Horizon 2020

Project acronym: **LASH FIRE**

Project full title: **Legislative Assessment for Safety Hazard of Fire and Innovations in Ro-ro ship Environment**

Grant Agreement No: **814975**

Coordinator: **RISE Research Institutes of Sweden**

Deliverable D08.8

Stowage plan visualization aid

Demonstration

August 2023

Dissemination level: **Public**

Abstract

This report confirms the successful execution of the D08.8 demonstration for the Stowage Plan Visualization Aid as specified in the LASH FIRE Grant Agreement. The project centered on the development of a software tool to reduce fire risk related to cargo. This innovative tool uses a sophisticated algorithm that calculates fire risks according to individual cargo units and their deck positions.

Using the OpenBridge design system [1], interactive digital prototypes were crafted in a human-centered design process, and put through a demonstration. The aim was to gauge participants' impressions of the tool's functionality, especially its capability to showcase fire hazard ratings effectively. Various tasks were defined for different user types, including shore-based planners, deck crew, and tug/tractor drivers, each intended to reflect typical interactions with the Stowage Planning Tool (SPT).

Feedback from the demonstration indicated the tool's potential in enhancing efficiency and safety in cargo management on Roro ferries. Users appreciated many features but also pointed out areas for enhancement, particularly in terms of transparency. The demonstration verified that the tool successfully guides users in rating and optimizing stowage plans and presents real-time warnings for heightened risks due to changes during the loading process

In conclusion, the objectives of the Grant Agreement have been met, the demonstration showing that participants agreed to the usefulness of the SPT and were positive to the tool's user interface- The results indicate that intended users could accept this type of tool and that the SPT has potential to improve fire safety during the stowage planning and loading stages of RoRo ferries.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814975

Document data

Document Title:	D08.8 Stowage plan visualization aid [Demonstration]		
Work Package:	WP08		
Related Task(s):	T08.6; T08.9		
Dissemination level:	Public		
Lead beneficiary:	29 - NTNU		
Responsible author:	Hedvig Aminoff		
Co-authors:			
Date of delivery:	2023-08-25		
References:	D8.3, D8.4		
Approved by	Francisco Rodero on 2023-08-09	Robert Rylander on 2023-08-07	Maria Hjohlman on 2023-08-16

Involved partners

No.	Short name	Full name of Partner	Name and contact info of persons involved
19	CIM	Centre Internacional de Metodes Numerics en Enginyeria	Francisco Rodero, francisco.rodero@upc.edu
26	NTNU	Norges Teknisk-Naturvitenskapelige Universitet NTNU	Hedvig Aminoff, hedvig.aminoff@ntnu.no Jooyoung Park, jooyoung.park@ntnu.no Erik Styhr Petersen, erik.s.petersen@ntnu.no

Document history

Version	Date	Prepared by	Description
[01]	2021-11-15	Erik Styhr Petersen	Draft of Structure
[02]	2023-02-22	Hedvig Aminoff	Outline of demonstration objectives
[03]	2023-08-01	Hedvig Aminoff	Final report
[04]	2023-08-25	Hedvig Aminoff	Report finalised

Contents

1 Executive summary

1.1 Problem Definition

Current management of cargo-related fire risk focuses mainly on dangerous goods through established guidelines like "Accord européen relatif au transport international des marchandises Dangereuses par Route" (ADR) and International Maritime Dangerous Goods Code (IMDG). However, recent data about cargo-related fires over the past 25 years indicate the need to consider fire hazards from other cargo types, including vehicle-related threats.

1.2 Method

Action A in WP8 aimed to create a Stowage Planning Tool (SPT) to enhance fire safety. The tool integrates a Vehicle Hotspot Detection system and software that uses historical data about cargo fires to assign risk scores to cargo units. The user interface shows risk scores and placement suggestions to minimize fire threats. This data-driven approach allows for strategic cargo placement, an innovative way to lower fire risks. To showcase the utility of the SPT, two prototypes were developed using Figma and Axure. The interactive mock-ups were developed according to a human-centred design process (HCD) [2] and follow the OpenBridge Design Guidelines [1]. One prototype was designed for desktop stowage planning and the other was designed for tablet-based use during loading. The demonstration provided feedback about ease of use and usefulness from intended users.

