



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 D03.9
Final Exploitation Plan
29 August 2023

Dissemination level: **Public**

Abstract

The D03.9 Final Exploitation Plan summarizes the LASH FIRE project's innovative efforts to mitigate fire risks on ro-ro ships. It aims to operationalize developed solutions and technologies in the maritime industry through strategic market analysis, intellectual property rights management, stakeholder engagement, and effective marketing. The project aligns with the International Maritime Organization's safety objectives and interacts with maritime authorities and ship owners/operators to communicate its proposals and disseminate results.

The plan, structured in ten sections, includes an executive summary, introduction, preliminary exploitation strategy, project deliverables, and exploitation activities overview. Detailed exploitation potentials of project outcomes, barriers, post-project steps, and the project's impact on the SOLAS Convention are analyzed. Additional guidelines and supporting materials are provided in the annexes. This comprehensive guide facilitates the practical application of LASH FIRE project outcomes to improve the safety and competitiveness of ro-ro ships worldwide.



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

The information contained in this deliverable reflects only the view(s) of the author(s). The Agency (CINEA) is not responsible for any use that may be made of the information it contains.

The information contained in this report is subject to change without notice and should not be construed as a commitment by any members of the LASH FIRE consortium. In the event of any software or algorithms being described in this report, the LASH FIRE consortium assumes no responsibility for the use or inability to use any of its software or algorithms. The information is provided without any warranty of any kind and the LASH FIRE consortium expressly disclaims all implied warranties, including but not limited to the implied warranties of merchantability and fitness for a particular use.

© COPYRIGHT 2019 The LASH FIRE Consortium

This document may not be copied, reproduced, or modified in whole or in part for any purpose without written permission from the LASH FIRE consortium. In addition, to such written permission to copy, acknowledgement of the authors of the document and all applicable portions of the copyright notice must be clearly referenced. All rights reserved.

Document data

Document Title:	D03.9 – Final Exploitation Plan		
Work Package:	WP03 – Cooperation and Communication		
Related Task(s):	IR03.4, T03.1-4, T03.3, and all LASH FIRE tasks		
Dissemination level:	Public	Deliverable type: R	Report
Lead beneficiary:	17 – MAG		
Responsible author:	Reza Karimpour		
Co-authors:	Filipe Riberio		
Date of delivery:	2023-08-29		
References:			
Approved by	Carola Doerrie on [2023-08-16]	Jonatan Gehandler on [2023-08-18]	Maria Hjohlman on [2023-08-21]

Involved partners

No.	Short name	Full name of Partner	Name and contact info of persons involved
17	MAG	Magellan-Associacao para a Representacao dos Intresses Portugueses no Exterior	Reza Karimpour, reza.karimpour@magellancircle.eu Filipe Ribeiro, filipe.ribeiro@magellancircle.eu
7	CMT	Center of Maritime Technologies gGmbH	Carola Dörrie – doerrie@cmt-net.org
8	BV	Bureau Veritas Marine & Offshore Registre International de Classification de Navires	Eric De Carvalho – eric.de-carvalho@bureauveritas.com
11	INF	Interferry	Capt. John Garner – john.garner@interferry.com
12	SEA	Shipyards and Maritime Equipment Association of Europe	Benoît Loicq – bl@seaeurope.eu
15	SAS	Sociedad de Salvamento y Seguridad Marítima	Jaime Bleye, jaimebv@centrojovellanos.es

Document history

Version	Date	Prepared by	Description
01	2023-05-31	MAG	Draft Structure (ToC)
02	2023-06-29	MAG	Working document
03	2023-07-24	MAG	Working document
04	2023-08-16	MAG	Working document
05	2023-08-17	MAG	Working document
06	2023-08-29	MAG	Final version

Content

1	Executive summary	5
1.1	Problem definition	6
1.2	Contribution to LASH FIRE objectives	6
2	List of symbols and abbreviations.....	8
3	Introduction	9
3.1	Summarised Project Description.....	9
3.2	Deliverable Scope and objectives	9
3.3	Deliverable Methodology and structure.....	11
4	Preliminary Exploitation Strategy	12
4.1	An overview of the Exploitation from the Project Grant Agreement.....	12
4.2	Preliminary Exploitation Strategy Outlined in the Internal IR03.4 Report	12
5	Project Deliverables and Exploitation Activities	16
5.1	LASH FIRE Project Deliverables	16
5.2	Exploitation Activities During the Project's Lifespan	20
5.3	Contributions of Project Partners And Stakeholders In Exploitation Activities.....	25
5.4	Collaboration With External Entities for Exploitation and Dissemination.....	25
6	Analysing LASH FIRE Beneficiary Solutions, and Developing Exploitation Plans	26
6.1	LASH FIRE Beneficiary Solutions and Technologies Potentials for Exploitation	26
6.2	Exploitation Plans for Each LASH FIRE Beneficiary Solutions & Technologies.....	31
7	Post-Project and Further Steps.....	57
7.1	Identifying Barriers to Implementation of LASH FIRE Solutions	57
7.2	Post-Project Exploitation and Sustainability of the Project's Results.....	58
7.3	Impact of LASH FIRE on the SOLAS Convention of IMO and also EU Regulations	59
8	Conclusion.....	60
9	ANNEXES	60
9.1	ANNEXE A - LASH FIRE Guideline - Improvement In Current Signage And Marking Standards /Conditions.....	61
9.2	ANNEXE B - LASH FIRE Guideline - Guidelines For Crew-Centered Fire Safety Design.....	61
9.3	ANNEXE C - LASH FIRE Two- Pager Information Sheets.....	62
9.4	ANNEXE F - LASH FIRE Final Video Transcript	63
9.5	ANNEXE G - LASH FIRE Traing Video/Course on SEABLY - Transcript	65
10	Indexes.....	68



10.1 Index of Figures..... 68

10.2 Index of Tables 68

1 Executive summary

Main authors of the chapter: Reza Karimpour, Filipe Riberio, MAG

The D03.9 Final Exploitation Plan for the LASH FIRE project represents the culmination of extensive research and development efforts to reduce the risk of fires on board ro-ro ships. This plan is an essential part of the project, aiming to ensure that the solutions and technological innovations developed are effectively introduced to the market and adopted by relevant stakeholders in the maritime industry.

The LASH FIRE project addresses a critical safety concern in the maritime industry, focusing on more efficient fire management operations, inherently safe design, ignition prevention, enhanced fire detection, quick extinguishment, and improved containment. The project aligns with the objectives of the International Maritime Organization (IMO) and other regulatory bodies to enhance the safety of ro-ro ships.

The plan outlines a comprehensive market analysis to understand the current trends, competitors, and potential customers in the ship building, designing, and operation sectors. It addresses the importance of intellectual property rights management to ensure the legal protection of developed technologies. Strategic planning outlines an exploitation strategy for each solution, incorporating potential exploitation models and pricing strategies. Stakeholder engagement, marketing, and communication are highlighted as critical aspects of the plan, focusing on promoting the project outcomes and ensuring their acceptance and adoption by the relevant entities. The plan concludes with the implementation and monitoring phase to ensure the objectives are achieved effectively.

Work Package 3 (WP03) of the project ensures interaction with external entities, garnering acceptance from maritime authorities, ship owners/operators, and communicating the project proposals to the IMO and other relevant authorities. It also includes disseminating project results to European citizens, policy makers, and the wider European maritime industrial, research, and academic communities.

The final exploitation plan is structured into ten sections. It starts with an executive summary and a list of symbols and abbreviations. An introduction then follows, summarizing the project description, scope, objectives, and key insights from the IR03.4 Internal Report on Exploitation. A preliminary exploitation strategy is then outlined, followed by an overview of the project deliverables and exploitation activities carried out during the project lifespan.

The report then delves into the detailed exploitation potentials of the LASH FIRE outcomes, including an overview and detailed analyses of these outcomes for exploitation plans. A section is dedicated to post-project steps, identifying potential barriers to the implementation of the project solutions, post-project exploitation and sustainability, and the impact of the LASH FIRE solutions on the SOLAS Convention of the IMO.

The report concludes with annexes containing examples of guidelines for improvements and two-pager information sheets. These annexes provide additional guidance and support for the implementation and exploitation of the project outcomes.

In summary, the D03.9 Final Exploitation Plan is a comprehensive document that guides the successful implementation and exploitation of the LASH FIRE project outcomes to benefit the global maritime industry, ultimately enhancing the safety and competitiveness of ro-ro ships.

1.1 Problem definition

From 2006 to 2015, 32 serious fires were recorded on RoPax vessels. The LASH FIRE project aims to provide the European industry with knowledge for building safer and more competitive ships for sustainable transport and to provide a basis for the revision of international maritime regulations. To this end, the project will develop innovative and cost-effective measures to increase fire safety at sea.

These solutions must not only be tested by ship operators for feasibility and cost-effectiveness but also consider the mitigation of fire risk in relation to the environmental, cost and crew impact. An impact which causes changes to the environment, costs and crew operations to ensure that fire safety on ro-ro ships is improved in a sustainable, practicable and long-term manner. It is also helpful to cooperate and exchange ideas with other projects that are dedicated to the topic of fire safety or overlap with similar approaches in other areas.

For the proposed solutions to be finally applied and considered in future regulations, they must be brought to the attention of legislative bodies. This will require not only the agreement of maritime stakeholders and other relevant actors, but also the advocacy and support of flag states to submit these proposals for rule adaptations to the International Maritime Organization (IMO) and other authorities.

In this scope, the third work package has been set up to address internal and external communication and foster potential cooperation to maximize awareness and support for the exploitation of project outcomes and thus optimize its achievement.

1.2 Contribution to LASH FIRE objectives

The final exploitation plan is a significant and vital component of the LASH FIRE project. This plan meticulously intertwines with all project objectives, contributing extensively to their realization, optimization, and execution.

- 1- **Enhanced Safety:** The final exploitation plan embodies the project's primary objective to reduce the risk of fires on board ro-ro ships significantly. The plan facilitates the transition of novel procedures and technological innovations developed through LASH FIRE from theory to practical, market-ready applications. The application of these innovations will enhance safety by improving fire management operations, implementing inherently safer design principles, reducing ignition sources, and upgrading detection, extinguishment, and containment methods.
- 2- **Holistic Approach:** Reflecting the project's holistic approach, the exploitation plan considers all aspects, from effective manual operations, inherently safe design, ignition prevention, detection, and extinguishment to containment. The plan will ensure that the solutions developed in the project are effectively disseminated and adopted, with a focus on both market feasibility and safety enhancement.
- 3- **Knowledge Advancement and Global Collaboration:** Following the guideline of WP03, the exploitation plan promotes an active interaction with external entities. The plan keeps abreast with global advancements in fire-related research, establishes cooperation, and communicates safety proposals. This ensures that LASH FIRE remains at the forefront of innovation, contributes to a global approach to maritime fire safety, and influences international maritime regulations.
- 4- **Industry Development:** In accordance with the ambition of the LASH FIRE project, the exploitation plan will not only work towards enhancing ship safety but also provide knowledge and innovative

solutions that allow European shipyards, system suppliers, and related industries to develop and build safer, more competitive, and sustainable ships.

- 5- Stakeholder Engagement and Dissemination: Following the instructions provided in the general guideline for creating an exploitation plan, the final exploitation plan includes a comprehensive stakeholder engagement strategy and a marketing and communication plan. This ensures that all relevant stakeholders - from ship owners, operators, and maritime legislators to European citizens and policymakers - are informed about the project outcomes, thus promoting wider adoption and acceptance of the solutions.

The final exploitation plan aligns with and supports all key objectives of the LASH FIRE project. The exploitation plan plays a critical role in translating the project's goals into tangible and impactful outcomes by ensuring the practical application and dissemination of the project's findings.

2 List of symbols and abbreviations

APV - Alternatively Powered Vehicles

CMG - Communication Management group

EMSA - European Maritime Safety Agency

GMDSS - Global Maritime Distress and Safety System

IMDGC - Maritime Dangerous Goods Code

IMO - International Maritime Organization

IR - Infrared

ISM - International Safety Management

MAAG - Maritime Authorities Advisory Group

MLC - Maritime Labour Convention

MSC - Maritime Safety Committee

MOAG - Maritime Operators Advisory Group

RV - Recreational Vehicle

SMS - Safety Management System

SOLAS - International Convention for the Safety of Life at Sea

STCW - Standards of Training, Certification, and Watchkeeping

UHF - Ultra High Frequencies

VHF - Very High Frequencies

3 Introduction

Main author of the chapter: Reza Karimpour, MAG

3.1 Summarised Project Description

The "Legislative Assessment for Safety Hazards of Fire and Innovations in Ro-ro ship Environment" (LASH FIRE) project is dedicated to improving fire safety measures on all types of ro-ro vessels. The project seeks to mitigate fire risks by developing and implementing innovative solutions and impactful strategies for communication, exploitation, and data management.

The LASH FIRE project, an international research initiative funded by the European Union's Horizon 2020 research and innovation programme (grant agreement No 814975), aims to substantially reduce the risk of fires aboard ro-ro ships. It aspires to develop and demonstrate new procedures and technical innovations for maritime applications by bringing together relevant expertise from diverse sectors. This is in alignment with the ambitions of the International Maritime Organization (IMO) and other regulatory bodies to greatly enhance the safety of ro-ro ships.

The project applies a holistic approach to addressing various aspects of fire safety aboard ships. It focuses on improving fire management at all stages, from risk-based cargo screening to efficient firefighting. By developing inherently safe designs, the project aims to minimise potential human error and improve decision support in case of fire incidents.

LASH FIRE's ambition extends to ignition prevention, significantly reducing ignition sources and combustible deck materials. It also seeks to improve detection capabilities, ensuring quicker, more reliable, and robust means for fire detection, confirmation, and localisation. Moreover, it works on developing effective extinguishment strategies and containment measures, targeting the elimination of significant weaknesses and ensuring smoke, fire, and heat integrity.

The project's deliverables encompass multiple aspects, including Effective Manual Operations, Inherently Safe Design, Ignition Prevention, Detection, Extinguishment, and Containment. As part of the broader project framework, it fosters collaborations with external entities, developing global fire safety proposals, and actively communicating the project's outcomes to stakeholders.

3.2 Deliverable Scope and objectives

Work Package 3 (WP03) of the LASH FIRE Project ensures comprehensive interaction between the project consortium and external entities. Its objectives include keeping up-to-date with global advancements in fire-related research and technology, fostering acceptance and consensus with Flag States, maritime authorities, and ship owners/operators, and communicating proposals to the International Maritime Organization (IMO) and other relevant authorities.

LASH FIRE also highly emphasises result dissemination and exploitation, devising strategies to optimize its impact. It features plans for Exploitation and Dissemination of Results (PEDR), a dynamic plan that evolves based on project progress. A Communication Management Group (CMG), comprising project partners to guide PEDR implementation, is established. Furthermore, the project recognizes the importance of data

management, implementing a preliminary Data Management Plan to responsibly manage and use data while respecting copyright and confidentiality.

The LASH FIRE project represents a significant endeavour to improve fire safety aboard ro-ro ships through a multi-faceted approach encompassing research, development, demonstration and dissemination of new procedures, technologies, and strategies. By engaging with a broad range of stakeholders, from ship owners to maritime authorities, it aims to make a lasting impact on fire safety standards in the maritime sector.

Throughout the duration of the LASH FIRE project, WP03 has played a critical role in identifying and initiating measures for knowledge sharing and international cooperation with a focus on ro-ro ship fire safety. This includes monitoring and examining advancements in fire prevention technologies, fire management strategies, and regulatory modifications. The Communication Management Group (CMG) has been in charge of the project's communication, working in close collaboration with WP03 and other partners. The CMG convenes on a quarterly basis to evaluate ongoing activities and suggest measures for improved communication and collaboration. It also plays a key role in promoting the project's dissemination and exploitation and coordinating public events with other initiatives.

