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Alarm system interface prototype Demonstration

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2.0	2022-08-30	Erik Styhr Petersen	Final report, uploaded to the LASH FIRE Teams Site

Contents

1 Executive Summary

The goal for LASH FIRE task T07.5 was to develop a demonstrator/prototype of a holistic alarm interface of a Digital Fire Central (DFC), the aim being to utilize the potential of an integrated digital interface for fire plans and alarm displays by combining various already existing interfaces as well as new concepts in one. This approach delivers a demonstration of an interface which shows live information about the fire and the firefighting effort directly on the fire plan while also enabling the fire commander to exclude irrelevant information. In addition, a centralised, digital interface integrates all the information necessary in one place. This has been achieved by prototyping in four iterations and user testing of the DFC with active crewmembers.

The demonstration of the DFC, including experimental sessions, was conducted in a laboratory environment at a shipowner's headquarters with active fire commanders. LASH FIRE D07.6 'Alarm System Interface Prototype Development and Testing' includes detailed descriptions of the different elements of the interface of the DFC, the physical design of the operator's station, the testing of the DFC and the corresponding results; the present document is limited to include a short summary, the primary purpose being to serve as evidence of the testing.

2 Introduction

Current design of fire centrals and fire plans on board are a long way behind the options provided by current technological developments. Paper-based fire plans, where each deck is shown in its entirety and all possibly useful information is simultaneously included, often provide a cluttered overview of the ship, with minute details that may be hard to decipher. In addition, its static nature means that all dynamic information about the fire and the crew has to be drawn and updated manually. This creates a significant workload for the operator and thus invites potential mistakes. Even the process of locating the fire can be tedious and time consuming, which means that valuable time for the attack on the fire is lost.

On vessels with digital systems, decentralization is a big issue. More often than not, systems are decoupled, meaning one single system for alarm positions, one for CCTV, one for fire doors, etc., all with their own screen and input devices, as well as their own interaction paradigms and styles. Apart from providing operational inconsistency, this creates additional of clutter in control rooms and makes it difficult to gather the necessary information for the correct conclusions for an effective attack on the fire.

Digital systems are under rapid developments, also in the shipping industry, but experientially, simply converting existing practices into digital solutions will not necessarily achieve the full potential; indeed, such solutions may exhibit poor usability. The work on LASH FIRE task 7.5 is set to explore whether the application of Human-Centred Design (HCD), as well as Ecological Interface Design, can mitigate such potential shortcomings, and bring about an improvement in the usability of digital firefighting.

3 A summary of demonstration objectives

The main objective of the DFC is to provide the human operators with the information they need to fight the fire effectively. As identified in LASH FIRE D07.2 'Field Study Report of Alarm Panel Insufficiencies and Improvement Identification', the perceptual and cognitive processes involved in identifying and processing information for firefighting, i.e., the mental workload, was high. A suggestion for supporting the management of firefighting was therefore to find a way to present available data in a more easily comprehended fashion, thus freeing mental resources to be used in directly manage firefighting. This became the aim of the DFC: to provide immediate, precise and accessible information that supports the localisation and monitoring of a fire, and that provides the information necessary to support firefighting. Supporting the activation of drenchers was specially prioritized as this is a highly effective firefighting tool.

The design phase stretched over more than 2 years and constituted four full iterations, including heuristic evaluations and user feedback. The demonstration was designed to more formally investigate the key question 'does the DFC improve firefighting capability in ro-ro ships?', as well as to uncover limitations and suggestions that can inform further design and redesign. In other words, the DFC demonstration reported comprehensively in D07.6, and briefly reported here, was an opportunity to directly investigate the extent to which the DFC supports users' performance in terms of usability[1] (ISO9241-210, 2019) and intuitiveness[2], and how it meets their needs and expectations. It also presented an opportunity to assess how using the DFC might contrast to current procedures, as well as to learn more about managing firefighting on ro-ro ships in general. Finally, the

[1] Usability is central concept within HCD, containing the dimensions of effectiveness, efficiency and satisfaction.
[2] Intuitiveness is in the present case described by the extent to which a design taps into existing user memory structures, thus appearing familiar and easy to use.

demonstration was seen as capable of informing other LASH FIRE work streams, including input and feedback for Action 7-C.