1.3 Results

Stowage in ro-ro ships currently offers room for enhanced fire safety. The SPT successfully integrates fire management into the stowage process. The demonstration indicated that participants could see the SPT as an effective tool to mitigate fire risks. The visualization features were appreciated as a means to increase efficiency also during fire emergencies.

The demonstration also provided insight into potential challenges for implementation. The diversity in ro-ro operations, such as quick port turnarounds, highlighted potential hurdles in detailed stowage planning. Concerns were raised about cargo owners being hesitant to share cargo details for security reasons. For further enhancement, users suggested clearer explanations on hazard rating calculations and confirmation of safety regulation compliance to increase trust and adoption.

2 Introduction

This report serves as documentation to verify the execution and delivery of the D08.8 demonstration of the Stowage Plan Visualization Aid, as outlined in the LASH FIRE Grant Agreement. As it primarily functions as evidence of the task's completion, the document does not provide a comprehensive description or analysis of the demonstration. Instead, pertinent details related to the demonstration can be found in D08.7.

3 A summary of demonstration objectives

As part of the Lash Fire project, a fire hazard optimisation tool was developed, to prevent ignition through focus on the stowage planning process. The tool utilises an advanced algorithm to calculate and minimise fire risks based on individual cargo units and their relative deck positions. Interactive prototypes were developed in a Human-centred design process [2], using the OpenBridge design system [1, 1] to showcase the proposed fire hazard optimisation tool. These interactive digital prototypes, or mock-ups, of the user interface for the Stowage Planning Tool (SPT) underwent a demonstration, which focused on participants' perceptions of the tool's usability and usefulness, with an emphasis on getting feedback regarding the SPT's capability to effectively manage and display fire hazard ratings. A series of tasks were defined for shore-based planners, deck crew and tug/tractor drivers, in order to reflect typical user interactions and key functionalities of the SPT.

The shore-based planners were mainly tasked with optimizing stowage plans, inspecting cargo information, obtaining fire hazard ratings, and sharing stowage plans. How risk levels were visualised, how dangerous goods were differentiated, and how workflows were supported was of particular interest. The deck crew carried out tasks such as checking loading status, navigating to the Deck page, reviewing cargo details, checking hazard ratings, identifying incoming cargo, and utilizing the loading confirmation dialog. The prototype for the tug/tractor drivers simulated the loading process and provided feedback on the tool's information handling and the suggested workflow. Their tasks encompassed selecting and placing cargo units, noting damage, confirming fire hazard scanning, and requesting alternative placements.

The demonstration objectives are thoroughly described in report D08.7, section 6.

4 A summary of pre-demonstration preparatory actions

Prior to the actual demonstration, a pilot test was conducted to troubleshoot any potential issues. In the demonstration, each participant had an individual session lasting between 30-90 minutes. Participants for the demonstration were recruited from LASH FIRE partners, corresponding to the main user types, and the schedules were arranged based on their availability.

The preparatory actions are fully described in D8.7.

5 A summary of the demonstration event(s)

The demonstration of the Stowage Planning Tool followed a task-based approach, with individual sessions for each participant. It included 4 online and one in-person session, with 3 participants representing the planner role, and two representing deck crew and tug-drivers. Participants first tested the prototype that was closest associated with their work role, and then also had the opportunity to try the other two prototypes as well.

The demonstration itself began with a briefing on purpose of the demonstration as well as about the background to the tool and the fire optimisation tool. After this introduction they then interacted with the tool to complete the requested tasks. Their interactions with the SPT were observed and recorded, and feedback during the tasks was actively encouraged.

The tug-driver tasks included cargo selection, confirmation of pick up, making a note on damage, signing off on fire hazard scanning results, and support for cargo placement. The deck crew tasks involved checking loading status, navigating to the Deck page, reviewing cargo details, checking hazard ratings, identifying incoming cargo, and using the loading confirmation dialog.

Stowage planner tasks included generating fire hazard ratings for a stowage plan, and using the tool to generate an optimized stowage plan.

It was noted that roles and responsibilities can vary across shipping companies and vessel types. Therefore, planning tasks may involve crew roles like the Chief Officer or First Officer, rather than land-based staff.