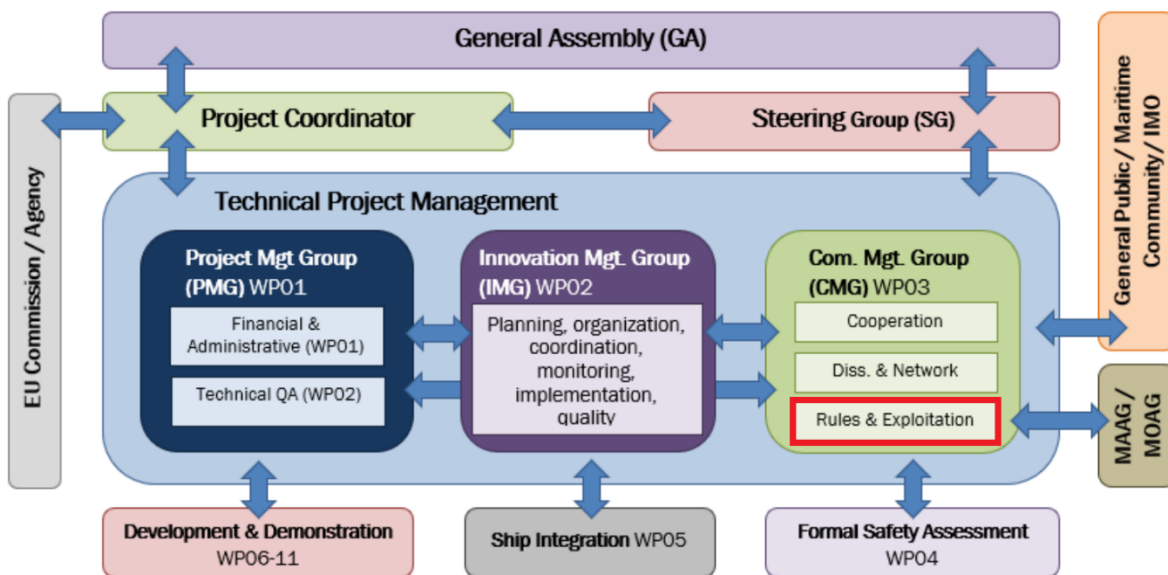


Figure 1 Management structure & Exploitation task

The D03.9 document, "Final Exploitation Plan," marks a significant milestone in the LASH FIRE project. It not only encapsulates the project's accomplishments but also outlines a strategy for the efficient utilization and dissemination of the results within the ro-ro shipping sector. The Communication Management Group (CMG), responsible for project communication, has played a key role in propelling the project's dissemination and exploitation. Through regular updates and meetings, the CMG ensures that the project's findings are conveyed to the relevant stakeholders. In the end, the D03.9 document acts as an exhaustive plan to enhance maritime safety and fire prevention through the use of the project's findings.

3.3 Deliverable Methodology and structure

The methodology used to formulate this plan is a systematic approach which has taken into account the comprehensive nature of the LASH FIRE project, including its innovative research, technological advancements, regulatory considerations, and industrial implications. This approach aligns with creating an exploitation plan, which comprises steps like market analysis, intellectual property rights management, strategic planning, stakeholder engagement, marketing and communication, and implementation and monitoring.

Initially, an in-depth analysis of the maritime industry and the potential markets was conducted. This involved examining current trends, competitors, potential customers, existing solutions, and the unique value propositions of the LASH FIRE project's outcomes.

Simultaneously, the project's intellectual property rights were assessed to secure the legal protection of the technologies developed. This assessment is crucial to prevent potential unauthorized use or patent infringement issues.

A strategic plan was then formulated for each potential solution, considering appropriate exploitation models, pricing strategies, distribution channels, and commercial partners. During this stage, input and feedback were solicited from stakeholders like ship owners, operators, maritime legislators, and flag states to ensure wide acceptance and usability of the solutions.

Subsequently, a robust marketing and communication plan was developed to promote the solutions. This involved presentations at industry conferences, scientific publications, press releases, and digital marketing.

Lastly, the exploitation plan was implemented in a phased manner and monitored regularly to measure progress and make adjustments as necessary.

The structure of this exploitation plan follows the general outline of the table of contents for the D03.9 Final Exploitation Plan. It starts with a summary of the project, the problem definition, the technical approach, and the results achieved. The report then discusses the preliminary exploitation strategy, the deliverables, and the specific exploitation activities carried out during the project's lifespan. This includes details of the project's interactions with external entities and advisory groups like MOAG and MAAG.

A substantial portion of the report is dedicated to a detailed analysis of the exploitation potentials of the LASH FIRE outcomes, including an overview and detailed analyses of key outcomes for potential exploitation strategies.

The final sections address the post-project steps, barriers to implementation, the sustainability of the project's results, and the impact of the LASH FIRE solutions on the SOLAS Convention of the IMO. The document concludes with several annexes providing additional information on various aspects of the project, and an index of figures for easy navigation.

4 Preliminary Exploitation Strategy

Main author of the chapter: Reza Karimpour, Filipe Riberio, MAG

4.1 An overview of the Exploitation from the Project Grant Agreement

The project's primary objective, as stated in the grant agreement, is to amplify its impact through an efficient and far-reaching dissemination and exploitation of results. A Communication Management Group (CMG) orchestrates this process, incorporating measures for the post-project phase, including capitalizing on the gathered data and fostering established partnerships. The exploitation strategy elucidates on aspects such as exploitable outcomes, access rights, exploitation rights, and the protection of intellectual property rights. Technical Work Package leaders play a pivotal role in steering this approach.

4.2 Preliminary Exploitation Strategy Outlined in the Internal IR03.4 Report

The internal IR03.4 report outlines a preliminary plan for exploiting the outcomes of the LASH FIRE project. This strategy centers around the effective use of the project's results and includes several core components. Among these are the formulation of Risk Control Measures and Options, a comprehensive assessment of costs involved, and a series of activities designed to ensure the wide implementation of these control measures.

These activities are intended to be multi-pronged and include the creation of new standards for fire safety, visiting various ships for inspection and data gathering, organising stakeholder workshops, and developing innovative products that can be utilized in the industry to improve fire safety.

In addition to these strategic components, the IR03.4 report also offers a brief overview of the LASH FIRE project as a whole. It emphasizes the project's significant commitment to enhancing fire safety aboard ro-ro ships through a comprehensive approach that involves not only research and development, but also the wide dissemination of novel procedures, technological advancements, and strategic methods.

One of the defining features of the LASH FIRE project, as outlined in the IR03.4 report, is its broad engagement with various stakeholders. These include ship owners, operators, and maritime authorities, among others. By engaging with these stakeholders, the project aims to create a lasting and significant improvement in fire safety standards within the maritime sector.

The IR03.4 report shines a light on the exploitation strategy of the LASH FIRE project, placing special emphasis on the practical application of the project's results. The strategy's main objective is to promote the widespread adoption of Risk Control Options. To achieve this, the plan calls for establishing new safety standards and organising workshops that involve all relevant stakeholders.

4.3 Contributions of Maritime Operators Advisory Groups (MOAG) & Maritime Authorities Advisory Group (MAAG) Shaping Exploitation

The Maritime Advisory Groups consist of two pre-identified, selected and committed external parties which have a prime interest in the work of the project due to their daily business and expertise.

The first group, the Maritime Operators Advisory Group (MOAG) involved ship end-users and users of innovative firefighting technologies, facilitators (equipment suppliers and shipyards), and other maritime

stakeholders such as insurance companies. The main purpose of the MOAG is to ensure practical feasibility and broad acceptance of new technologies, rules and regulations by the users. The MOAG is coordinated and facilitated by Interferry (INF2), an association representing the ferry industry on an international level. Interferry is the partner who facilitates and monitors the activities of the MOAG and provides direct contact between the MOAG members and the partners of the consortium.

The membership of the Maritime Operators Advisory Group (MOAG) is as follows:

Eleven ship end-users:

- Balearia Lines, Spain
- British Columbia (BC) Ferries, Canada
- Calmac Ferries, Scotland
- Condor Ferries Ltd, UK
- DFDS, Denmark
- Grimaldi Group, Italy
- Mitsui O.S.K. Lines, Ltd., Japan (MOL)
- Scandlines, Denmark
- Stena Rederi AB, Sweden
- Wallenius Marine AB, Sweden
- Volkswagen Konzernlogistik

One end-user of innovative firefighting technologies:

- RelyOn Nutec, Holland

Two facilitators, one equipment supplier and one shipyard:

- SHIFT, previously Sterling PBES Energi Solutions Ltd, Canada
- FSG Design GmbH, Germany

Three associations of marine insurers;

- International Group of P & I Clubs
- International Union of Marine Insurance (IUMI)
- The Nordic Association of Marine Insurers (Cefor)

The establishment of the Maritime Operators Advisory Group (MOAG) is complete with a total of seventeen members, eleven of which are first class operators and end-users of ro-ro passenger, ro-ro cargo and pure car carrier vessels, an end-user of innovative firefighting technologies, two facilitators consisting of an energy equipment supplier and a shipyard and three associations of marine insurers . See Figure 1 .



Figure 1 The Maritime Operators Advisory Group (MOAG)

The Maritime Authorities Advisory Group (MAAG) consists of representatives of Flag states Authorities/Organisations and was established with the following objectives:

- to collect input regarding future regulations and legislations, to analyse and discuss this and to find consensus in view of the proposals to be elaborated by the project
- to allow for review of the project results and discussion of regulatory aspects and proposals prior to communicating them to the International Maritime Organisation (IMO) with a view at facilitating a wide support and consensus of the findings and increases the probability of formal implementation.

The membership of the Maritime Authorities Advisory Group (MAAG) is shown in Figure 2.



Figure 2 The Maritime Authorities Advisory Group (MAAG)

Liaison with the Project will be facilitated by the MAAG Member through one person, the appointed MAAG Member's representative. This representative is appointed by the national authorities as an expert with specific expertise on safety hazards of fire and innovations in ro-ro ship environment. As a partner in the LASH FIRE Consortium, SEA Europe (the European Association of Shipyards and Maritime Equipment Manufacturers) is coordinating MAAG's activities. Memorandum of Understanding Agreements have been signed with MAAG members (except for those partners in the LASH FIRE consortium).

The Maritime Authorities Advisory Group (MAAG) and the Maritime Operators Advisory Group (MOAG) are essential pillars of the LASH FIRE project. While MAAG, comprising representatives from global flag states, focuses on regulatory propositions and smooth formal implementation, MOAG, with ship end-users and innovative firefighting tech enthusiasts, ensures the practical applicability of new technologies, rules, and regulations.

SEA, in collaboration with BV, worked on data access from flag states or PSCs. The primary partners overseeing MAAG were SEA, supported by RISE, BV, INF, and CMT, while MOAG was led by INF with backing from MAG, RISE, and CMT. Both groups were instrumental in shaping the LASH FIRE project's strategy. They documented their meetings, kept the consortium updated on outcomes, and met more than ten times during the project.

The MOAG and MAAG were thus present at several different stages of development of the project, namely in moments where the consortium gathered but also with periodical meetings with certain players within LASH FIRE. Meetings and Workshops:

- **Initial Meetings and Webinars:**
 - A joint advisory meeting took place on 5th March 2020 in London, coinciding with the IMO SSE 7 session. The session was enriched by presentations introducing the LASH FIRE project, ship integration, and other pivotal topics.
 - On 14th October 2020, a webinar titled "Fires in Alternatively Powered Vehicles Onboard Ships" was hosted, witnessing participation from over 300 industry representatives. Coordinated by Interferry, Sea Europe, CMT2, and Magellan, the event disseminated critical information, establishing it as a notable success.
- **Solution Workshops:**
 - Between June 2021 and June 2022, nine technical workshops were organized. These workshops primarily focused on assessing the project's challenges, actions, and Risk Control Measures (RCMs). Workshop #9 was particularly notable as it concluded the review phase of RCMs and embarked on the selection of Risk Control Options (RCOs).
- **Level of Support Workshop:**
 - Held on 7 and 8 June 2022, this was a conclusive workshop to decide on the RCOs from the RCM review results. Here, the 'Mentimeter' application played a pivotal role by allowing participants to score various solutions, giving a clear direction to the exploitation strategy.
- **Advisory Group Meetings:**

- An advisory meeting was conducted on 10th October 2022 during the CFIS 2022, aiming to summarize the feedback and delineate the future course of the LASH FIRE project.
- The final advisory meeting took place in Pula, Croatia on 27 June 2023, preceding the CFIS 2023. Here, project partners showcased results, FSA, and Risk Control options. Both Maritime Authorities Advisory Group (MAAG) and the Maritime Operators Advisory Group (MOAG) of the LASH FIRE project met for the final solution workshop in Pula, Croatia on 27 June 2023. Results of the cost-effectiveness assessment of the LASH FIRE solutions and Risk Control Options (RCOs) were presented by project partners and discussed with the MAAG and MOAG members. The event preceded the Conference on Fire Safety at Sea (CFIS 2023). Some RCOs related to APVs and known to be of particular interest were discussed in particular due to expected special interest from the members. These were:
 - RCO 4 - Manual firefighting of Alternatively Powered Vehicles
 - RCO 5 – Improved alarm system interface
 - RCOs 8 & 9 - Safe Electrical Connections of reefers and electric vehicles
 - RCO 11 – Alternative fire detection in closed and open ro-ro spaces
 - RCO 13 – First response dry-pipe sprinkler system for vehicle carriers
 - RCO 15 - Fixed autonomous fire monitors using water for weather decks
 - RCO 16 – Improved knowledge in fire ventilation for closed ro-ro spaces

5 Project Deliverables and Exploitation Activities

Main authors of the chapter: Reza Karimpour, Filipe Riberio, MAG

The LASH FIRE project aims to enhance fire safety in the maritime sector, specifically focusing on the roll-on/roll-off (ro-ro) shipping sector. The project intends to produce innovative technical solutions for the efficient handling of fire-related incidents and proposals for revising relevant international safety regulations.

5.1 LASH FIRE Project Deliverables

This section presents the project deliverables resulting from the LASH FIRE initiative, a comprehensive endeavor addressing numerous aspects of maritime safety. These deliverables, while primarily public, include a few internally directed administrative documents. They span several work packages, from Cooperation and Communication to Ignition Prevention and Extinguishment. The variety of topics reflects the multidisciplinary approach taken to improve the safety of ro-ro spaces, and underlines the potential for broader exploitation in various maritime industry sectors. It provides an overview of these deliverables, showcasing the wide-ranging efforts of LASH FIRE to enhance fire safety standards.

The project deliverables are public, with a few project internal administration documents as exceptions, and are collected listed below :

Table 1 List of LASH FIRE Project Deliverables

Work Package	No.	Deliverable
WP 3 – Cooperation and Communication	D03.3	First Dissemination and Communication Report and updated plan
WP 3 – Cooperation and Communication	D03.4	Updated Dissemination and Communication Report and updated plan
WP 3 – Cooperation and Communication	D03.5	First proposal on updated rules and regulations on fire safety
WP 3 – Cooperation and Communication	D03.8	Final Report on Dissemination, Communication and Cooperation
WP 3 – Cooperation and Communication	D03.9	Final Exploitation Plan
WP 4 – Formal Safety Assessment	D04.1	Review of accident causes and hazard identification report
WP 4 – Formal Safety Assessment	D04.2	Ro-ro space fire database and statistical analysis report
WP 4 – Formal Safety Assessment	D04.3	Simulation tool for consequence quantification
WP 4 – Formal Safety Assessment	D04.4	Holistic risk model
WP 4 – Formal Safety Assessment	D04.5	Development of holistic risk model report
WP 4 – Formal Safety Assessment	D04.6	Cost-effectiveness assessment report
WP 4 – Formal Safety Assessment	D04.7	Cost-effectiveness assessment report: Uncertainty and sensitivity analysis report
WP 4 – Formal Safety Assessment	D04.8	Impact on regulations by new solutions and consolidation of new proposals for regulations
WP 4 – Formal Safety Assessment	D04.9	Preliminary impact of solutions and related testing and demonstrations plan
WP 4 – Formal Safety Assessment	D4.10	LASH FIRE_D04.10_Consolidation of performance assessment and solutions' impact on safety_V05
WP 5 – Ship Integration	D05.1	Definition of generic ships
WP 5 – Ship Integration	D05.2	Cost assessment tool
WP 5 – Ship Integration	D05.3	Development of cost assessment tool
WP 5 – Ship Integration	D05.4	Environmental assessment tool
WP 5 – Ship Integration	D05.5	Development of environmental assessment tool
WP 5 – Ship Integration	D05.6	Ship integration requirements
WP 5 – Ship Integration	D05.7	Ship integration evaluation
WP 5 – Ship Integration	D05.8	Ship integration cost and environmental assessment
WP 5 – Ship Integration	D05.9	Performance, feasibility and integration assessment
WP 6 – Effective Manual Operations	D06.1	Development of and guidelines for quick manual fire confirmation and localization
WP 6 – Effective Manual Operations	D06.2	Guidelines for manual screening of cargo fire hazards and effective fire patrols
WP 6 – Effective Manual Operations	D06.3	Development of guidelines for communication of fire confirmation
WP 6 – Effective Manual Operations	D06.4	Background and Testing of smart alert system of nearby first responders
WP 6 – Effective Manual Operations	D06.5	Development of new standards for effective fire patrols and recommendations for manual screening of cargo fire hazards