4 A summary of pre-demonstration preparatory actions

Three main activities were undertaken prior to the demonstration:

1. The development of the demonstrator software in Axure
2. The development and construction of the custom-built console for the DFC
3. Practical arrangements relating to setting up demonstrations off the NTNU site

All activities are described in detail in D07.6.

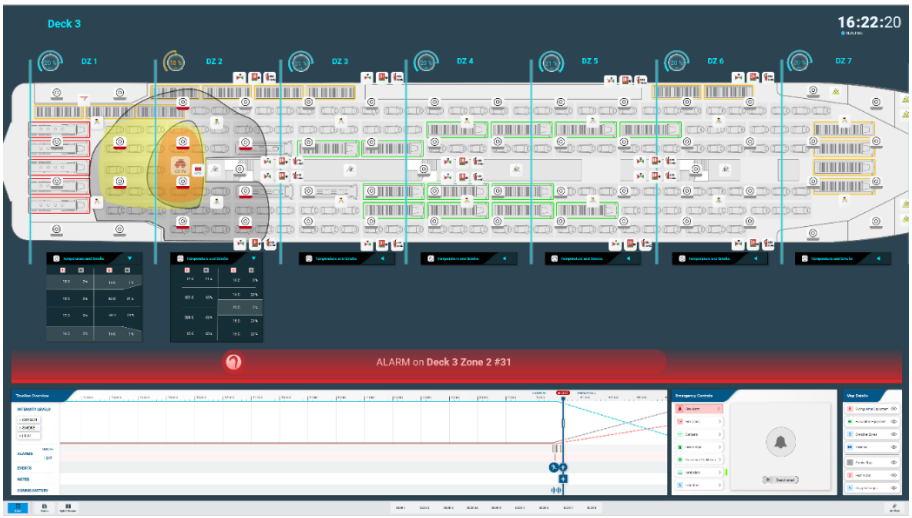

Figure 1 – The DFC demonstrator – a fire is developing

5 A summary of the demonstration event(s)

The pilot test was conducted in the facilities of the Shore Control Lab of NTNU. The prototype was set up in a lab room, and the researchers acting as crewmembers of the fire teams and the engine control room staff were located in an observation room. Those researchers observed and recorded the session with a ceiling-mounted camera and communicated with the participant over an intercom system. The debriefing was conducted in a meeting room next to the laboratory.

Figure 2 - Setting up the DFC demonstrator

Figure 3 - The DFC demonstrator including the custom-built console, the 55" display as well as displays for CCTV and external drone

The main demonstration was conducted at a major ferry operator's headquarters. Two meeting rooms were used; one for the test session with the DFC and all recording devices and the other for researchers acting as crewmembers. The second room was also used for pre-test information talk and post-test interview. During the tests, the participant was accompanied by a person working for the same shipowner, who was familiar with the project and the DFC. This person observed the familiarization session, and also played the role as captain during the scenario. One researcher facilitated the familiarization session. Another researcher was also present to observe both sessions.

6 A summary of demonstration results

The results of the DFC demonstration show a lot of potential for such an integrated system. Participants especially liked how easy it was to gain full understanding of the location, spread, and intensity of the fire, in addition to an understanding of what happened before they took their position at the fire control centre. Further tracking of the development of the fire, as well as the effectivity of used countermeasures was also perceived as very easy. Seen to save time, increase situational awareness, and present high usability, a graphical visualisation of the fire on the fire plan, together with a visualisation of the historical development, was seen to be effective and is recommended to be implemented in future systems.

The integration of safety-relevant information about loaded goods (lorries, electric cars etc.) was also very valuable. Being able to interact with the cargo on the fire plan to access information about dangerous goods was significantly more effective than looking up the information in a separate cargo manifest. It allowed for less errors and gave the operator immediate access to the wanted information in its context on the deck. Furthermore, the holistic integration of the different emergency controls in one system shortened response times to the fire and eliminated

misunderstandings between the operator and crewmembers who otherwise would have to engage those systems on different locations.

7 Conclusion

The work presented in D07.6, and briefly summed up in the present document, achieved its goal of demonstrating a prototype of a digital alarm panel in the form of the DFC. Going forward, the design solutions used in this prototype show significant potential to improve fire safety on board and present possible guidance for new requirements in a digital age.

8 References

ISO9241-210. (2019). ISO 9241-210: Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems. In (Vol. ISO 9241-210): ISO.

9 Indexes