6 A summary of demonstration results

The demonstration of the Stowage Planning Tool indicates that the tool was perceived as valuable for efficiency and safety. It also provided insights into user needs and expectations, and revealed areas for improvement. Participants emphasized the need to understand how system recommendations were derived, and for transparency in changes made during stowage plan optimization.

Participants using the tug-driver view found the tool's features generally intuitive and useful. The cargo list was sufficient for cargo unit selection, and the pickup confirmation process was straightforward. Initial hesitation over the fire hazard scan process was resolved through use. Damage reporting was found useful and easy, and especially the option to attach a photo was seen as valuable. Cargo placement instructions were clear, but there was room for improvement as the process of requesting alternative placement could be more intuitive. In addition, three was discussion about how the guidance for cargo placement could be implemented, as there are many potential technical solutions, and deciding which would be the best would depend on the specific work context. Overall, the integration of features like the VHD fire hazard scan, hazard ratings, stowage plan optimization, and detailed cargo information was positively received.

The deck crew appreciated the Loading Status page for a quick work situation overview but suggested improvements in the selection and presentation of the information. The tool's navigation design, the expanded view of the Cargo List, and hazard rating icons were also appreciated. The Incoming Cargo view and search feature were seen as features that could contribute to efficiency, although the option of camera-based identification of incoming units had mixed reviews. The loading confirmation dialog was found useful, especially for checking loading positions, electrical connections, and lashing. Direct reporting of deviations was another feature that was considered an advantage for efficiency.

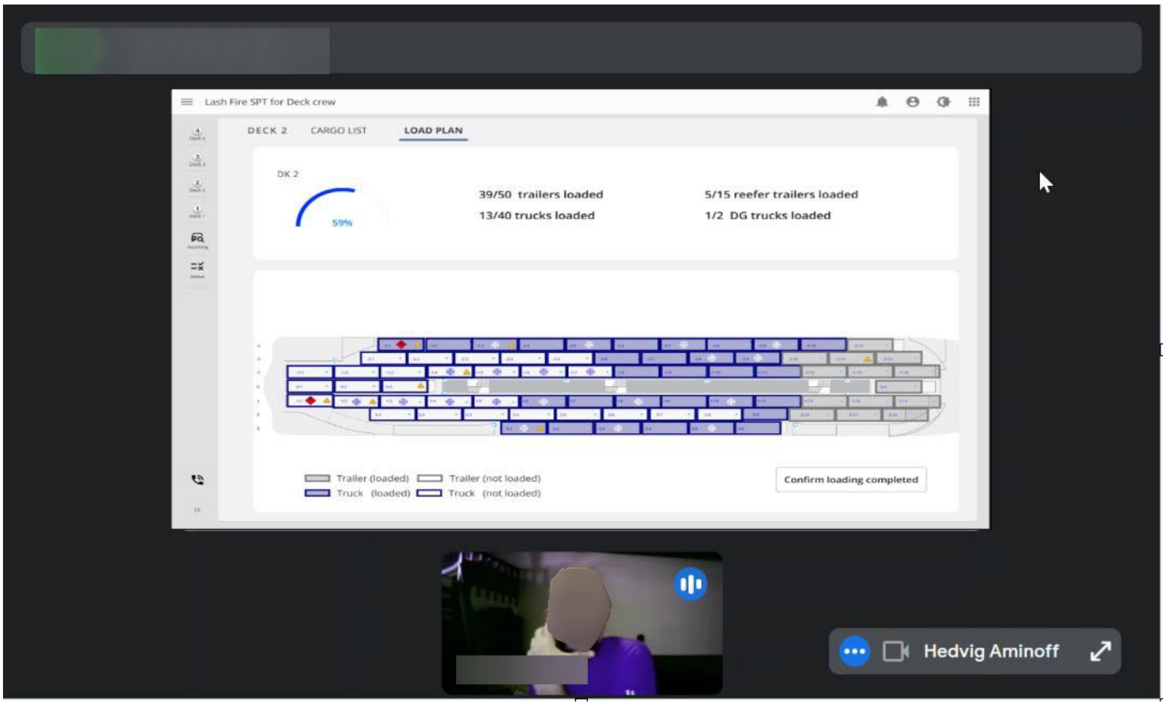

Figure 1 Screenshot from a recording of an online demonstration session of the Figma prototype, showing the load plan for the deck crew view.