WP 6 – Effective Manual Operations	D06.6	Development of smart alert of nearby first responders
WP 6 – Effective Manual Operations	D06.7	Evaluation and development of tactics, gear, equipment and guidelines for effective first response
WP 6 – Effective Manual Operations	D06.8	Development and testing of APV firefighting routines, equipment and tactics
WP 6 – Effective Manual Operations	D06.9	Guidelines for firefighting gear, equipment and tactics, considering APVs
WP 7 – Inherently Safe Design	D07.1	Study and analysis of regulations, accident investigations and stakeholders for bridge alarm panel design
WP 7 – Inherently Safe Design	D07.2	Field Study Report of Alarm Panel Insufficiencies and Improvement Identification
WP 7 – Inherently Safe Design	D07.3	Design guidelines for bridge alarm panels
WP 7 – Inherently Safe Design	D07.4	Development of firefighting resource management centre design
WP 7 – Inherently Safe Design	D07.5	Alarm system interface prototype Demonstration
WP 7 – Inherently Safe Design	D07.6	Alarm system interface prototype development and testing
WP 7 – Inherently Safe Design	D07.7	Development and onboard assessment of drone for assistance in firefighting resource management and rescue operations
WP 7 – Inherently Safe Design	D07.8	Design definition and development of firefighting resource management simulator prototype
WP 7 – Inherently Safe Design	D07.9	Development and implementation of design guidelines and procedures for extinguishing system activation
WP 7 – Inherently Safe Design	D07.10	Deployment and validation of firefighting resource management simulator prototype
WP 7 – Inherently Safe Design	D07.11	Firefighting resource management simulator prototype
WP 8 – Ignition Prevention	D08.1	Definition and parametrization of critical fire hazards, classification of cargoes, transport units, engines, fuels and vessels and identification methodologies
WP 8 – Ignition Prevention	D08.2	Fire hazard mapping visualization tool with fire hazard matching integrated
WP 8 – Ignition Prevention	D08.3	Development of fire hazard mapping visualization tool with fire hazard matching integrated
WP 8 – Ignition Prevention	D08.4	Stowage planning optimization and visualization aid
WP 8 – Ignition Prevention	D08.5	Development and validation of safe electrical systems, equipment and routines
WP 8 – Ignition Prevention	D08.6	Guidelines for electrical systems, equipment and routines, providing safe electrical connection of reefers and electrical vehicles in ro-ro spaces
WP 8 – Ignition Prevention	D08.7	Description of stowage plan visualization aid demonstration

WP 8 – Ignition Prevention	D08.8	Stowage plan visualization aid
WP 8 – Ignition Prevention	D08.9	Prototyping and demonstration of vehicle identification tool
WP 8 – Ignition Prevention	D08.10	Demonstration of prototype for detection of potential ignition sources
WP 8 – Ignition Prevention	D08.11	Description of prototypes and demonstration for identification of vehicles and ignition sources
WP 8 – Ignition Prevention	D08.12	Consolidated guidelines on screening systems [including ignition prevention sensors], appropriateness and placement indications
WP 8 – Ignition Prevention	D08.13	Overall integration with firefighting control centre
WP 8 – Ignition Prevention	D08.14	Fire risk assessment and establishment of requirements [material property performance and test method for evaluation] for combustible surfaces in ro-ro spaces
WP 10 – Extinguishment	D10.1	Description of the development of automatic first response fire protection systems for ro-ro spaces on vehicle carriers
WP 10 – Extinguishment	D10.3	Description of the development of weather deck fire-extinguishing systems and selected solutions
WP 10 – Extinguishment	D10.	Large-scale validation of the new fire test standard for alternative fixed fire-fighting systems
WP 10 – Extinguishment	D10.4	Large-scale validation of the new fire test standard for alternative fixed fire-fighting systems
WP 11 – Containment	D11.1	Development, theoretical evaluation and preliminary assessment of requirements for horizontal division of ro-ro spaces
WP 11 – Containment	D11.2	Development of means for sub-division of ro-ro spaces
WP 11 – Containment	D11.3	Development of means for Ro-Ro ship safe evacuation conditions in relation to fire integrity and walk-off abandonment
WP 11 – Containment	D11.4	Description of development and assessment of safe ro-ro space openings
WP 11 – Containment	D11.5	Elucidation and guidelines for ro-ro space ventilation in case of fire
WP 11 – Containment	IR11.15	Calculation methods for safety distances of ro-ro space openings
WP 11 – Containment	IR11.16	Hull Exposure Levels Above Openings and Limits for Unprotected Areas

The LASH FIRE project has yielded several key outcomes and deliverables that show potential for exploitation in various maritime industry sectors. These include, but are not limited to:

1. **Design and installation guidelines for local application fire-extinguishing systems for closed ro-ro spaces on vehicle carriers:** Developed by RISE, these guidelines show promising applications

- for ship builders, ship designers, ship owners, ship operators, and maritime legislators. They are already published, and their components are commercially available (Maturity level: 6).
2. **New standard for alternative fire suppression systems for closed and open ro-ro spaces:** This standard, also created by RISE, is ready for exploitation in the same sectors. Its components are commercially available, and it could be market-ready in as soon as three months (Maturity level: 4).
 3. **Automatic screening and management of cargo fire hazards by means of Automated Guided Vehicles (rolling drone):** This solution from RISE could be beneficial for ship owners and ship operators, with a predicted market-ready time of 36 months (Maturity level: 6).
 4. **Drone-based monitoring system for open decks targeting fire patrols, firefighting resource management and search & rescue:** Also developed by RISE, this solution presents potential applications for ship owners and ship operators. Its components are commercially available today, but regulatory risks may delay its time to market (Maturity level: 6).
 5. **Guidelines for safe electrical power connections in ro-ro spaces for reefer units:** Another deliverable from RISE, these guidelines can be used by ship builders, ship designers, ship owners, ship operators, authorities, and maritime legislators. Its components are commercially available today, and it could be market-ready in as soon as nine months (Maturity level: 6).
 6. **New equipment and procedures to suppress fires in Alternative Fuel Vehicles with a special focus on Li-ion battery fires:** Developed by SAS, this solution has potential for ship owners, ship operators, authorities, and maritime legislators. Some proposed equipment is still in the definition process, with a predicted time to market of nine months (Maturity level: 6).
 7. **Water fire monitor system for the protection of weather decks, autonomous and/or remotely controlled.**
 8. **Alarm system interface prototype (Digital Fire Central):** Developed by NTNU, this solution could benefit ship builders, ship designers, ship owners, ship operators, and maritime legislators. It has been published, and its components are commercially available today (Maturity level: 6).
 9. **Cargo scanning and identification and tracking system by means of a Vehicle Hot Spot Detector system:** This solution, developed by SCK, could be exploited by ship builders, ship designers, ship owners, ship operators, authorities, and maritime legislators. It has a predicted time to market of three months, with equipment already commercially available (Maturity level: 7).

The above examples represent a range of technologies, from design guidelines to automatic screening systems, each providing a unique contribution to the project's goal of improving fire safety in ro-ro spaces. The maturity level of these technologies ranges from 4 to 8, indicating that while some are ready for immediate implementation, others require additional time for development or regulatory approval.

5.2 Exploitation Activities During the Project's Lifespan

Throughout the LASH FIRE project, various strategic activities were executed to harness and disseminate the project's key findings effectively. These activities encompassed the development and distribution of guidelines, organization of workshops, establishment of a cargo fire hazard management database, hosting public conferences, production of a training video, and the drafting of a Final Exploitation Plan. Together, these exploitation activities ensured the results of the LASH FIRE project were made accessible to the relevant stakeholders and had a lasting impact on fire safety in maritime operations.

WP3 is lead by CMT, with RISE, Magellan, SEA Europe, Interferry, Bureau Veritas and Flow Ship Design supporting. The biggest achievements have been the organisation of the yearly CFIS – Conference on Fire Safety at Sea which saw its final edition this June 2023 as the project’s final event. As also listed on the website of the project, <https://lashfire.eu/>, the other activities of the cooperation and communication work package team so far included:

- Establishment and facilitation of Maritime Authorities Advisory Group (MAAG) and Maritime Operators Advisory Group (MOAG)
- Conduction of advisory group meetings
- Presentations at IMO held and submission of INF papers to IMO planned
- Organisation of CFIS2021 on 14 December 2021 (online), CFIS2022 on 11 October 2022 in Lisbon and CFIS2023 on 28 June 2023, in Pula.
- Creation and promotion of training movies for firefighting techniques
- Promotion of videos including main project characters as well as test site movies filmed during test days in Gijon, Spain- Interviews with LASH FIRE partners about project progress and next steps in the sector
- Specific Work Package videos on the update and status – WP10 & WP11
- Creation and update of the 8-page flyer on the project objectives and status
- Development of social media campaign focused on myths and facts about fire risks on board ro-ro ships (particularly fire risks of APVs)(WP6)
- Creation of 2-pager information sheets
- Creation of guidelines
- Creation and promotion of the final project movie
- Support to different conferences where LASH FIRE participated and management of webinars
- Creation of roll-ups for CFIS2023
- Production of final brochure (which is published already).

Over the course of the LASH FIRE project, a series of exploitation activities were undertaken to capitalize on the outcomes of the project effectively. These activities centred around the creation, analysis, and potential application of Risk Control Measures (RCMs) and Risk Control Options (RCOs), emphasising safe design and the prevention of ignition. Notably, the project involved the development and cost-assessment analysis of these RCMs and RCOs to ensure both their feasibility and effectiveness. In order to broaden the reach and impact of the project, a robust **dissemination strategy** was implemented. This strategy included sharing the project results with a diverse array of stakeholders via different platforms, such as conferences, informational brochures, and a dedicated project website.

LASH FIRE Website

The LASH FIRE project website, accessible at "<https://lashfire.eu/>", serves as a central hub for all information related to the LASH FIRE international research project. This project, which ran from September 2019 to August 2023, was primarily aimed at significantly reducing the risk of fires aboard ro-ro ships.

Key features of the website include:

- News: Keeps visitors updated with the latest developments and activities related to the project.
- Project Details: Offers insights into the project's goals, partners involved, and their collaborative efforts.
- CFIS 2023: Likely a section detailing an event or a specific phase of the project, complete with its agenda and presentations.
- LASH FIRE Results: A showcase of the project's outcomes and milestones achieved.
- Videos: This section houses various multimedia, including the final LASH FIRE video, which encapsulates the essence of the project in a 12-minute visual narrative, as well as other educational and informational videos like the crew training videos about Effective Manual AFV Firefighting.
- For Media: Possibly contains press releases, resources, and other materials useful for media outlets.
- Contact: Provides a means for interested parties to get in touch with the project team.
- Work Packages, News, Meet the Partners: These sections further delve into the project's objectives, the latest updates, and introduces the consortium of 27 research and industry partners from 13 EU member states that came together for LASH FIRE.
- Funding Acknowledgment: The project is funded by the European Commission under the Horizon 2020 research and innovation programme.

Additionally, an important note on the website indicates that its content primarily represents the authors' perspectives and not necessarily the views of the funding agency or the LASH FIRE consortium members.

For the public and interested stakeholders, the website acts as the primary source of information about the LASH FIRE project and its consequential findings. The site underwent regular updates throughout the project's duration. Furthermore, it's designed to remain accessible for at least 10 years post the project's conclusion, ensuring long-term access to the valuable resources, results, and insights the project has produced.

LASH FIRE Guidelines

The LASH FIRE project resulted in the development of comprehensive guidelines, the culmination of outcomes from the majority of the project's work packages. The guidelines, housed on the project's website, follow a formal structure to clearly convey the key findings from the project's varied activities. They provide practical guidance for ship operators and other maritime stakeholders, addressing various areas of concern, such as improvements in current signage and marking standards and guidelines for crew-centred fire safety design.

LASH FIRE is providing a set of Guidelines as outcomes from most of the Work Packages. The Guidelines that are available up to the date of preparing this deliverable document are listed in ANNEX A, B, and C, which are also available on the website (<https://lashfire.eu/lash-fire-guidelines/>). However, there will be more Guidelines that may not be mentioned in this document due to their date of issuance, nevertheless, they will be published on the project website.

They follow a formal structure developed by the project which allows ship operators and other players of the maritime sector to understand in a clear way the main findings of the different activities undertaken in the project. Some examples include "Improvement in current signage and marking standards/conditions", "Guidelines for crew-centered fire safety design", and others.

LASH FIRE Workshops

In order to facilitate wide-ranging application, dissemination, and exploration of the project's outcomes, LASH FIRE hosted a series of workshops. To foster the dissemination and broad application of the project's results, LASH FIRE organized a series of workshops. These sessions were instrumental in defining future exploitation strategies, obtaining the requisite funding, and laying the groundwork for potential subsequent projects. They provided a vibrant platform for stakeholders to deliberate on exploitation avenues and craft approaches for maximizing the project's findings. The initiative not only ensured that the outcomes remained impactful and pertinent after the project's conclusion but also set the stage for further advancements in maritime fire safety research and innovation. The Participation in the Transport Research Arena 2022 in Lisbon (TRA2022), Waterborne booth: An updated version of the first project brochure was handed out, and the LASH FIRE teaser (video) and a two-sided panel (poster) was shown. And for the EC booth: given a presentation named LASH FIRE - Improving fires safety on ro-ro ships.

LASH FIRE Cargo Fire Hazard Management Database

As part of its dissemination and also exploitation activities, the LASH FIRE project established a cargo fire hazard management database. It also explored technologies for cargo identification and fire ignition prevention. The initiative identified a series of hazards related to cargo, ranging from the status of reefer units and substandard electrical connections to the presence of ignition sources and thermal runaway on Li-ion batteries. This database added a significant dimension to the project's exploitation activities.

The establishment of a cargo fire hazard management database and the exploration of technologies aimed at cargo identification and fire ignition prevention added another significant dimension to the project's exploitation activities. The main hazards identified were:

- The status of reefer units.
- Substandard electrical connections.
- Suspicious noise or smell.
- Fuel leakage (solid, gas)
- Portable fuel containers or added fuel tanks.
- Handmade installations on RVs like Christmas trees or heaters.
- Stowaways' activities.
- Presence of ignition sources (hot spot/surfaces)
- Thermal runaway on Li-ion batteries of APV
- Self-reactions with IMDG
- Lashing arrangements failure (specifically with bad weather forecast)

- Other obvious fire hazards (smoke, sparks)

LASH FIRE Final Event

The LASH FIRE project concluded with a final event, the CFIS2023 conference, featuring a panel discussion moderated by the project coordinator Franz Evegren and including participation from several experts in the field. The final event also premiered a video summarizing the aims and accomplishments of the LASH FIRE project, specifically its efforts to improve fire safety on ships. This video served as a strong culmination of the project's exploitation activities, showcasing a selection of initiatives and developments achieved throughout its lifespan.

In the CFIS2023 conference with a panel discussion moderated by Franz Evegren with the participation of 4 experts (from left to right):

- Serge Heyraud of Centre de Sécurité des Navires PACA Corse
- Geir Hudø Jørgensen of Skuld
- Adrian Scales of Brookes Bell
- Martin Carlsson of Stena Line

It performed in form of discussing live the opinions & answers of the audience regarding battery electric vehicles (BEVs) and the best way to suppress fires on-board ships.

Furthermore, in the final event in Pula, the final video of the LASH FIRE was presented. The final event video highlighted that the LASH FIRE project aimed to improve fire safety on ships with examples from all WPs. The initiatives include a scanning system to detect hazardous cargo, a solution to monitor electrical connections for vehicle charging, and various fire detection systems tested for different environments. The project also developed training course and a digital fire control centre for better decision-making during fires. A supplementary sprinkler system was created for fire suppression, and specific strategies were suggested for handling fires from electric cars. The project also focused on reducing smoke during a fire's early phase and developed remotely controlled or autonomous fire systems for outdoor fires. The full transcription of the video is presented in **ANNEXE F** of this deliverable document.

LASH FIRE Training Course/Videos

An important component of the LASH FIRE project's exploitation activities was the creation of training videos. Made freely available, one of these videos was designed to enhance manual firefighting capabilities on RoRo ships, thus addressing a critical area of fire safety. Available online, this video serves as a lasting resource and a testament to the project's commitment to improved safety standards. The LASH FIRE team also developed a series of freely available training videos aimed at enhancing firefighting capabilities on RoRo ships, thus directly addressing a critical area of fire safety, available at <https://www.seably.com/courses/crew-training-on-effective-manual-afv-firefighting> and which is effectively another exploitation tool to be used post-project. The full transcript of this training video/course is included in **ANNEXE G**.

Creating D03.9, the Final Exploitation Plan, is another significant achievement. This plan elucidates the strategies for leveraging the findings of the LASH FIRE project in real-world contexts, thus providing a road map for their future application.

5.3 Contributions of Project Partners And Stakeholders In Exploitation Activities

The LASH FIRE project has been a concerted effort involving the active participation and contribution of a variety of project partners and stakeholders. An integral part of this collective endeavour was the establishment of an innovation repository. This repository collected and curated a wide range of third-party research, related projects, and collaborations. Doing so enriched the project's knowledge base and laid a solid foundation for ongoing activities and future collaborative ventures.

