Bionic

Faith in machines and computers has led to increasingly sophisticated bridges, but the realisation that the human must be kept in the loop has caused a shift in thinking, as ***Mike Gerber*** discovered

Ten years from now, ship's bridges might resemble something out of the science-fiction TV series *Star Trek*, with technology that adapts to humans, not the other way round. That is the thinking that underpins a new, part-EU funded three-year research project that could radically transform bridge design within our lifetime.

The aim of the CASCADe project is to develop an adaptive bridge system that recognises, prevents and recovers from human errors by improving the interaction between crew and machines on the bridge.

Seven project partners from five countries are collaborating on the project: Oldenburg Research and Development Institute for Information Technology Tools and Systems (Germany), design, engineering and risk management consultants BMT Group (UK), integrated bridge and navigation systems developer Raytheon Anschutz (Germany), shipowner/manager Mastermind Shipmanagement (Cyprus), the University of Cardiff (UK), maritime R&D manufacturer Marimatech (Denmark) and ergonomic and human-centred designer Symbio (Belgium).

Their research will build on previous studies which show that the proliferation of increasingly complex technology that confronts officers on bridges, the multitude of different user interfaces and provision of too much information, leads to crew errors.

"CASCADe is not directly addressing situations where outright system failure of bridge equipment leads to an incident," explained BMT senior research scientist Dr Gary Randall, one of the key figures behind the project. "What we want to do is deal with the majority of safety-related incidents that, as it's well-established, are caused by human error." This may be error as a result of not dealing well with equipment failure, but is often an error that is initiated by what the operator does, or does not do, as a result of what context they are in, he clarified.

Randall explained that the project owners want to make the bridge more sensitive to the context of the vessel "so that it is more difficult for the human to get into a chain of events in which they lose situation awareness and eventually have an incident". The project is "about consistency of information presentation, removing excess redundancy, the usability of displays, detection of 'bad' or inappropriate bridge settings, supporting communication between the bridge team members etc."

By way of example, a frequent factor in groundings or collisions, he told *SAS*, is that people lose situational awareness. "If information is not shared or not understood by the bridge team of a single vessel, this can be extrapolated so you're then not sure about what people are doing on other vessels, and that can be exacerbated by confusing or unfamiliar presentation of information on bridges," Randall explained.

Most bridge displays are not optimal for what they are supposed to do. "A lot of existing bridges are cobbled together piecemeal with bits of hardware from different manufacturers," Randall maintained.

As part of the project his team made several research trips on a ferry. The vessel was professionally run and travelled between two Danish islands. There were seven representations of the bearing of the vessel on the bridge and these varied in how they provided the information to the user. This highlighted an issue about variability and redundancy in the interfaces, Randall said.

Typically in computer interaction or human-machine interface studies, the working environment concerns one person

A lot of bridges are cobbled together with bits of hardware from different manufacturers

Gary Randall: *senior research scientist, BMT*

CASCADe

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bridges

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sitting in front of a computer, or sometimes one person in front of several screens. Randall compares this situation with a ship's bridge on which several people are sitting in front of several screens. This is then replicated on other vessels.

"It's a distributed system and there are open research questions about what's necessary and what's sufficient, or what are the best levels for maintaining distributed situational awareness among this team of people," Randall explained.

The thrust of the project, Randall said, is to take account from the start of the design process of what people are comfortable and familiar with. For example, displays that are customisable, particular layouts of information, colours, and spatial configuration of components on a screen.

ECDIS questions

Much of the feedback that Randall obtained concerned ECDIS. "There's a lot of functionality built in, but it's hidden away in menus or behind a series of clicks. There are fundamental usability issues about why people are not using some of the functions that are there at the moment," he said. One of these functions allows alarms to be set if a series of way-points are missed. If, for example, a bridge crew member falls asleep and the way-points are missed, these alarms should wake him/her. "But groundings happen all the time, so people don't use this state-of-the-art functionality. We try to assess why," Randall stated.

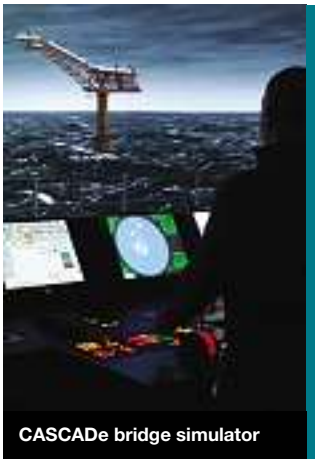
Six months into the project, Randall revealed ideas that have begun to emerge around specific scenarios, for instance when a pilot comes aboard or when somebody takes over the watch. "You can have a bad handover. Somebody comes on to the bridge, he points out the window and says, 'the weather's out there, the radar's here. Goodbye, I'm off to bed'. That could obviously lead to problems, so we would like to not take away people's ability to do that, but try to support the handover situation by automatically gathering information on different bits of equipment on the bridge and showing a sort of précis of the situation."

