

How Low Can You Go?

Lessons learned from attempting to reduce submarine manning

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Background

20 years in submarines human factors

Developed manning for 2 classes of submarine

Drive to reduce crew numbers

- Reduce cost of both crew and platform
- Reduce demand on navy to recruit and retain

Limited success – why?

Adoption of new technology

What's wrong with the old?

- Its proven and trusted
- No development cost
- Low risk

How much?!

- High integrity = high cost?

Where are the benefits?

- Is it worth it?
- Yes, eventually?



Adoption of new technology

- Evolution not revolution?
- Current class = development platform for the future
- Ability to upgrade / replace on-board systems
- Extend life of the submarine?



Is it safe?

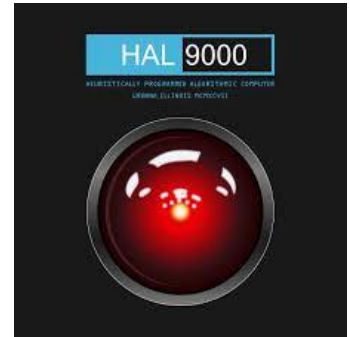
What if it fails?

Reversionary = Manual = Crew

How does it fail?

The less the crew are involved the less they understand?

Do we trust it?



Do we need a new approach to safety cases?

Human Machine Teaming

A better term than automation or autonomy?

Changes to the way the crew will interface with increasingly intelligent systems.

The submarine is another member of the crew making decisions based on its own perceptions
Do the crew and the submarine agree?



Means new approach to interface design
and new tools and techniques required

Navy Organisation, Training and Qualification

Is the user prepared for and willing to change?

Navy want to transfer crew between their classes as quickly and easily as possible

A very lean submarine is likely to require a very different crew to current and hence significant retraining

High fidelity shore based training

Train and qualify more quickly?

Eliminate seagoing trainee burden



Technology Advancements that support crew reduction

Damage control and fire fighting

Situation awareness – sensing and communication

Remote control

Increased integrity?

Information processing

Tactical decision making

Logistic and medical aids



Lean Crew Exercise Assumptions

Attack Submarine, SSN or AIP

Crew all qualified and experienced

Ranks, rates, organisation not considered

One in three watch system

No heightened watch state: either 1-in-3, or all at stations

A Very Lean Crew?



A Dose of Realism



Could such a small crew manage a patrol of several months?

Some will not have experience and will require supervision.

Significant reductions from current SSN crew size still possible.

Thank You

Questions?