In an effort to foster dialogue, solicit feedback, and promote the project's findings, considerable efforts were made to engage with stakeholders. The advisory groups, namely the MAAG and MOAG, played pivotal roles in these activities. Moreover, continuous and targeted communication and dissemination activities ensured that the project's findings reached a wider audience and motivated the implementation of the proposed safety improvements.

5.4 Collaboration With External Entities for Exploitation and Dissemination

This section elucidates how strategic partnerships, knowledge exchange, and external collaborations have greatly bolstered the outcomes and exploitation strategies of the project. The collaborations with external entities like Opel, Volkswagen, Bridgehill, and ALBERO have significantly enhanced the value of the project. These entities have contributed to the project by providing necessary resources, sharing their subject matter expertise, and facilitating technology transfer.

Within the framework of the project, two advisory groups were established - the Maritime Operators Advisory Group (MOAG) and the Maritime Authorities Advisory Group (MAAG). These groups played a crucial role in providing feedback, aligning consensus on project regulations, and helping to streamline the integration of the developed technologies.

Moreover, the project deployed a structured methodology to collect, organize, and critically evaluate external advancements and innovations. This three-tiered process encompassed data collection, data structuring, and comprehensive analysis. Prominent external developments were identified, evaluated, and subjected to in-depth analysis.

In addition to the above partnerships, the LASH FIRE project proactively engaged in cooperation with relevant sectors outside the consortium. This includes collaborations with car manufacturers, ship operators, local fire departments, and manufacturers, such as fire blanket and fire detection providers. Moreover, there were some collaborations with the ALBERO project and SafePass project. Thirteen scientific papers were also published as part of the project's dissemination strategy to facilitate the transfer of knowledge and share research outcomes widely.

Furthermore, entities like the IMO and EMSA were at the seed of LASH FIRE, being responsible for the work done prior to the opening of the call that led to the LASH FIRE proposal. As such, the constant communication and work done with the input and knowledge of these entities will now, in turn, generate

exploitable results from the project to them. This will be consolidated in detailed in the final report, in form of an “Information Paper”, submitted to the IMO after the end of the project.

6 Analysing LASH FIRE Beneficiary Solutions, and Developing Exploitation Plans

Main author of the chapter: Reza Karimpour, MAG

6.1 LASH FIRE Beneficiary Solutions and Technologies Potentials for Exploitation

The "LASH FIRE Beneficiary Solutions and Technologies Potentials for Exploitation" section provides a concise overview of the impressive array of solutions and technologies birthed by the beneficiaries of the LASH FIRE project. Each of these innovations carries its distinct potential for exploitation. These beneficiaries have paved the way forward with innovative designs, set new standards and guidelines, and introduced sophisticated monitoring systems, not to mention their advanced fire detection and suppression technologies. Notably, many of these state-of-the-art solutions stand ready for deployment, poised to elevate fire safety standards in maritime operations. They span various maturity levels and present different projections for their time-to-market. To give readers a clearer perspective, a table follows this description, presenting a condensed snapshot of these potential exploitations. This table elucidates aspects such as the type of solution or technology, the prospective sector of application, and even pinpoints the specific beneficiary behind each innovation within the project.

However, as readers delve into this table, there are several pertinent points to be kept in mind the following explanations as a guide to the numbers in fifth coloumn of the table (**Exploitation potential or sector of application**):

1. Some of these solutions are proposed for changes in IMO regulations, identifiable by their Risk Control Options (RCOs) numbers in column five of the Table 2.
2. Many can find application by entities like Classification Societies, Insurance Companies, and national or port authorities as they craft their exclusive rules.
3. Ship operators could also harness some of these innovations.
4. On a similar note, ship owners, builders, and designers might find certain solutions particularly applicable to their operations.
5. There is a potential for the development and offering of specialized training courses around these technologies.
6. A noteworthy segment of these products either stands ready for commercialization or has already made its debut in the market.

Speaking of commercialization, it's essential to highlight that only a select few partners, namely UNF, F4M, APS, SCK MAR, and FKE, focus on system supply. The remaining entities, such as RISE, VTT, NSR, NTNU, CIM, FRN, alongside universities like LUL and UCY, and training facilities like SAS, primarily function as research institutes. Their core mission is not necessarily aligned with commercial supply strategies.

Table 2 Summarised potential exploitations

RCM	WP No	Beneficiary	Type of solution or technology	Exploitation potential or sector of application	Maturity level (TRL) ¹	Time to market/application
Op1	6	SAS	New assisting equipment (IR cameras, improved check point readers, light flashlights, gas detectors, press to talk buttons for communications) for a more effective manual screening of cargo fire hazards during patrolling	1 (RCO1), 2, 3, 5, 6	5	3 months, the equipment is commercially available today.
Op2	6	SAS	Manual screening of cargo at port before the loading operations	2, 3, 5	5	3 months needed for the training of the operator and the implementation of procedures
Op3	6	NSR	Improvement of current signage and markings standards. Conditions to support effective wayfinding and localization	1 (RCO 2), 2, 3, 4	5	6 months for the adaption of the marks on board
Op4	6	NSR	Guidelines for the standardization and formalization of manual fire confirmation and localization	1 (RCO1), 2, 3	5	3 months needed for the standardization of procedures
Op5	6	SAS	First response guidelines and new equipment to put out the fire in the initial stage	1 (RCO 3), 2, 3, 5, 6	6	3 months, the equipment is commercially available today.

¹ https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

Op6	6	UCY	Technology for localization of first responders through digital information processed via network	2, 3, 4, 6	6	6 months, components commercially available today. No extra infrastructure is needed
Op7	6	SAS	New equipment and procedures to suppress fires in Alternative Fuel Vehicles with special focus on Li-ion batteries fires	1 (RCO 4),2,3,5	6	9 months, Some proposed equipment is still in the definition process
Des1	7	RISE	Design guidelines for alarm system interface	2,3,4	8	3 months
Des2	7	NTNU	Alarm system interface prototype (Digital Fire Central)	1 (RCO 5),2,3,4	6	Prototype description already published
Des3	7	NSR	Process for development of procedures and design for efficient activation of extinguishing system	1 (RCO 6),2,3,4,5	6	3 months
Des4	7	SAS	Training module for activation of extinguishment systems	1 (RCO 7), 2, 3,5	5	3 months
Des5	7	RISE	Drone-based monitoring system for open decks targeting fire patrols, firefighting resource management and search & rescue (subsystem of Des5)	2,3,4,5,6	6	12 months, components commercially available today, regulatory risks.
Des5	7	NSR	Integrated solutions for fire resource management, combining relevant sources of information, including drone and camera monitoring system	2,3,4,6	6	4 months
Des6	7	NSR	Guidelines for organizing the response in case of a fire emergency	2,3,4,5	6	4 months

Pre1a	8	SCK	Cargo scanning and identification and tracking system by means of a called Vehicle Hot Spot Detector system	2,3,4,6	7	3 months, the equipment is commercially available today.
Pre1b	8	RISE	Automatic screening and management of cargo fire hazards by means of Automated Guided Vehicles (rooling drone)	3,4,6	6	36 months
Pre2	8	CIM	Stowage planning tool with optimization algorithm for cargo distribution	3,4	4	12 months
Pre3	8	RISE	Guidelines for safe electrical power connections in ro-ro spaces for reefer units	1 (RCO 8,9), 2,3,4,6	6	9 months, components commercially available today.
Pre4	8	RISE	Guidelines for safe electrical power connections in ro-ro spaces for charging of EVs	1 (RCO 9),2,3,4,6	6	9 months, components commercially available today.
Det1	9	FRN, FKE, UNF	Flame detectors for the detection of open flames on weather decks	1 (RCO 10),2,3,4,6	7	Components commercially available today
Det3 & Det5	9	FRN, FKE	Video fire analytics for the detection, visual confirmation, and localization of fires on closed ro-ro decks	1 (RCO 12),2,3,4,6	7	Components commercially available today
Det4	9	FRN, APS, FKE	Adaptive threshold settings for detection systems to continue fire detection during loading/offloading operations	3,4,6	1	Components commercially available today
Det7	9	FRN, APS	Linear heat detection system for the detection of fires on open and closed ro-ro spaces	1 (RCO 11),2,3,4,6	7	Components commercially available today

Det8 & Det6	9	FRN, FKE, UNF	Thermal cameras for the detection, visual confirmation, and localization of fires and hot surfaces on weather decks	2,3,4,6	7	Components commercially available today
Ext1	10	RISE	Design and installation guidelines for local application fire-extinguishing systems for closed ro-ro spaces on vehicle carriers	2,3,4,6	6	Already published, components commercially available today.
Ext3	10	UNF	Water fire monitor system for the protection of weather decks, autonomous and/or remotely controlled	1 (RCO 14, 15), 2,3,4,6	6	Components commercially available today
Ext4	10	F4M	Remotely-controlled Compressed Air Foam fire monitor system for the protection of weather deck	3,4,6	6	Components commercially available today
Ext5	10	RISE, MAR	New standard for alternative fire suppression systems for closed and open ro-ro spaces	1 (Ext 5), 2,3,4	4	3 months, components commercially available today.
Cont13 & Cont14	11	RISE	Tactical guidelines for manual interventions - Requirement of reversible fans	3	4 & 5	Guideline published
Cont1b1	11	RISE	A-30 Fire insulation	3,4	5	Products available on the market. However, not yet mature for regulation proposal due to needs to consolidate the real heat stress and the real thermal performance of insulants.
Cont1b2	11	RISE	Extinguishing system simultaneously activated above and below sub-dividing deck	2,3,4,6	5	Components commercially available but the solution should be further assessed before regulation proposal.
Cont9	11	VTT	Ship manoeuvring/operation to limit the effect of fire, at least in critical areas	1 (Cont9), 2,3	6	Guideline available

6.2 Exploitation Plans for Each LASH FIRE Beneficiary Solutions & Technologies

Each beneficiary is supposed to exploit their results after the specified period, either directly or through indirect means. The results hold potential for further research, product evolution, service development, and standardization efforts. In light of these responsibilities, comprehensive exploitation strategies are crafted for each solution. Factors like solution maturity, target audience, and anticipated time-to-market are taken into account. This systematic approach encompasses thorough market assessment, strategic direction, intellectual property rights handling, engaging with stakeholders, and employing effective marketing and communication techniques to assure expansive reach and significant impact.

Transitioning from these obligations to tangible applications within the LASH FIRE project demands a contextual understanding. Here, exploitation isn't just a theoretical notion but a methodical series of actions set to suggest and recommend to convert latent capabilities into viable, market-fit solutions. Given the distinctiveness of every beneficiary's contribution, individualized exploitation tactics are designed. As deepened into the particulars of the LASH FIRE project, it is uphold the intrinsic guidelines, ensuring each solution undergoes meticulous analysis, strategic planning, and market integration for a triumphant debut in the maritime sector. To gain a better grasp, let's outline a general procedure for drafting an exploitation plan for the LASH FIRE initiative.

It's vital to acknowledge that many of our beneficiaries, including research entities like RISE or VTT, aren't primarily aiming to commercialize systems. Their strength and contribution often lie in the depth of their research and the clarity of their deliverables. The true value emerges when external stakeholders leverage these deliverables, whether it's through legislative adoption, onboard ship implementations, or introducing market solutions.

The below listed beneficiary names signify who held responsibility during the solution's developmental phase, be it a manufacturer, an academic institution, or a research body. However, it's worth noting that institutions or universities might extend their reach by offering services to assist ship operators in adopting specific guidelines or evaluating product performance. While certain activities might resonate more with manufacturers or consultants keen on marketing the solution, it's essential to recognize and respect the primary role of each beneficiary. Your discretion is advised when navigating through these details, but a clear explanation within this context will undeniably enhance clarity and understanding.

Below it is developed general guidelines on how an exploitation plan can be created for the LASH FIRE project solutions. All these guidelines include a general format on how an exploitation plan can be created for the results and solutions of the LASH FIRE project:

1. **Market Analysis:** Understand the market and industry in which these solutions will be launched. Analyse the current trends, competitors, and potential customers in the ship building, ship designing, and ship operation sectors. Assess what kind of solutions already exist in the market and how your solutions provide a unique value proposition.
2. **Intellectual Property Rights Management:** Evaluate the Intellectual Property (IP) rights of the solutions to ensure the legal protection of the developed technologies. This step is important in order to prevent unauthorized use or patent infringement issues in the future.
3. **Strategic Planning:** Develop an exploitation strategy for each solution, which includes identifying the appropriate exploitation models (licensing, joint ventures, spin-offs, sale of IP etc.) and determining the pricing strategies, distribution channels, and commercial partners if required.

4. **Stakeholder Engagement:** Engage with relevant stakeholders, such as ship owners, operators, maritime legislators, and flag states. This step can involve consultations, collaborations, and agreements to ensure the adoption and acceptance of the solutions.
5. **Marketing and Communication:** Create a communication and marketing plan to promote these solutions. This can include presentations at industry conferences, scientific publications, press releases, digital marketing, and targeted outreach to potential customers and relevant maritime authorities.
6. **Implementation and Monitoring:** Once the plan is set, implement it phased. Monitor the progress and make necessary adjustments as needed. This could include tracking market response, customer feedback, and technological advancements.

It should be noted that the exploitation plans need to be further detailed and customized for each solution based on its unique characteristics, market potential, and other factors. However, the above steps provide a broad guideline to start with. This process will ensure that the developed technologies and guidelines from the LASH FIRE project reach the intended beneficiaries and achieve the desired impact in enhancing the safety of ro-ro ships.

For each of the LASH FIRE beneficiaries solutions and technologies mentioned previously, a comprehensive exploitation plan is developed, suggested , and recommended for post-project time, as per below.

A detailed exploitation plan proposed for the "*Design and Installation Guidelines for Local Application Fire-Extinguishing Systems for Closed Ro-Ro Spaces on Vehicle Carriers*", of RISE:

Exploitation Step	Details / Description
1- Market Analysis	The target market primarily includes ship builders, ship designers, ship owners, ship operators, and maritime legislators. It's crucial to identify the needs and requirements of these stakeholders and assess the current trends and solutions in the field. The unique value proposition of the guidelines developed by RISE lies in their potential to significantly reduce the risk of fires on board ro-ro ships, which is a common and critical concern in the industry.
2- Intellectual Property Rights Management	Evaluate the IP rights associated with these guidelines to protect the developed technology. Since they are already published, it's essential to ensure that the IP rights have been appropriately addressed and secured to prevent unauthorized use or potential infringement.
3- Strategic Planning	Identify suitable exploitation models for the guidelines, such as licensing to shipbuilders and designers, offering consulting services for installation, or partnerships with maritime authorities for implementation. Determine the pricing strategies, distribution channels, and potential commercial partners.
4- Stakeholder Engagement	Engage with the identified stakeholders - ship owners, operators, maritime legislators, and flag states - to gain acceptance and adoption of the guidelines. Collaboration with industry bodies, like the International Maritime Organization, and advisory groups, like the Maritime Authorities Advisory Group (MAAG) and Maritime Operators Advisory Group (MOAG) could be beneficial.

5- Marketing and Communication	Develop a communication and marketing plan to effectively promote the guidelines. This could involve presentations at industry conferences, publication of scientific papers, press releases, and targeted digital marketing campaigns. The aim is to reach potential customers and relevant maritime authorities, highlighting the benefits and unique aspects of the guidelines.
6- Implementation and Monitoring	After finalizing the exploitation plan, it should be implemented in a phased manner. Monitoring progress regularly and making necessary adjustments based on market response, customer feedback, and technological advancements is important. Given that the guidelines have already been published and the components are commercially available, the focus should be on promoting their adoption and gathering feedback for future improvement.

This plan aims to ensure that the developed guidelines by RISE are effectively exploited to realize their full potential in improving the safety of ro-ro ships.

An exploitation plan proposed for RISE's "***New standard for alternative fire suppression systems for closed and open ro-ro spaces***":

Exploitation Step	Details
1- Market Analysis	Given maritime safety's paramount importance, the market for advanced fire suppression systems is broad. The potential customers would be ship builders, ship designers, ship owners, ship operators, and maritime legislators. Competitor solutions would need to be assessed, but given the solution's unique approach to fire suppression in both closed and open ro-ro spaces, a unique value proposition exists.
2- Intellectual Property Rights Management	RISE would need to evaluate any existing IP on this solution. It's crucial to identify and apply for any patents or other protection mechanisms as appropriate to prevent unauthorized use or patent infringement in the future.
3- Strategic Planning	<p>Given the solution's high potential for application in the maritime industry, a multi-pronged approach might be suitable. Considering the solution's marked potential for enhancing safety standards in the maritime industry, the primary objective is to propose this test standard to the IMO as a replacement for the existing mandatory test standard. The aim is to elevate performance requirements, aligning them with the standards set for water-based systems. Hence, the IMO emerges as the principal target for this endeavor.</p> <p>It's crucial to recognize that while RISE, being an independent research and testing institute, plays a pivotal role in evaluating such systems, it doesn't have vested interests in their marketing. That said, ship builders or owners might stipulate system suppliers to undergo testing according to this new proposal. This is because the proposed standard signifies more stringent performance requirements, surpassing even those mandated by the IMO.</p>
4- Stakeholder Engagement	Extensive engagement with stakeholders would be necessary to secure buy-in and promote widespread adoption. This would involve targeted outreach to ship owners, operators, maritime legislators, and flag states. These parties would need to be involved in discussions and consultations, potentially even collaborative agreements to ensure the acceptance and adoption of the solution.