The planner view received positive feedback and it was seen as a powerful tool for fire hazard management, as the fire hazard management features and the visibility of fire hazard ratings was highly valued.

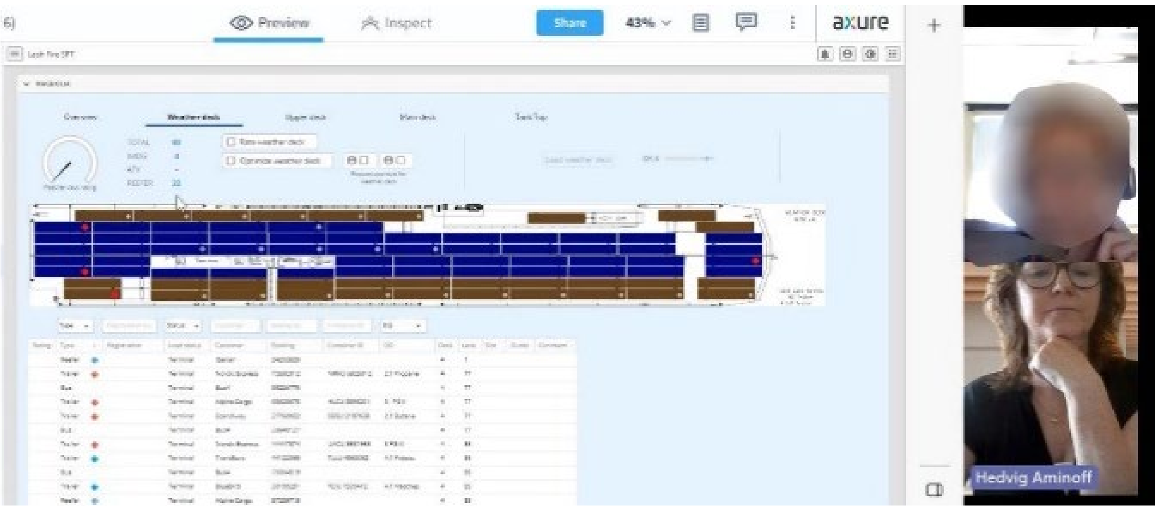

Figure 2 Screenshot from a recording of the online demonstration of the SPT for the planner role, in the Axure prototype.

Participants found generating fire hazard ratings easy and useful but suggested help sections and keys for rating factors, icons, and colour coding. Participants appreciated the stowage optimization tool's intuitive design, but also stressed the need for manual adjustments of the optimisation results. Users found the sortable cargo list, cargo card, and deck map practical, but requested colour highlighting for hazardous cargo rather than icons which some perceived as giving a cluttered impression. Stowage planners emphasized that it must be easy to manage loading constraints on the decks, as these restrictions directly influence how the optimization algorithm generates the optimal stowage plan. These constraints must be flexible and easy to adjust, sometimes on a daily basis, to account for factors such as maintenance on a deck, or changing weather conditions, which also is taken into consideration during planning.

7 Conclusion

The demonstration stipulated in the Grant Agreement (GA) has been successfully completed, and the outlined objectives are considered fulfilled. The GA describes that the Fire hazard matching and mapping configuration was to feature a human-centred design for visualization of interactive stowage plans. This demonstration involved showcasing the layout organization optimization tool developed by CIMNE through visualisation of these interactive stowage plans, via interactive prototypes made accessible to participants representing the load-planner, the cargo-officer, and tug-driver.

The demonstrated design was shown to successfully guide the user in the rating and optimisation of stowage plans, as well as during the cargo scanning process, cargo stowing, and for presenting real-time warnings for increased risk due to changes resulting from these actions.

8 References

[1] "OpenBridge Design System," [Online]. Available: https://www.openbridge.no/figma/current-release. [Accessed 15 6 2023].

[2] International Organisation for Standardization, "ISO 9241-210:2019 Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems," [Online]. Available: https://www.iso.org/standard/77520.html. [Accessed 10 5 2023].

9 Indexes

9.1 Index of figures