my basement. The number of firsts achieved included the first time a weapon mount was driven by direct digital drive. In addition to installing the equipment and then evaluating it while keeping it running I was in being used as the guinea pig or

prototype CSE. There was a feeling among some in authority that the Navy did not need another Electrical Officer so these were turbulent times – an interesting story but no time here.

As the engineer during construction of the Combined Support Division I was able to compare different design approaches for all the new combat systems destined for the Tribal and Improved Restigouche classes. The difference between a systems designed as such versus one tied together after the fact was very obvious. It was a unique opportunity. A couple of years of post grad doing a PhD at Dalhousie was not only great technically but the opened a lot of doors - people listened to me when they should have known better.

In 1974, when I again went to Disneyland on the Rideau, I was given two major projects. ADLIPS [2] provided the 'steamers' with a data link and C^2 capability – it was a great small system with a single shared display. The other project was SAILS [Shipboard Action Information Link System] which morphed into SHINPADS – my boss John Mathewson loved creating acronyms.

SHINPADS

It would be something like 20 years from the time I started working on SHINPADS before the first ship incorporating part of the concept was operational. It was first put forward in '74, we had prototypes available in '79 and it was at sea in '94. Unfortunately my ideas of wider ship system integration were never realized and in the end the concepts were only applied to C^2 system.

SHIPADS in my mind was, and remains, a concept [3, 4, and 5]. In my way of thinking it is just common sense:

- A warship requires resiliency. Resilience means redundancy and re-configurability.
- Practical redundancy means equivalent components.
- Equivalent components are realized through standardization.
- Standardization means same device used across all applications.
- This means all devices must be multi-purpose
- Having multiple applications run on a single device means turning everything into data.
- Reconfigurable means getting rid of wiring.
- Getting rid of wiring means a data bus.
- And so on …

This seems logical and straightforward - it should be how any ship system is designed. But there were a few 'minor' issues:

- Such an approach would mean existing systems must be broken up, standardization applied and the resources made available at the system level.

- Vendors, technical directorates and requirements folks all made their livings in the world of stove-piped systems - which in many cases generated outright hostility to the concept.
- The required standardized devices such as a multipurpose digital display, a high speed reconfigurable data bus and a modular single board standard computer did not exist.
- There was no money for such an undertaking.

NEEDED TO CONVINCE

For this to move ahead I had to change the thinking of those already involved and get the support of many others who while not involved could influence decisions. Those I had to get onside included:

- The operational requirements folks. Operators needed to understand that this approach would give them increased capability while providing resilience and agility.
- Technical authorities, who in many cases approached acquisition of new systems as 'shoppers' and were not at all inclined to delve into development. They had to be convinced that they needed to build systems this way.
- Equipment suppliers, who had much to lose or if they got onboard much to gain. Companies, particularly naval equipment manufacturers, inherently try to avoid the uncertainly involved with such a radical change.
- Other navies, particularly the USN, in part to develop a larger market so that development costs could be shared and our manufacturers could develop an offshore market but also in order to influence our decision makers who often seemed to be looking for approval from outside the country.
- Those up the chain who would provide money.

Those whom I worked for such as John Mathewson, Jock Allan, Ernie Ball, Ray Ross, Cam McIntyre, Mac Whitman, Dudley Allan and others were the key to moving ahead. Without their support SHINPADS would not have happened.

DEVELOPMENT NEEDED

While SHINPADS is a concept there was no intention to leave it there. The goal was development of a distributed ship data system. The required building blocks are readily available in commercial form these days but they did not exist back in the '70's. In 1974 the first minicomputers were coming into use and it seemed like a good idea to try to use these in our standardization efforts. My first attempt at computer standardization was based on use of a minicomputer from Data General. However this was shot down, no doubt because both the idea of standardization and move to commercial machines was too much at once. A second attempt several months later based on use of the UYK-20 was successful.

In order to realize the concept I needed:

- A smaller, cheaper computing element with standard interfacing which emulated the UYK-20. Such a device was needed to provide a standard way to plug in existing subsystems. Sperry UNIVAC developed a single board unit and established a plant in Winnipeg for its manufacture along with other SHINPADS elements – the UYK- 502 [6].
- At the time all sensor signals available were analog. A way of turning analogue signals into data so general devices could handle any type of data and all signals could be mixed on a single wire was needed. As part of the effort development was carried out on handling signals such as radar through digitization.
- Analog signals then being used meant point to point interconnection between the device originating the signal and a 'consumer' such as a display. Ship's wiring was already a burden and the thought of achieving redundancy by, for example, running every sensor signal to every display, was clearly not only difficult but would also reduce reliability given the number of connections and connectors required. The increased weight and cost would also preclude it. In order to make all data available to all components while providing redundancy a data bus [or in today's terminology a LAN] had to be developed. The SHINPADS data bus [7] was the solution.
- A key element of a fault tolerant reconfigurable system is a display capable of displaying any type of data. One manufacturer had developed a high resolution raster scan tube and another manufacturer had made the first 1K memory chips which were key components that allowed us to build a high resolution graphics capable raster data display device which eventually morphed into the SHINPADS display [8]. It didn't hurt the case for funding that the 1K chips were made by a Canadian start-up Microsystems International, of Terry Matthews fame. [Today every home has such a device known as a HDTV].