5- Marketing and Communication	Communication and marketing would be crucial to promoting this new standard. This could take the form of presentations at maritime and safety industry conferences, publication of scientific papers outlining the benefits and effectiveness of the system, press releases to reach a wider audience, and digital marketing to specifically targeted potential customers and maritime authorities.
6- Implementation and Monitoring	Once the exploitation plan is set, it should be implemented step by step, with key milestones set for assessing progress. It will be important to track market response, gather customer feedback, and monitor any technological advancements that could impact the solution's market position.

Please note that this is a high-level plan. Each of these activities would require detailed planning, consultation with relevant experts, and careful implementation to ensure success.

A detailed exploitation plan proposed for the ***"Automatic screening and management of cargo fire hazards by means of Automated Guided Vehicles (rooling drone)"***, of RISE:

Exploitation Step	Details
1- Market Analysis	The market for automated screening and management of cargo fire hazards using automated guided vehicles (AGVs) revolves primarily around the shipping industry, specifically ship owners and operators. Given the increasing demand for safety measures in ship operations, the technology has significant potential. The market is driven by the need to ensure effective fire safety, reduce human error, and increase efficiency. Competitors may include other manufacturers of maritime safety equipment. The unique value proposition of this technology is the ability to automate the screening and management of fire hazards, reducing reliance on manual operations.
2- Intellectual Property Rights Management	RISE should evaluate the IP rights associated with the technology. This involves filing for patents if the technology is novel and non-obvious, thereby protecting it from unauthorized use or patent infringement. An IP attorney can help navigate this complex process.
3- Strategic Planning	The exploitation strategy may involve licensing the technology to shipbuilders and operators or forming joint ventures with other maritime safety companies. Pricing strategies can be developed based on market research, cost analysis, and perceived value. Distribution by manufacturers may be direct to ship operators and owners, or through maritime safety equipment distributors.
4- Stakeholder Engagement	Engaging with ship owners, operators, and maritime safety regulators is crucial to gain acceptance and ensure adoption of the technology. Regular consultations, collaborations, and potentially agreements with these stakeholders can facilitate this. Involvement in advisory groups like MAAG and MOAG as part of the LASH FIRE project also offers opportunities for engagement.
5- Marketing and Communication	The promotion of this technology can be done through presentations at industry conferences, publishing scientific papers detailing the technology and its benefits, issuing press releases, leveraging digital marketing channels, and conducting direct outreach to potential customers and relevant maritime authorities.
6- Implementation and Monitoring	The exploitation plan should be executed in a phased manner, with regular monitoring of progress and adjustments made as needed. This might involve tracking market response, feedback from customers and users, and keeping up with advancements in technology and industry trends.

The 'time to market' indicates that the technology should be commercially available in about 36 months, which also provides a timeline for implementing this exploitation plan.

The detailed exploitation plan proposed for the technology developed” ***Drone-based monitoring system for open decks targeting fire patrols, firefighting resource management and search & rescue***” of RISE:

Exploitation Step	Details
1- Market Analysis	The market for ship safety technologies and fire management systems is vast and constantly evolving. RISE's drone-based monitoring system targets a critical safety area – fire patrols, firefighting resource management, and search & rescue – providing a unique and effective solution for ship owners and operators. However, competitors in this field include other tech companies offering fire detection and management solutions. Therefore, it is essential to highlight the unique features of this drone-based system, such as advanced fire detection, resource management capabilities, and possible integration with existing systems.
2- Intellectual Property Rights Management	RISE must ensure that the technology behind the drone-based monitoring system is legally protected. This includes checking for potential patent infringements and ensuring that all necessary patents are filed and protected. It may be beneficial to work with an intellectual property lawyer or consultant to ensure all legal aspects are addressed.
3- Strategic Planning	The exploitation strategy for this solution can involve a combination of licensing the technology to shipbuilders or ship operators, forming joint ventures with maritime safety companies, or possibly selling the IP rights to larger entities. The pricing strategy should reflect the value the system offers in terms of increased safety and risk mitigation. Distribution by manufacturers might be direct to ship owners/operators or via maritime safety equipment suppliers.
4- Stakeholder Engagement	RISE should work closely with ship owners, operators, maritime legislators, and flag states to ensure they understand the benefits and operational requirements of the drone-based monitoring system. This might involve demonstrations, trials, and collaborative partnerships. Given the regulatory risks and the need for rules to allow the operation of such systems on ships, engagement with legislative bodies like the International Maritime Organization will also be key.
5- Marketing and Communication	A comprehensive marketing and communication plan should be developed. This could involve presenting the drone-based monitoring system at maritime industry conferences, publishing scientific papers demonstrating the effectiveness of the system, issuing press releases at key development and implementation milestones, and digital marketing activities targeted at ship owners, operators, and maritime safety authorities.
6- Implementation and Monitoring	The technology is quite mature (TRL 6) and components are commercially available today. The major hurdle before the commercial launch (in about 12 months) might be the regulatory environment. Therefore, it will be important to keep track of legislative changes and to lobby for favourable rules. Once the system is launched, customer feedback should be carefully monitored and used to make necessary adjustments and improvements. This monitoring should also include keeping an eye on market trends and technological advancements that might affect the system's competitive position.

A detailed exploitation plan proposed for the "***Design guidelines for alarm system interface***" developed of RISE:

Exploitation Step	Details
1- Market Analysis	Given that the solution will be of potential interest to ship builders, designers, owners, operators, and maritime legislators, RISE needs to understand the current trends and competitors in this niche. It should identify the needs and challenges of these stakeholders, and how their solution addresses these needs uniquely. They should also review the adoption of similar technologies and standards in the market, and understand the potential barriers and drivers for adoption.
2- Intellectual Property Rights Management	RISE should evaluate whether any aspects of the design guidelines can be legally protected through IP rights, such as copyrights. Given that the maturity level is quite high (TRL 8), this step should be taken as soon as possible.
3- Strategic Planning	The strategic plan should identify potential routes to market, such as direct sales to ship builders and designers, licensing the guidelines to maritime safety organisations, or forming joint ventures with shipbuilding companies to integrate the guidelines into their processes. The pricing strategies should reflect the value delivered by the solution, and the distribution channels should be selected based on the target customers.
4- Stakeholder Engagement	RISE needs to engage with all relevant stakeholders, starting with ship builders, designers, owners, and operators, to gauge their interest in the solution, and potentially secure early adopters. They also need to communicate with maritime legislators to ensure that their solution is compliant with all relevant regulations and to advocate for its adoption as a safety standard.
5- Marketing and Communication	A marketing and communication plan should be created to promote the design guidelines. This could include presentations at maritime and safety conferences, publications in scientific and industry journals, press releases, digital marketing, and direct outreach to potential customers. RISE should leverage its existing network in the maritime industry to get the word out about its solution.
6- Implementation and Monitoring	Once the exploitation plan is set, it should be implemented in a phased manner, given the short time to market (3 months). The progress should be constantly monitored, and adjustments should be made based on market response, customer feedback, and any advancements in technology or changes in regulations.

This table is a high-level roadmap for exploiting the solution. It's important to note that each step requires detailed planning and execution, and adjustments may be needed based on real-world feedback and conditions.

An exploitation plan proposed for RISE's "***Guidelines for safe electrical power connections in ro-ro spaces for reefer units***":

Exploitation Step	Details
1- Market Analysis	Analyse the current demand for safer electrical power connections in ro-ro spaces for reefer units within the shipping industry. Identify key players in the ship building, ship designing, ship owning, ship operating, and maritime legislation sectors who may benefit from this solution. Assess the competition and unique selling proposition of this technology.

2- Intellectual Property Rights Management	Evaluate the intellectual property rights for the technology, seek patent protection if applicable, and ensure future usage does not infringe upon any existing patents. Create guidelines to prevent unauthorized use.
3- Strategic Planning	Formulate a strategy for the exploitation of the technology. Consider different models such as licensing the technology to ship builders or selling the IP to a single entity. Determine pricing strategies, distribution channels, and potential commercial partners.
4- Stakeholder Engagement	Engage with ship builders, designers, owners, operators, and maritime legislators to gain acceptance of the guidelines. This could involve presentations, workshops, or consultations with industry players and authorities.
5- Marketing and Communication	Develop a comprehensive communication and marketing strategy that includes presenting at industry conferences, publishing scientific papers, issuing press releases, utilizing digital marketing, and directly reaching out to potential customers and authorities.
6- Implementation and Monitoring	Implement the exploitation plan in phases. Monitor the market response, feedback from users, and any advancements in the field of electrical safety in ro-ro spaces. Make necessary adjustments to the plan based on these factors.

Please note that all of these activities are subject to RISE's organizational structure and resources, as well as the broader dynamics of the shipping industry.

An exploitation plan proposed for SAS's "***New assisting equipment for a more effective manual screening of cargo fire hazards during patrolling***":

Exploitation Step	Details
1- Market Analysis	Study the current need for advanced manual screening equipment in the maritime sector. Identify key stakeholders such as ship owners, operators, and maritime legislators who can benefit from this solution. Evaluate competitors and the unique selling proposition of this technology.
2- Intellectual Property Rights Management	Assess the intellectual property rights for the technology, apply for patent protection if necessary, and ensure future usage does not infringe on existing patents. Develop guidelines to prevent unauthorized use.
3- Strategic Planning	Design a strategy for exploiting the technology. This could involve licensing the technology to ship operators or selling the IP outright. Develop pricing strategies, identify distribution channels, and find potential commercial partners.
4- Stakeholder Engagement	Liaise with ship owners, operators, and maritime legislators to gain acceptance for the equipment. This could involve conducting presentations, use in training courses, workshops, or consultations with industry players and regulators.
5- Marketing and Communication	Create a robust communication and marketing strategy that includes presenting at industry conferences, publishing scientific papers, issuing press releases, utilizing digital marketing, and reaching out directly to potential customers and authorities.
6- Implementation and Monitoring	Implement the exploitation plan in stages. Track the market response, user feedback, and advancements in manual screening technology. Adjust the plan as necessary based on these factors.

Please note that these activities are subject to SAS's organizational structure and resources, as well as the broader dynamics of the maritime sector.

An exploitation plan proposed for SAS's "**Manual screening of cargo at port before the loading operations**":

Exploitation Step	Details
1- Market Analysis	Investigate the current procedures for manual cargo screening at ports and identify any shortcomings or opportunities for improvement. Identify key stakeholders such as ship owners, operators, and maritime legislators who can benefit from enhanced manual screening procedures. Assess competitors and identify unique selling points of SAS's screening process.
2- Intellectual Property Rights Management	Identify and manage any Intellectual Property (IP) rights relating to the manual screening process. This may include proprietary procedures or technologies developed by SAS. If necessary, apply for patents to protect the IP and ensure future usage does not infringe on existing patents.
3- Strategic Planning	Develop a plan for exploiting the manual screening process. This might involve licensing the process to ship operators or training operators in exchange for a fee, however, it depends the ownership of this solution within the LASH FIRE project. Determine the pricing strategy, potential partners, and distribution channels.
4- Stakeholder Engagement	Engage with ship owners, operators, and maritime legislators to gain acceptance for the manual screening process. Showcase the benefits of the process through presentations, workshops, or consultations. Establish partnerships for trials or pilot programs.
5- Marketing and Communication	Develop a marketing and communication strategy to promote the manual screening process. This can include presentations at industry conferences, scientific publications, press releases, digital marketing, and targeted outreach to potential customers and relevant maritime authorities.
6- Implementation and Monitoring	Implement the exploitation plan in stages. Monitor the response, gather feedback, and make adjustments as necessary. This could include tracking process uptake, customer satisfaction, and advancements in cargo screening technology.

Please note that these activities should be tailored to SAS's organizational structure, resources, and the dynamics of the maritime sector.

An exploitation plan proposed for NSR's "**Improvement of current signage and markings standards. Conditions to support effective wayfinding and localization**":

Exploitation Step	Details
1- Market Analysis	Study the current standards and practices for signage and markings in the maritime sector, and identify areas of potential improvement. Identify key stakeholders such as ship builders, designers, owners, operators, and maritime legislators who would benefit from improved standards. Assess the current market competitors and define unique selling propositions of NSR's improved signage and markings standards.
2- Intellectual Property Rights Management	Evaluate any Intellectual Property (IP) rights related to the improved signage and markings standards. This could include proprietary design principles or technologies developed by NSR. If necessary, apply for patents to protect the IP and ensure future usage does not infringe on existing patents.

3- Strategic Planning	Develop an exploitation strategy for improved signage and marking standards. This might include licensing the standards to ship builders and designers, or selling or sharing for free the IP to other interested parties. Determine pricing strategies, potential commercial partners, and distribution channels.
4- Stakeholder Engagement	Engage with ship builders, designers, owners, operators, and maritime legislators to promote the adoption of the improved signage and marking standards. This can be done through demonstrations, presentations, or consultations. Establish partnerships for trials or pilot implementations.
5- Marketing and Communication	Create a marketing and communication strategy to promote the improved signage and marking standards. This can include presentations at industry conferences, scientific publications, press releases, digital marketing, and targeted outreach to potential customers and relevant maritime authorities.
6- Implementation and Monitoring	Implement the exploitation plan in phases. Monitor the response, collect feedback, and make adjustments as necessary. This could include tracking adoption rates, customer satisfaction, and advances in signage and markings technology.

Please note that these activities should be tailored to NSR's organizational structure, resources, and the dynamics of the maritime sector.

A detailed exploitation plan proposed for the technology "***Guidelines for the standardization and formalization of manual fire confirmation and localization***" of the beneficiary NSR:

Exploitation Step	Details
1- Market Analysis	The target market for NSR's guidelines is ship owners, operators, authorities, and maritime legislators. The current market trends point towards increased safety regulations and standards in ship operations, including fire safety. To position these guidelines, NSR must understand the existing practices for fire confirmation and localization, and how its guidelines improve upon these existing standards. The value proposition is the increased efficiency and safety these guidelines provide.
2- Intellectual Property Rights Management	NSR must evaluate if there are existing intellectual property (IP) rights related to their guidelines. If so, they need to ensure they do not infringe on these rights. They should also consider filing for IP rights on their guidelines to protect their work.
3- Strategic Planning	NSR's exploitation strategy could include licensing the guidelines to ship builders, owners, and operators. Pricing strategies could be determined based on the perceived value these guidelines bring in terms of increased safety and efficiency. Distribution channels could include direct sales to ship owners, operators, and partnerships with maritime legislators or safety regulatory bodies.
4- Stakeholder Engagement	NSR should engage with ship owners, operators, maritime legislators, and flag states to build consensus and acceptance for these guidelines. This could involve consultations, demonstrations, or pilot programs to showcase the effectiveness of their guidelines.
5- Marketing and Communication	NSR should develop a comprehensive marketing and communication plan to promote its guidelines. This can include presenting at industry conferences, publishing in scientific and industry journals, and targeted outreach to ship owners, operators, and maritime legislators.

6- Implementation and Monitoring	Once the exploitation plan is implemented, NSR should track the adoption and use of these guidelines. Feedback should be solicited to make necessary adjustments and improvements. The market response and customer feedback will provide valuable insight into these guidelines' perceived value and effectiveness in improving fire safety on ships.
----------------------------------	--

Please note that this plan should be considered as a guideline and may need adjustments based on real market feedback and dynamics. Also, depending on the context, the exploitation process may involve significant negotiation and agreement with various stakeholders.