That, as the CASCADe team presently conceives it, could be on a tablet device that displays a representation of local traffic, weather information, speed, bearing, anything else that supports the handover, particularly where language issues are a problem.

Another scenario is where the captain is not on the bridge when an impending emergency is detected by someone who does not feel competent enough to know what to do. Randall acknowledged that on many vessels, there will be remote screens in the captain's cabin giving him a representation of radar and traffic.

Randall envisages that feeding this information onto a tablet computer or a similar portable device could also be beneficial as it could provide an expedient way for the master to get up to speed on the situation before he or she reached the bridge.

The partners are also wondering if better use could be made of the whiteboards that are



CASCADe

CASCADe bridge simulator

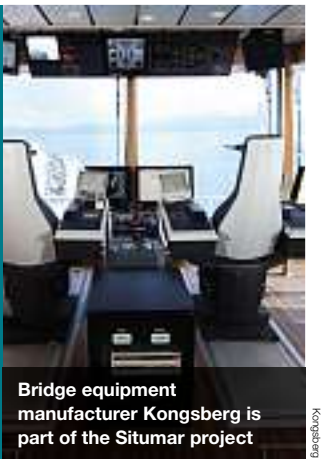
Bridge research: the key aims

CASCADe

- To address the lack of symbiosis that exists between current bridge design, operational procedures and the end user
- To develop an adaptive bridge system
- To disseminate the project's findings

Situmar

- To design automation systems that keep humans 'in the loop'
- To strip away all unnecessary information presented and focus on the vital function at the time.
- Design new bridge systems, to change the engineer's mindset from 'tech-think' to 'human- and task-think'



Kongsberg

Bridge equipment manufacturer Kongsberg is part of the Situmar project

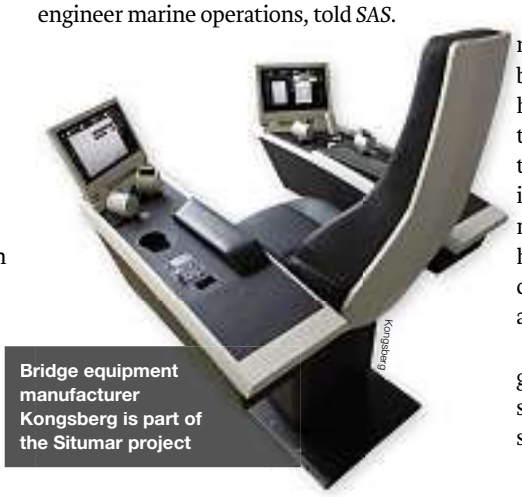
usually found at the back of the bridge. "It's usually a dead area," said Randall. "You could imagine projecting information onto that. Instead of having six people in panic situations crowding round one monitor, it's all up there on the wall."

He also proposed making the bridge more intelligent so it becomes "context sensitive". In other words, it becomes more aware of what the user needs.

Once CASCADe has developed the prototypes and disseminated its findings, it is up to the inter-connected industries, perhaps with regulatory prompting, to take proposals forward. Randall envisions that the bridge of the future could look very different: "You'll have something that looks a bit more like the bridge of the *Enterprise* in *Star Trek* rather than something that looks like a bulk carrier."

Fore and aft

One company that is aiming to make similar strides in bridge development is Kongsberg Maritime. In February 2012 Kongsberg launched the Situmar project to study how people make decisions during demanding and advanced marine operations, particularly under stress. Its objective was to build optimal systems for situational awareness and operator decision support. "We are now exactly half way through the three-year project and this autumn will be dedicated to the system design," Thor Hukkelås, Kongsberg's principal engineer marine operations, told *SAS*.



Kongsberg

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He sees many similarities between the Situmar and CASCADe projects. "Perhaps the main difference is that the Situmar has its main focus on demanding offshore operations connected to the offshore oil and gas industry; the main bridge is the aft bridge. The CASCADe project seems to be more focused on traditional shipping and the fore bridge."

Hukkelås' views on bridge design have radically shifted in recent years. He firmly believes that technology should adapt to humans, not the other way around. "We need to design automation systems and technology that adapt to humans and maintain the human in the loop at all times," he affirmed. "We must see the environment, the machines and humans as a whole. Combining engineering cybernetics with cognitive psychology is one approach to achieve this."

With nearly 80% of collisions and groundings attributed to failures of bridge systems and their use, the industry must surely wish a fair wind to these projects.