GETTING BY WITH LITTLE FUNDING

There is never enough funding and this is particularly true for concepts as opposed to 'real' stuff. It was difficult to get serious funding until there was a program which would use it. In the time before CPF started there was no ship program but once CPF started the hierarchy wanted proven equipment not concepts. The well known 'chicken and egg' dilemma.

The research organization provided much of the original development funding. Whether they did it with a clear knowledge of what was happening is open to interpretation. I do know that subsequently, for a period of several years, the Chief of Research (CRAD) and Chief of Supply (CS) wrote letters demanding that SHINPADS funding be investigated.

Computer standardization was a continuing problem. A collision at sea did not ruin our day. The USS Kennedy and USS Belknap met and in the ensuing fire the Belknap's superstructure was consumed. For the NTDS rebuild they needed SYA-4A

displays that were no longer in production. We had a number of SYA-4s left over from the data system never fitted in the hydrofoil. We arranged a trade through Crown Assets and obtained a gaggle of UYK-20s that were made available to subsystem equipment programs, thereby helping the standardization effort.

Most people would agree that an important part of team success is for members to have some 'skin in the game'. In SHINPADS I was able to convince both Sperry UNIVAC and Computing Devices that they needed to contribute significant resources if we were going to be able to push ahead. Both companies also showed great patience in waiting for DND funding. They were in the game.

INDIRECT MARKETING

To move from an idea to implementation in NDHQ takes constant pushing as we all know. The SAILS/SHINPADS committee, which included representatives of all naval technical sections, data system related requirements staff, research staff and even DOT and ITC representatives, was used to get everyone thinking. The process of asking each technical authority to explain 'why not' in front of the combined group lead many reluctant participants to reassess their positions.

I wrote papers, and continually gave presentations to anyone, anywhere, who would listen. NATO group IEG5 was an excellent forum which led to formation of a subgroup focussed on this approach to ship integration. Most NATO nations subsequently became involved to some extent which helped validate the concept in the eyes of our decision makers.

On 27 Dec 79 I went to the Pentagon to brief the Assistant Secretary of the Navy, Gerald Cann. On arriving back at work after New Year the organization at all levels was in motion responding to strong USN interest including funds for the project. The situation moved from no money available to DND/DSS/ITC being alarmed and concerned they could provide enough funding so that SHINPADS remained Canadian. In my opinion this interest from down south was the trigger that broke the log jam and ensured SHINPADS would proceed.

SOMETIMES IT COMES TOGETHER

A key step in getting a project approved is the presentation to what was then called the Defence Management Committee. The DMC on the day of my presentation was 'made' to approve SHINPADS. Headed up by the DM Buzz Nixon who was not only formerly a naval officer but electrical, the CDS Ramsey Withers was an electrical engineer, Jock Allen DCDS was standing in for VCDS had been my boss and ADM(Mat) was Lou Crutchlow. DMC not only approved the project but directed it be sent to Treasury Board immediately. The documents were signed by the Minister and in TB hands by the end of the week, bypassing the Chief of Supply organization and once again earning the enmity of the CS.

It would be 20 years from the time I came to NDHQ and started working on the project before SHINPADS was at sea. I left in NDHQ '81 to go to Halifax as DCOS(EM)

and CO NEUA. As a unilingual Albertan, well past the point of having to be bilingual, in 1982 I left the navy altogether. After 25 years as CEO of NORPAK Corp I retired in 2006 and am once again able to think about things naval. However I still haven't passed high school ……

OBSERVATIONS/QUESTIONS

For some time we have understood the need for naval architects. I suspect Noah had a naval architect nagging him to ensure the arch's hull / propulsion system were an integrated design. The payload is the business end of a warship, it is more complex, and costs a lot more than the hull/propulsion system. Why don't we have a payload architect?

Capt Kirk knew you needed to consider all resources and direct them to the warp drive or shields. Will our next generation ship systems be resilient and agile? Why aren't we pushing the envelope to build resilient systems using all the ship resources?

The government in recognition of the need for a Canadian source for build and subsequent repair and overhaul of government ships on an ongoing basis has developed a National Shipbuilding Procurement Strategy. Why doesn't the same logic hold for what is the most expensive part of warships – the payload. Why do we not understand the need to nurture the high technology industries who not only provide high level jobs but a valuable source of expertise through a National Payload Policy?

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