Here is an exploitation plan proposed for the solution of the beneficiary **SAS: First response guidelines and new equipment to put out the fire in the initial stage** :

Exploitation Step	Details
1- Market Analysis	<ul style="list-style-type: none"> - Analyse the market for fire safety solutions in maritime applications, particularly ro-ro ships. - Understand the trends in the industry. For example, the need for enhanced fire safety measures, advancements in fire fighting technologies, or new regulatory requirements. - Identify competitors offering similar solutions and analyse their products, strategies, and market share. - Identify potential customers, which would include ship owners, ship operators, and authorities, and understand their needs and preferences. - Assess how the first response guidelines and new equipment developed by SAS are unique or better than existing solutions in the market.
2- Intellectual Property Rights Management	<ul style="list-style-type: none"> - Evaluate if there are any unique technologies or processes developed as part of the solution that can be patented. - Apply for patents if applicable to ensure legal protection against unauthorized use. - Ensure that the developed solution does not infringe upon the IP rights of others.
3- Strategic Planning	<ul style="list-style-type: none"> - Identify the best exploitation model for the solution. Given that the equipment is commercially available, direct sales or licensing could be potential models. - Determine the pricing strategy based on costs, competitor prices, customer willingness to pay, and other relevant factors. - Identify distribution channels. This could include direct sales to ship owners or operators, sales through ship equipment dealers or suppliers, or partnerships with shipbuilding companies. - Identify potential commercial partners who can help in the exploitation of the solution.
4- Stakeholder Engagement	<ul style="list-style-type: none"> - Engage with relevant stakeholders such as ship owners and operators to understand their needs and get their feedback on the solution. - Collaborate with maritime legislators and authorities to ensure the solution complies with regulatory requirements and to get their support for the solution. - Reach out to flag states to garner their acceptance of the solution. - Develop agreements with stakeholders as required, for example, licensing agreements with partners.
5- Marketing and Communication	<ul style="list-style-type: none"> - Create a marketing plan to promote the solution. This could include showcasing the solution at maritime industry conferences, publishing articles or papers in scientific journals or industry publications, issuing press releases, and using digital marketing techniques. - Communicate the benefits and features of the solution to potential customers and relevant maritime authorities. Use success stories or testimonials from initial customers to build credibility.

6- Implementation and Monitoring	- Implement the exploitation plan in a phased manner. This could include a pilot phase with a few customers, followed by a full-scale launch. - Monitor the progress of the plan, including tracking sales, customer feedback, and market response. - Adjust the plan as necessary based on monitoring results. For example, if customer feedback indicates certain features are not working as expected, modifications should be made to address this. - Keep track of advancements in technology or changes in the market or regulatory environment and adapt the solution or strategy as necessary.
----------------------------------	--

The exploitation plan proposed for the technology developed of the beneficiary **UCY** (University of Cyprus) - "**Technology for localization of first responders through digital information processed via network**" can be created as follows:

Exploitation Step	Details
1- Market Analysis	The market for this technology includes ship builders, ship designers, ship owners, ship operators, authorities, and maritime legislators. Current solutions for localizing first responders might rely on traditional communication methods or rudimentary tracking systems. The technology provided by UCY presents a unique value proposition as it leverages digital information and network processing for more accurate and reliable localization.
2- Intellectual Property Rights Management	UCY should conduct an evaluation of the IP rights associated with this technology. Legal advice might be necessary to ensure the technology is adequately protected from unauthorized use or potential patent infringements.
3- Strategic Planning	UCY can consider different exploitation models, such as licensing the technology to ship builders or operators or forming joint ventures with other maritime technology companies. The pricing strategy should reflect the value the technology brings to the users, and UCY might need to identify appropriate distribution channels and commercial partners.
4- Stakeholder Engagement	UCY should engage with ship owners, operators, maritime legislators, and flag states to promote the adoption and acceptance of the technology. This might involve consultations, collaborations, and possibly agreements or partnerships.
5- Marketing and Communication	A detailed communication and marketing plan should be created to promote this technology. This might include presenting at industry conferences, publishing scientific papers on the technology, press releases, digital marketing, and targeted outreach to potential customers and relevant maritime authorities.
6- Implementation and Monitoring	After the plan is set, it should be implemented in a phased manner. Regular monitoring is needed to track market response, customer feedback, and technological advancements that could affect the adoption and use of the technology. Adjustments should be made as needed based on this ongoing monitoring.

Note: The above exploitation plan is built based on the provided information and may need adjustments or further detail depending on additional insights about the technology, the market, and the strategic goals of UCY.

The exploitation plan proposed for the technology developed of the beneficiary **SAS**, i.e., the **new equipment and procedures to suppress fires in Alternative Fuel Vehicles with a special focus on Li-ion batteries fires**, can be described as follows:

Exploitation Step	Details
1- Market Analysis	Given the growing trend towards alternative fuel vehicles, this solution will have significant relevance in the ship-owning and ship-operating sectors. Competitors may offer fire suppression technologies, but the specificity for Li-ion batteries provides a unique value proposition. Potential customers are ship owners, ship operators, authorities, and maritime legislators.
2- Intellectual Property Rights Management	The IP rights for the new equipment and procedures need to be thoroughly evaluated. It's important to ensure that SAS possesses the legal rights to the technologies developed and that their use doesn't infringe upon existing patents.
3- Strategic Planning	The strategic plan for exploiting this solution may include licensing the technology to ship manufacturers, establishing joint ventures with companies in the maritime industry, or selling the IP rights. Pricing strategies need to consider the cost of development and the value proposition. Distribution could be achieved through shipbuilders and manufacturers, as well as maritime safety equipment suppliers.
4- Stakeholder Engagement	Engaging with ship owners, operators, maritime legislators, and flag states is crucial for gaining acceptance of the technology. This might involve demonstrations of the solution's effectiveness, consultations about its applicability, and agreements about its implementation.
5- Marketing and Communication	A marketing and communication plan would be created to highlight the benefits of this solution in preventing Li-ion battery fires on ships. This could involve industry conferences, scientific publications, press releases, and digital marketing. Targeted outreach should be directed at potential customers and relevant maritime authorities.
6- Implementation and Monitoring	The exploitation plan should be implemented in a phased manner, allowing for adjustments based on market response, customer feedback, and technological advancements. This could be accomplished within a 9-month timeframe, although some equipment is still in the definition process.

Please note that this is a high-level plan and each step would need to be fleshed out in detail for a comprehensive exploitation strategy. Based on the information given, the estimated time to market is 9 months, but this is highly dependent on the actual development progress, approval processes, and market conditions.

The detailed exploitation plan proposed for the "**Guidelines for safe electrical power connections in ro-ro spaces for charging of EVs**" technology of the beneficiary RISE:

Exploitation Step	Details
1- Market Analysis	An analysis will identify current trends, competitors, and potential customers interested in innovative fire safety solutions. The market research will also aim to understand the extent of similar guidelines currently in use and emphasize the unique value proposition of RISE's guidelines for safe electrical power connections in ro-ro spaces for charging EVs.
2- Intellectual Property Rights Management	The IP rights associated with the solution should be evaluated. This may involve patent application (if applicable), copyright protection or other forms of IP rights management to ensure the legal protection of the developed technology and prevent unauthorized use.

3- Strategic Planning	An exploitation strategy needs to be developed, which could include licensing the guidelines to ship builders, designers, operators, maritime authorities and legislators, or forming joint ventures with these entities. Pricing strategies will be determined based on the value these guidelines bring to the industry and the chosen distribution channels. Commercial partners for potential collaboration can also be identified during this phase.
4- Stakeholder Engagement	RISE needs to engage with relevant stakeholders such as ship owners, operators, maritime legislators, and flag states. This will involve consultations, collaborations, and agreements to ensure the acceptance and adoption of the guidelines. This process will be facilitated by the Maritime Authorities Advisory Group (MAAG) and the Maritime Operators Advisory Group (MOAG) established in the LASH FIRE project.
5- Marketing and Communication	A detailed communication and marketing plan will be developed to promote these guidelines. This may include presentations at industry conferences, scientific publications, press releases, digital marketing, and direct communication with potential customers and relevant maritime authorities. RISE's reputation as a research institute and active player in the LASH FIRE project will be leveraged during the promotion.
6- Implementation and Monitoring	Following the above stages, the exploitation plan will be implemented. Regular monitoring of the progress will be done to track market response, customer feedback, and any advancements in technology or changes in the market environment that may require adjustments to the plan. The time to market is estimated to be 9 months as the components for implementing these guidelines are commercially available.

This is a proposed outline for the exploitation plan, which can be refined further based on the specific circumstances and requirements of RISE and the LASH FIRE project.

The exploitation plan proposed for UNF's ***water fire monitor system for the protection of weather decks, which can operate autonomously and/or be remotely controlled***, is suggested as below. Please note that some of the details might need more specific information which can only be supplied by the project team itself:

Exploitation Step	Details
1- Market Analysis	The target market for this solution includes ship builders, ship designers, ship owners, and ship operators. This market is continually seeking improved safety measures and efficient solutions for fire management. The uniqueness of this solution lies in its autonomous and remote-controlled features, providing better and faster response to fire situations on weather decks.
2- Intellectual Property Rights Management	Since the components of the solution are already commercially available, it will be necessary to evaluate whether any new integration or application requires IP protection. If there are unique methods of implementation, they should be protected to prevent patent infringement.
3- Strategic Planning	The system could be licensed to shipbuilders and operators who wish to improve their ship's safety against fires. It could also be sold directly to ship owners or maritime companies interested in enhancing their fire safety measures. The price should be competitive yet profitable, and distribution could be done through major marine equipment suppliers and direct sales.

4- Stakeholder Engagement	This involves reaching out to the identified market of ship builders, ship designers, ship owners, and ship operators. Engagements could include demonstrations, discussions, and collaborations to ensure that the solution meets the needs and standards of the industry. Input from maritime authorities will also be crucial in gaining acceptance.
5- Marketing and Communication	This could include presentations at maritime and safety conferences, publication of scientific papers, press releases announcing the availability of the technology, digital marketing strategies targeting the maritime sector, and outreach to maritime authorities to encourage the acceptance and use of the system.
6- Implementation and Monitoring	After the plan is set, it can be implemented phased, starting with a pilot phase. Progress will be monitored closely to allow for adjustments and improvements. This would include tracking market response, customer feedback, and staying updated with technological advancements.

This is a general plan and would need further fine-tuning based on more specific information about the product and the target market.

The detailed exploitation plan proposed for ***the remotely-controlled Compressed Air Foam fire monitor system for the protection of the weather deck*** of the beneficiary **F4M**:

Exploitation Step	Details
1- Market Analysis	The ship building, designing, and operation market appears to need advanced fire protection solutions. Existing competitors might include other manufacturers of firefighting equipment, but F4M's remotely-controlled compressed air foam fire monitor system offers a unique value proposition with its specific suitability for weather deck protection.
2- Intellectual Property Rights Management	F4M needs to ensure the legal protection of their technology. This would involve looking into existing patents in the field and potentially filing for a patent if one has not already been secured. The intellectual property rights would protect the innovation from unauthorized use.
3- Strategic Planning	The exploitation strategy could involve licensing the technology to ship builders and designers, entering into joint ventures with these entities, or even directly selling the technology. The pricing strategy will need to consider production costs, competitor pricing, and perceived value to the customers. Distribution may occur directly or through partner channels.
4- Stakeholder Engagement	F4M should engage with key stakeholders in the shipping industry, such as ship owners, operators, maritime legislators, and flag states. This could involve presentations, demonstrations, and trials to prove the effectiveness of the technology and garner support for its adoption.
5- Marketing and Communication	A comprehensive marketing plan should be created to promote the technology to potential customers and relevant maritime authorities. This could involve presenting at industry conferences, publishing scientific papers, issuing press releases, and engaging in targeted digital marketing efforts.
6- Implementation and Monitoring	F4M should set out a phased implementation plan, perhaps initially targeting a specific segment of the market or region before expanding. Monitoring the progress is crucial, including tracking market response, customer feedback, and technological advancements.

Please note that this table is a high-level summary and that each area needs to be explored in more detail for a comprehensive exploitation plan.

A detailed exploitation plan is proposed for the solution of the beneficiary **NSR**, a ***process for the development of procedures and design for efficient activation of extinguishing systems***. This solution has an exploitation potential in ship owners and ship operators, with a technology readiness level (TRL) of 6 and a time to market of 3 months:

Exploitation Step	Details
1- Market Analysis	Analysis should focus on ship owners and operators who are the key market players. Evaluating the current fire extinguishing systems and procedures in place in the market will provide insight into potential improvements and unique value that NSR's solution can bring.
2- Intellectual Property Rights Management	Assess the distinctiveness of the procedure and design, then seek patent protection if the solution meets the criteria of novelty, utility, and non-obviousness. Consult with a patent attorney to ensure all IP aspects are adequately covered.
3- Strategic Planning	Given the TRL of 6, the solution is close to market-ready, and the strategic planning should focus on licensing the technology to ship owners and operators. Also, determine the pricing strategy based on the value addition, potential cost savings due to improved safety, and market trends.
4- Stakeholder Engagement	Actively engage with ship owners and operators for the adoption of the solution. Consult with maritime authorities and flag states to align with regulations and possibly influence policy-making for enhanced safety.
5- Marketing and Communication	Develop a targeted marketing plan for ship owners and operators. Promote the advantages of the solution in maritime safety conferences through digital marketing and press releases. Highlight the enhanced safety measures, regulatory compliance, and cost-effectiveness due to the potential reduction in fire-related incidents.
6- Implementation and Monitoring	The plan is set to be implemented within 3 months. Continuous monitoring of the market response, user feedback, and adjustments as needed will ensure a successful implementation.

Remember, this is a general guideline for developing an exploitation plan. Specific strategies may differ based on the maritime sector's specific context and market dynamics.

A detailed exploitation plan is proposed for the solution of the beneficiary **NTNU**, the ***Alarm system interface prototype (Digital Fire Central)***. This solution has an exploitation potential in ship builders, ship designers, ship owners, ship operators, and maritime legislators, with a technology readiness level (TRL) of 6 and already published.

Exploitation Step	Details
1- Market Analysis	This analysis will focus on ship builders, designers, owners, operators, and maritime legislators. Understanding their current fire alarm systems and challenges will provide insight into the unique value proposition of NTNU's Digital Fire Central.
2- Intellectual Property Rights Management	Consult with an IP attorney to ensure the prototype interface is patentable and adequately protected, or if it's more prudent to protect the technology through trade secrets or other means.

3- Strategic Planning	As the prototype is already published, the exploitation strategy may involve licensing the technology for ship builders and designers to integrate into their designs or directly selling the technology to ship owners and operators. Pricing strategies should be aligned with the value addition and potential cost savings due to improved fire management capabilities.
4- Stakeholder Engagement	The engagement should actively involve all stakeholders to adopt the solution successfully. Regular consultations and collaborations with ship builders, designers, owners, operators, and maritime legislators are crucial to understand their needs and adapting the solution accordingly.
5- Marketing and Communication	The communication plan should highlight the benefits of the alarm system interface prototype, including its enhanced fire management capabilities. This can be done through presentations at maritime conferences, scientific publications, press releases, and targeted digital marketing.
6- Implementation and Monitoring	Although the prototype is already published, it is important to monitor its implementation closely, addressing any issues that may arise. This would involve tracking market response, stakeholder feedback, and technological advancements and making necessary adjustments as needed.

Again, this is a general guideline for developing an exploitation plan, and specific strategies may differ based on the maritime sector's specific context and market dynamics.

A detailed exploitation plan proposed for the solution of the beneficiary **SAS**, the **Training module for activation of extinguishment systems**. This solution has an exploitation potential in ship owners, ship operators, and maritime legislators, with a technology readiness level (TRL) of 5 and an expected time to market of 3 months:

Exploitation Step	Details
1- Market Analysis	This analysis should focus on the current training modules used by ship owners, operators, and maritime legislators for fire safety training. It should identify the strengths and weaknesses of these existing solutions and determine how SAS's Training Module provides a unique value proposition.
2- Intellectual Property Rights Management	It's essential to consult with an IP attorney to understand the potential for patenting the training module or protecting it through other means such as copyright or trade secrets. This will prevent unauthorized use or infringement issues in the future.
3- Strategic Planning	As the training module is nearing readiness (TRL 5), the exploitation strategy could involve directly selling the technology to ship owners and operators or licensing it to other training program providers. Pricing strategies will need to reflect the value provided by the enhanced training capabilities of the module.
4- Stakeholder Engagement	Active engagement with ship owners, operators, and maritime legislators will be critical for the adoption of the training module. This may involve conducting demonstrations, offering trial versions, and collecting feedback for continuous improvement.
5- Marketing and Communication	A comprehensive marketing plan should be designed to highlight the advantages of the SAS training module over existing solutions. This can include presentations at maritime safety conferences, press releases, digital marketing campaigns, and targeted outreach to potential customers.

6- Implementation and Monitoring	After the exploitation plan is set, it will be crucial to track the implementation process closely and adjust strategies as necessary. This could include monitoring the market response, collecting customer feedback, and tracking technological advancements in the field of fire safety training.
----------------------------------	---

Please note that this is a general guideline for developing an exploitation plan. Specific strategies may vary based on the context and market dynamics of the maritime sector.

An exploitation plan proposed for ***the integrated solutions for fire resource management, combining relevant sources of information, including drone and camera monitoring system*** of the beneficiary **NSR**. This solution has potential in the ship owners and operators sector, with a Technology Readiness Level (TRL) of 6 and an expected time to market of 4 months:

Exploitation Step	Details
1- Market Analysis	Understanding the current market landscape in fire resource management technologies used by ship owners and operators is crucial. The market analysis should consider existing fire management solutions, their strengths and weaknesses, and how NSR's integrated solution provides added value.
2- Intellectual Property Rights Management	Consultation with an IP attorney will be necessary to assess the possibility of patenting the integrated solution or protecting it through other means, such as trade secrets or copyrights, thus safeguarding the technology from unauthorized use.
3- Strategic Planning	Given the maturity of the technology (TRL 6), NSR could consider direct sales to ship owners and operators, or license the technology to other maritime safety providers. Pricing strategies should reflect the unique value proposition of the integrated solution.
4- Stakeholder Engagement	Stakeholder engagement with ship owners and operators will be key to the successful adoption of the technology. Demonstrations, trials, and feedback collection could be part of this process.
5- Marketing and Communication	Marketing the integrated solutions effectively will be paramount. This could involve industry conference presentations, press releases, digital marketing campaigns, and direct outreach to potential customers and relevant authorities in the maritime sector.
6- Implementation and Monitoring	Following the execution of the plan, ongoing monitoring and adjustments will be necessary. This could involve tracking market responses, feedback from customers, and keeping abreast of technological advancements in the sector.

Please note that this plan is a general guideline. Specific strategies may vary based on the specific context and market dynamics in the maritime sector.

An exploitation plan proposed for ***the guidelines for organizing the response in case of a fire emergency*** of the beneficiary **NSR**. This solution has potential in the ship owners and operators sector, with a Technology Readiness Level (TRL) of 6 and an expected time to market of 4 months:

Exploitation Step	Details
1- Market Analysis	A detailed study of the current market for emergency response guidelines in the maritime industry is needed. Analysis should focus on available solutions and how NSR's guidelines provide a unique approach or added value in managing fire emergencies on ships.

2- Intellectual Property Rights Management	It will be important to secure the Intellectual Property (IP) rights for the guidelines to ensure its legal protection. The consultation with an IP attorney will clarify the type of protection suitable for such a non-tangible asset.
3- Strategic Planning	Considering the maturity of the guidelines (TRL 6), NSR can explore different exploitation models. These could include direct sales to ship owners and operators or licensing to maritime safety providers. Pricing strategies should reflect the unique value offered by the guidelines.
4- Stakeholder Engagement	Engaging with key stakeholders like ship owners, operators, and maritime regulators will be crucial for the successful adoption of the guidelines. Demonstrations, discussions, and partnerships can be part of this process.
5- Marketing and Communication	Effective marketing and communication are key to promoting the guidelines. Activities could include industry conference presentations, press releases, digital marketing campaigns, and targeted outreach to potential customers and relevant authorities.
6- Implementation and Monitoring	After the execution of the plan, continuous monitoring and adjustment will be necessary. This should involve tracking market responses, collecting feedback, and observing developments in the maritime industry's safety standards.

Please note that this plan is a general guideline. The specifics can vary depending on the actual context and market dynamics.

An exploitation plan proposed for the **Cargo Scanning and Identification and Tracking system, namely the Vehicle Hot Spot Detector system**, of the beneficiary **SCK**. This solution has potential in the ship building, designing, operating sector, maritime authorities, and legislators, with a Technology Readiness Level (TRL) of 7 and an expected time to market of 3 months. Given the technology is commercially available today, the time to market primarily refers to the period required to align with regulatory measures and actual implementation on ships.

Exploitation Step	Details
1- Market Analysis	Evaluate the maritime industry's current market for cargo scanning and identification systems. The analysis should study existing solutions, potential customers (ship builders, designers, owners, operators), and how the Vehicle Hot Spot Detector system provides unique value (e.g., increased accuracy, speed).
2- Intellectual Property Rights Management	It is necessary to review and secure the IP rights for the Vehicle Hot Spot Detector system, which can involve patent filing or ensuring proper licensing agreements to protect the technology legally.
3- Strategic Planning	Given the technology's maturity (TRL 7) and the broad range of potential customers, different exploitation models can be employed, including direct sales, licensing, or partnerships with ship builders and designers. Pricing strategies should be based on the technology's unique value and the current market dynamics.
4- Stakeholder Engagement	Engaging with key stakeholders like ship builders, owners, operators, and maritime legislators is crucial. These stakeholders can be introduced to the system through demonstrations, training, and consultation sessions, which will help gain acceptance and drive adoption.

5- Marketing and Communication	An effective communication and marketing plan will involve industry conference presentations, technical whitepapers, press releases, and targeted outreach to potential customers and relevant maritime authorities. Given the commercial availability, case studies demonstrating successful implementation can also be powerful.
6- Implementation and Monitoring	Upon execution of the plan, the progress should be continuously monitored and necessary adjustments made. This includes tracking market responses, customer feedback, and changes in industry standards or regulations.

Please remember that this is a generalized guideline, and the specifics can change depending on the actual context and market dynamics.

A detailed exploitation plan proposed for **CIM's Stowage planning tool with an optimization algorithm for cargo distribution**:

Exploitation Step	Details
1- Market Analysis	The stowage planning tool finds its application in the shipping industry, specifically for ship owners and operators. This industry has been progressively implementing digital tools to improve safety and efficiency. The market analysis should focus on assessing the adoption rate of similar technologies and the competitors offering related solutions. Understanding the potential customers' needs and preferences will help shape the unique value proposition of the tool.
2- Intellectual Property Rights Management	CIM should ensure it holds the necessary patents or copyrights for the stowage planning tool with the optimization algorithm. This will prevent unauthorized usage and safeguard the company against potential infringements. Legal counsel may be necessary to review the current state of IP rights.
3- Strategic Planning	For exploitation, the tool can be licensed to ship owners and operators. Pricing strategies can be developed based on the market analysis. Given the digital nature of the tool, online distribution channels may be most effective. Commercial partners could include shipping companies and software vendors within the maritime industry.
4- Stakeholder Engagement	CIM will need to engage with ship owners and operators, demonstrating how the tool can improve their operations. Further, discussions with maritime legislators and flag states may help facilitate the broader acceptance of the tool and influence any relevant regulations.
5- Marketing and Communication	CIM should design a marketing and communication strategy aimed at the target audience. This may include industry conference demonstrations, trade publications articles, press releases, and targeted digital marketing. The benefits of the stowage planning tool and its effectiveness in improving safety and efficiency should be emphasized.
6- Implementation and Monitoring	The tool should be launched in a phased manner, perhaps starting with a select group of early adopters. Performance should be tracked to understand the market response, gather customer feedback, and keep an eye on technological advancements that could impact the tool's relevance. Adjustments to the strategy can be made based on this continuous monitoring.

The exploitation plan for the "Stowage planning tool with optimization algorithm for cargo distribution " developed by CIM has a maturity level of 4 and a time to market of 12 months. The main sector of application includes ship owners and operators.

An exploitation plan proposed for the ***Flame detectors technology*** of the beneficiary **FRN, FKE and UNF**:

Exploitation Step	Details
1- Market Analysis	The market for flame detectors has a diverse customer base, including ship builders, ship designers, ship owners, ship operators, and maritime legislators. Current trends in the market indicate an increasing demand for advanced fire detection systems due to the rising concern for safety in the maritime industry. FRN's flame detectors could provide a unique value proposition by offering efficient and quick detection of open flames on weather decks. Competitor analysis and customer behavior studies would need to be conducted to identify potential opportunities and challenges in the market.
2- Intellectual Property Rights Management	Beneficiaries must ensure that the technology of these flame detectors is adequately protected. This may involve applying for patents and/or copyrights. Properly protecting intellectual property can help avoid future disputes and make the technology more attractive to potential partners or buyers.
3- Strategic Planning	The exploitation strategy for the flame detectors could involve licensing the technology to shipbuilders or selling it directly to ship owners and operators. It could also involve partnerships or joint ventures with other maritime safety companies to expand market reach. The pricing strategy would need to be competitive yet profitable, considering the costs of production, marketing, and distribution and the prices set by competitors. The primary distribution channels would likely be direct sales to shipbuilders, ship designers, and ship owners and through partnerships with maritime safety equipment suppliers.
4- Stakeholder Engagement	Key stakeholders to engage with would include ship owners, operators, maritime legislators, and flag states. Regular consultations and collaborations with these stakeholders could help ensure wide acceptance of the technology. Feedback from these stakeholders could also guide further improvements in the technology.
5- Marketing and Communication	A marketing and communication plan for the flame detectors could include presentations at industry conferences, press releases announcing the launch of the product, targeted digital marketing campaigns, and outreach to potential customers and maritime authorities. Informative content about the benefits and unique features of the flame detectors could be created and disseminated through various channels.
6- Implementation and Monitoring	The exploitation plan should be implemented in a phased manner, starting with a pilot phase involving a limited number of customers. This would allow any necessary adjustments based on the initial response before a full-scale launch. The progress of the plan should be regularly monitored and adjustments made as needed based on market response, customer feedback, and changes in the industry or technology.

It's important to note that this plan is a general guideline and may need to be adjusted based on specific circumstances and additional information.

The detailed exploitation plan proposed for the "***Video fire analytics for the detection, visual confirmation, and localization of fires on closed ro-ro decks***" technology of the beneficiary **FRN and FKE**:

Exploitation Step	Details
-------------------	---------

1- Market Analysis	This technology has a wide market in the shipbuilding industry, as it is designed for closed ro-ro decks on ships. The key players in the industry include ship builders, ship designers, ship owners, and operators. The potential customers for this technology could be new ship builders and existing ship owners looking to upgrade their fire detection systems. The value proposition lies in the technology's ability to visually confirm and localize fires, providing a safety advantage over traditional fire detection systems.
2- Intellectual Property Rights Management	The IP rights of the developed technology must be thoroughly evaluated to prevent potential infringement issues. Considering the technology's commercial availability, FKE should have already secured the necessary patent rights. This step would ensure the uniqueness of the technology and secure the benefits of the developed solutions for the company.
3- Strategic Planning	Given the maturity of the technology (TRL 7), and its current commercial availability, the exploitation strategy could involve licensing the technology to shipbuilders and designers. Alternatively, FRN could form strategic partnerships with shipbuilders to incorporate the technology directly into new ship designs. Pricing strategy should consider development costs, perceived value, and competitor pricing. Distribution channels could include direct sales, or through shipbuilding supply chains.
4- Stakeholder Engagement	FRN and FKE should engage with stakeholders such as ship owners, operators, maritime legislators, and flag states. These entities will play a crucial role in the acceptance and adoption of the technology. Discussions and presentations about the technology's benefits and effectiveness should be held with these stakeholders to build consensus and support.
5- Marketing and Communication	The promotion of the technology can be done through various methods such as presentations at industry conferences, publication of scientific papers demonstrating the effectiveness of the technology, press releases, digital marketing, and direct outreach to potential customers and maritime authorities. The communication plan should highlight the technology's effectiveness in detecting, confirming, and localizing fires on closed ro-ro decks, and how it can enhance safety on ships.
6- Implementation and Monitoring	Once the plan is in place, it should be implemented in phases. The market response to the technology should be monitored closely, with necessary adjustments made as needed. Feedback from customers, changes in market trends, and advancements in fire detection technologies should all be considered in the iterative development of the exploitation plan.

This exploitation plan can provide a guideline for FRN to leverage their technology effectively and maximize its commercial potential.

The exploitation plan proposed for the technology "***Adaptive threshold settings for detection systems to continue fire detection during loading/offloading operations***", of the beneficiary **FRN, APS and FKE**:

Exploitation Step	Details
-------------------	---------

1- Market Analysis	The technology targets the maritime industry, specifically focusing on ship builders, ship designers, ship owners, ship operators, and maritime legislators. It addresses the crucial need for effective fire detection during the loading and offloading operations. It would be important to study the current market scenario, identify the main competitors and understand their offerings, examine the industry trends and demands, and identify potential customers who would benefit from this technology. The value proposition of this solution lies in its potential to significantly improve the safety of ro-ro ships during loading and offloading operations.
2- Intellectual Property Rights Management	APS and FKE must assess the intellectual property rights for this technology. This might include filing for patents to legally protect the technology. Any potential infringement issues should be identified and addressed to avoid future legal disputes.
3- Strategic Planning	Based on the market analysis and IP management, FRN should develop a strategic exploitation plan. The plan should outline the best model for exploiting the technology, whether licensing, joint ventures, spin-offs, sale of IP, etc. It should also detail the pricing strategy, distribution channels, and potential commercial partners.
4- Stakeholder Engagement	The next step is to actively engage with relevant stakeholders, including ship owners, operators, maritime legislators, and flag states. Through collaborations, consultations, and agreements, the beneficiaries can ensure the broad acceptance and adoption of the technology. This also aligns with WP03's objective to garner favour and consensus while establishing a science-based approach to maritime fire safety.
5- Marketing and Communication	The communication and marketing plan should include various strategies to promote the technology. It might involve presenting at industry conferences, publishing in scientific journals, issuing press releases, engaging in digital marketing, and targeted outreach to potential customers and relevant maritime authorities. The marketing messages should emphasize the unique features and benefits of the technology and its potential to improve safety during loading/offloading operations.
6- Implementation and Monitoring	After the plan is set, it should be implemented phased. Monitor the progress regularly, track market responses, customer feedback, and changes in technology or market trends. Make necessary adjustments to the plan as needed.

Please note that the maturity level of this technology is at TRL 1, meaning it's at the very early stages of development. Therefore, it might take some time before it's ready for commercial deployment, even though the components are commercially available today. The time to market will depend on various factors, including development progress, regulatory approvals, and market conditions.

Exploitation Plan proposed for **FRN's** and **APS's *Linear Heat Detection System***:

Exploitation Step	Details
1- Market Analysis	Understand the demand for advanced fire detection systems in the ship building, ship designing, and ship operation sectors. Identify current solutions and how the linear heat detection system offers a unique value, such as its potential to detect fires in both open and closed ro-ro spaces. Consider the growth of the shipping industry, emerging safety regulations, and maritime fire safety technologies trends.

2- Intellectual Property Rights Management	Review the Intellectual Property (IP) rights associated with the linear heat detection system. Ensure that all necessary patents or proprietary technology rights are in place to protect the developed system legally. Consult with legal experts in IP management for maritime technologies.
3- Strategic Planning	Identify potential exploitation models for the linear heat detection system, such as licensing to ship builders or forming joint ventures with maritime safety solution providers. Set appropriate pricing strategies considering the technology's maturity level, market demand, and competitive landscape. Determine potential distribution channels, including direct sales to ship builders or maritime safety equipment distributors.
4- Stakeholder Engagement	Engage with relevant stakeholders such as ship owners, operators, maritime legislators, and flag states to introduce the system and its benefits. Coordinate with relevant maritime authorities to ensure that the system meets or exceeds current and upcoming safety regulations. Collaborate with ship operators to test and validate the system in real-world conditions.
5- Marketing and Communication	Develop marketing materials highlighting the system's unique ability to detect fires in both open and closed ro-ro spaces, its high Technology Readiness Level (TRL), and immediate availability. Promote the system at industry conferences, in scientific publications, and through digital marketing. Use targeted outreach to reach potential customers and relevant maritime authorities.
6- Implementation and Monitoring	Begin phased implementation of the exploitation plan. Monitor market response, customer feedback, and technological advancements that may necessitate adjustments to the plan. Continually seek to improve and innovate the system to maintain its competitive edge.

Exploitation Plan proposed for **FRN's**, **FKE's** and **UNF's *Thermal Cameras***:

Exploitation Step	Details
1- Market Analysis	Assess the need for advanced fire detection and localization technologies in the ship building, ship designing, and ship operation sectors. Identify existing solutions and how FRN's thermal cameras offer a unique value proposition with their ability to visually confirm and localize fires and hot surfaces on weather decks. Consider market trends, safety regulations, and competitor offerings in this space.
2- Intellectual Property Rights Management	Evaluate the Intellectual Property (IP) rights associated with the thermal cameras. Ensure any necessary patents or proprietary technology rights are in place to prevent future unauthorized use or patent infringement. Legal advice may be sought to confirm all aspects of IP protection for this technology.
3- Strategic Planning	Develop an exploitation strategy for the thermal cameras, considering options like licensing to ship builders or forming joint ventures with maritime safety solution providers. Determine pricing strategies based on factors like technology maturity, market demand, and competition. Identify potential distribution channels, such as direct sales to ship builders or through maritime safety equipment distributors.
4- Stakeholder Engagement	Engage with key stakeholders such as ship owners, operators, maritime legislators, and flag states to promote the benefits and features of the thermal cameras. Ensure that the technology meets or exceeds all relevant safety regulations. Collaborate with end-users for real-world testing and validation of the technology.

5- Marketing and Communication	Create a marketing and communication plan to promote the thermal cameras. Highlight the technology's unique capabilities, maturity level, and immediate availability in marketing materials. Share the technology's benefits at industry conferences, through scientific publications, and via digital marketing. Use targeted outreach to potential customers and maritime authorities.
6- Implementation and Monitoring	Implement the exploitation plan in a phased manner. Monitor the market response, customer feedback, and technological advancements that may impact the exploitation strategy. Make necessary adjustments to the plan based on these factors, and continue to innovate and improve the technology to maintain a competitive edge.

Exploitation Plan proposed for **RISE's A-30 Fire Insulation**:

Exploitation Step	Details
1- Market Analysis	Understand the need for advanced fire insulation solutions in the ship building, ship designing, and ship operation sectors. Identify the existing fire insulation solutions and how RISE's A-30 fire insulation may offer a unique value proposition in terms of enhanced fire safety. Assess current trends in maritime safety regulations, competitor offerings, and potential customers.
2- Intellectual Property Rights Management	Conduct an analysis of the Intellectual Property (IP) rights pertaining to the A-30 fire insulation. This step will involve legal advice to ensure that all necessary patents or proprietary technology rights are in place, thereby preventing unauthorized use or future patent infringement.
3- Strategic Planning	Formulate an exploitation strategy for A-30 fire insulation, considering options such as licensing the technology to ship builders or forming joint ventures with maritime safety solution providers. Determine pricing strategies based on factors such as the technology's development stage, market demand, and competitive landscape. Identify potential distribution channels and commercial partners.
4- Stakeholder Engagement	Liaise with key stakeholders, including ship owners, operators, maritime legislators, and flag states to ensure the technology meets or exceeds the safety regulations and standards. The engagement may also involve collaborations and agreements to ensure the technology's practical applicability, acceptance, and eventual adoption.
5- Marketing and Communication	Design a marketing and communication plan to effectively promote the A-30 fire insulation. This might involve highlighting the technology's potential benefits in enhancing fire safety aboard ships at industry conferences, scientific publications, press releases, and digital marketing. Additionally, targeted outreach initiatives can be conducted to engage potential customers and relevant maritime authorities.
6- Implementation and Monitoring	Once the exploitation plan is prepared, roll it out in a phased manner. Regular monitoring of the plan's progress is vital and adjustments should be made based on market response, customer feedback, and any technological advancements. Despite the product's current maturity level, continue to innovate and improve the technology to maintain a competitive edge.

Exploitation Plan proposed for **RISE's Extinguishing System Simultaneously Activated Above and Below Sub-Dividing Deck**:

Exploitation Step	Details
1- Market Analysis	Evaluate the demand for advanced extinguishing systems in the ship building, ship designing, and ship operation sectors, and advising ship operators to follow this strategy. Identify existing extinguishing systems and how RISE's solution provides a unique value proposition, such as enhanced firefighting efficiency in complex ship structures. Understand current trends in maritime safety regulations, competitor offerings, and potential customers.
2- Intellectual Property Rights Management	Examine the Intellectual Property (IP) rights related to the extinguishing system. Engage legal expertise to ensure necessary patents or proprietary technology rights are secured, to prevent future unauthorized use or patent infringement.
3- Strategic Planning	Develop an exploitation strategy for the extinguishing system, including potential exploitation models like licensing the technology to ship builders or forming joint ventures with maritime safety solution providers. Determine pricing strategies based on factors such as the technology's development stage, market demand, and competitive landscape. Identify potential distribution channels and commercial partners.
4- Stakeholder Engagement	Interact with key stakeholders such as ship owners, operators, maritime legislators, and flag states to ensure the technology aligns with safety regulations and standards. Collaborate and establish agreements to ensure the technology's practical applicability, acceptance, and eventual adoption.
5- Marketing and Communication	Establish a marketing and communication plan to promote the extinguishing system. This could involve showcasing the technology's potential benefits at industry conferences, scientific publications, press releases, and digital marketing. Conduct targeted outreach initiatives to engage potential customers and relevant maritime authorities.
6- Implementation and Monitoring	Roll out the exploitation plan in a phased manner once it is prepared. Regularly monitor the plan's progress and make adjustments based on market response, customer feedback, and technological advancements. Despite the product's current maturity level, continuously innovate and improve the technology to remain competitive.

A detailed exploitation plan proposed for ***Ship manoeuvring/operation to limit the effect of fire at least in critical areas***; of the beneficiary VTT's solution can be constructed as follows:

Exploitation Step	Details
1- Market Analysis	The exploitation plan should begin with a comprehensive understanding of the maritime market and the specific segments that would benefit from the technology. This will involve analysing the existing solutions for limiting the effect of fires in critical areas and understanding where the VTT's solution fits in. The unique value proposition of this solution should be clearly defined.
2- Intellectual Property Rights Management	It will be necessary to determine the IP rights for the technology. This step may involve filing for patents to protect the innovation and deter unauthorized use or copying. The IP rights scope should cover the technology's target markets.
3- Strategic Planning	A detailed plan outlining how VTT's solution will be introduced and distributed in the market should be developed. This includes selecting appropriate

	exploitation models, pricing strategies, and potentially identifying commercial partners.
4- Stakeholder Engagement	Engaging stakeholders is crucial for the success of the exploitation plan. In this case, it involves reaching out to ship owners, operators, maritime legislators, and flag states. Collaborations and agreements may be sought to ensure the widespread acceptance and implementation of the technology.
5- Marketing and Communication	A robust marketing and communication plan should be created to promote the technology. This plan should encompass a variety of channels, such as industry conferences, scientific publications, press releases, and digital marketing. A targeted outreach to potential customers and maritime authorities will also be crucial.
6- Implementation and Monitoring	Once all the steps are in place, the exploitation plan should be implemented in a phased manner. Monitoring the progress is vital to assess the market response, feedback, and adjust strategies as needed.

detailed exploitation plan proposed for the technology "**Tactical guidelines for manual interventions - Requirement of reversible fans**" of the beneficiary RISE.

Exploitation Step	Details
1- Market Analysis	Analyze the shipbuilding, ship design, ship ownership, and ship operation sectors for their current safety mechanisms, especially with regard to fire safety. Examine existing competitors and potential customers. Analyze the need and demand for enhanced fire safety technologies, such as tactical guidelines for manual interventions and reversible fans.
2- Intellectual Property Rights Management	Collaborate with RISE's legal team to examine the IP rights of the tactical guidelines and reversible fans technology. Establish a plan for patent registration if the technology is unique and novel, and consider potential patent licensing opportunities.
3- Strategic Planning	Identify potential business models for the exploitation of the technology. This could involve licensing the technology to ship builders, ship designers, or maritime legislators. Determine appropriate pricing strategies, potential distribution channels, and potential commercial partners within the maritime industry.
4- Stakeholder Engagement	Engage with relevant stakeholders including ship owners, operators, maritime legislators, and flag states. Discuss the technology and its benefits, and seek their feedback and potential interest. Develop agreements or partnerships where stakeholders see the value in adopting or implementing the technology.
5- Marketing and Communication	Create a marketing plan to increase awareness about the technology. This could involve presentations at maritime industry conferences, scientific publications, press releases, and digital marketing targeting potential customers and relevant maritime authorities.
6- Implementation and Monitoring	Once the plan is set, implement it in a phased manner. This could involve an initial pilot or trial phase with a few interested ship owners or operators. Monitor the progress of the technology's implementation, gather customer feedback, and make necessary adjustments as needed. This could also involve tracking advancements in fire safety technology to ensure the technology remains competitive.

This detailed plan helps in exploiting the technology "Tactical guidelines for manual interventions - Requirement of reversible fans" developed by RISE to its fullest potential. Remember, the actual timeline and specifics will depend on the stakeholders' and market's responses and feedback, along with the legal aspects surrounding Intellectual Property Rights Management.

In conclusion, these exploitation plans for each LASH FIRE beneficiary's solutions and technologies are essential strategic roadmaps designed to maximize the impact and value of the project's outcomes. Guided by the principles outlined in Article 28, these plans ensure that the results are leveraged effectively, contributing not only to the beneficiaries' individual growth but also to the broader maritime industry's progress. By considering each solution's unique characteristics and potential, and combining thorough market analysis with strategic planning, intellectual property rights management, stakeholder engagement, and effective marketing, we can anticipate significant advancements in the safety of ro-ro ships. Therefore, these plans represent a crucial step in translating the potential of the LASH FIRE project into tangible, impactful innovations.

7 Post-Project and Further Steps

The LASH FIRE project, centered on enhancing fire safety, aims for enduring impact through a sustainable post-project strategy. This strategy focuses on Risk Control Options (RCOs), which are derived from various fire safety Risk Control Measures (RCMs) and undergo cost-assessment analysis.

7.1 Identifying Barriers to Implementation of LASH FIRE Solutions

The LASH FIRE project harbors potential for substantial improvements in fire safety measures for ro-ro ships. However, the practical application of its outcomes may face certain impediments. These primarily encompass resistance from stakeholders due to increased costs, changes in customary practices, and regulatory obstacles. The process of regulatory alterations can be intricate and prolonged, potentially decelerating the execution of LASH FIRE's propositions. Additionally, the simultaneous management of data access and privacy can pose significant challenges.

Nevertheless, the LASH FIRE consortium remains committed to fostering productive partnerships with all associated entities to effectively circumvent these issues and ensure that the project's results are resourcefully integrated to enhance fire safety on ro-ro ships.

The key challenges and potential solutions for the implementation of LASH FIRE project outcomes, as discussed in Deliverable D03.9, are as follows:

1. **Universality of Application:** The universality of the project's outcomes may be restricted, causing difficulties in the incorporation of suggested regulations. This issue will be mitigated by aiming to derive results that are pertinent to a broad spectrum of ship categories.
2. **Slow Pace of Regulatory Revisions:** Changes in regulations often proceed at a slow pace. Measures have been planned to sustain the relevance of the project's impacts beyond its completion.
3. **Conflict Resolution:** The resolution of potential conflicts between project outcomes may present a challenge. This will be addressed by involving end-users and stakeholders in the decision-making process, thereby achieving a balance between divergent objectives.
4. **Resistance to Adoption:** Stakeholders may resist the incorporation of practices that extend beyond the scope of existing regulations. Active dialogue with seafarers and consultations with advisory groups like the Maritime Authorities Advisory Group (MAAG)

and Maritime Operators Advisory Group (MOAG) will be instrumental in overcoming this obstacle.

In Deliverable D03.9, a comprehensive implementation plan is delineated, which includes the formulation of an Exploitation Strategy, ensuring Intellectual Property Rights (IPR) protections, stakeholder engagement, effective data management, transparent communication of findings, continuous scrutiny of external developments, planning for protracted regulatory amendments, continuous monitoring and feedback mechanisms, and strategizing for future exploitation actions.

Additionally, several strategies are outlined to mitigate external obstacles to the implementation. These include augmenting the critical mass within the European shipbuilding and equipment community, establishing a comprehensive ro-ro space fire database, and initiating constructive dialogue with policymakers and stakeholders.

In summary, Deliverable D03.9 offers a robust plan for identifying and addressing potential roadblocks in the execution of LASH FIRE's outcomes. This includes measures to ensure the efficient exploitation of project results and strategies to overcome possible barriers, thereby ensuring a sustainable impact of the project.

7.2 Post-Project Exploitation and Sustainability of the Project's Results

The outcomes of the LASH FIRE project are designed to have a significant impact beyond the immediate project timeline. The project's main objective was to identify and validate solutions to fire safety challenges aboard ro-ro ships. This effort led to a comprehensive set of results, all of which hold promising potential for further utilization in the future. Our data collection, regulatory analysis, and demonstration of innovative solutions provide a solid groundwork for future advancements in this field. The broader maritime community, including stakeholders such as classification societies, marine insurers, flag states, and the shipping industry, stand to gain considerably from the findings of the LASH FIRE project. Furthermore, the knowledge and insights acquired can shape the development of future IMO regulations and safety guidelines.

The LASH FIRE project also led to the creation of advisory groups and communication networks. These serve as precious resources for future endeavors, providing platforms for ongoing knowledge sharing and expansion, thereby ensuring the sustainability of the project's impacts.

A key element of our strategy for extending the project's influence involves a wide range of activities aimed at broadly implementing Risk Control Measures (RCMs) and also RCOs. These include collaborating with external entities, conducting ship visits, and formulating new standards. Critical external partnerships with companies, significantly enhance the project's reach and potential for impact.

Our Alternative-fueled Vehicles (AFV) firefighting course hosted on the Seably platform is a primary deliverable. Its sustainability will be assured through routine updates, data-informed feedback, collaborations with industry experts, periodic audits, ongoing promotional activities, and a robust certification process.

The sections titled "Open Access for Scientific Publication and Research Data" and "Exploitation - Data Management Plan for Re-use of Research Data" reflect the project's commitment to ensuring accessibility of research findings for further exploitation. By using Zenodo as the primary repository for research data and scientific publications, it is aimed to maximize the reach and longevity of our findings.

The project's results could potentially shape the guidelines of classification societies, Protection & Indemnity (P&I) clubs, and even influence national or EU regulations. In particular, our findings concerning Alternative Powered Vehicles (APVs) **can enhance the IMO's work on fire protection for new energy vehicles**. Ultimately, the LASH FIRE initiative is designed to provide a robust technical foundation for revising international IMO regulations, with a strong focus on enhancing fire prevention strategies for ro-ro ships. The final exploitation plan, D03.9, ensures that the project's findings are effectively applied to optimize its impact, thereby improving maritime safety and fire prevention measures.

7.3 Impact of LASH FIRE on the SOLAS Convention of IMO and also EU Regulations

The EU Horizon 2020 project LASH FIRE, funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 814975, is aligned with Article 28 — Exploitation of Results. This mandates that the research outcomes should contribute to European or international standards. LASH FIRE, in light of this directive, has brought forth findings crucial for potential amendments in the maritime sector.

Key Takeaways from the LASH FIRE Report:

- LASH FIRE primarily focused on assessing risks associated with fire safety hazards, especially in the context of ro-ro ships.
- The project was instrumental in producing 44 innovative solutions, of which 16 were chosen as Risk Control Options (RCOs). These solutions target multiple aspects of fire protection, from prevention to evacuation.
- Two advisory groups, the Maritime Authorities Advisory Group (MAAG) and the Maritime Operators Advisory Group (MOAG), were actively involved throughout the project, ensuring the efficacy and relevance of the solutions.
- The LASH FIRE findings have been widely disseminated through conferences, webinars, presentations, and technical papers. These are accessible on the official LASH FIRE website.
- The project has paved the way for more than 20 regulatory proposals to be considered by the IMO, ensuring maritime safety standards are met and potentially expanded upon.

Consequently, the LASH FIRE project has deeply influenced maritime safety standards, focusing on:

1. Enhancing clarity in the IMO's requirements, such as providing detailed guidelines on implementing new requirements.
2. Introducing additional safety measures beyond the scope of the IMO draft amendments.

These solutions cover both general ro-ro cargo ships and vehicle carriers, introducing 9 RCOs that the IMO draft doesn't address. LASH FIRE aims to further contribute by presenting a comprehensive Information Paper to the IMO at the end of its term. This document will encapsulate solutions that emphasize ignition prevention and operational measures.

Furthermore, LASH FIRE's solutions go beyond the draft amendments proposed to the IMO, encompassing areas beyond just technical specifications. The project's results are anticipated to not only meet the stipulations of Article 28 but also significantly enhance maritime safety standards.

8 Conclusion

Main author of the chapter: Reza Karimpour, MAG

The LASH FIRE project, through its innovative research, technological advancements, and cooperative initiatives, has successfully addressed the challenge of reducing the risk of fires on board ro-ro ships. The project, driven by a holistic approach, has produced outcomes that are not only beneficial to the maritime industry but also align with the safety enhancement goals of the International Maritime Organization (IMO) and other relevant regulatory bodies.

The project's key outcomes have a high potential for exploitation, including guidelines for local fire-extinguishing systems in closed ro-ro spaces, a new standard for alternative fire suppression systems, automated cargo fire hazard management systems, and others. These solutions hold significant promise for transforming fire safety measures aboard ro-ro ships and making them inherently safer.

The exploitation strategies outlined for these key outcomes, from Intellectual Property Rights management to strategic planning, stakeholder engagement, and implementation, have been detailed. The proposed strategies consider the individual uniqueness of each solution, the target market, and the best means of bringing the solutions to those who need them.

However, while these plans are ambitious and well-articulated, potential barriers to the implementation of LASH FIRE solutions were identified, including the need for broad industry acceptance, the difficulty of integrating and retrofitting new technologies into existing infrastructures, and the necessity for regulatory adaptation. To tackle these barriers, we must continue to engage with stakeholders and regulatory bodies, consistently communicate the benefits and practicalities of the solutions, and demonstrate their effectiveness in real-world scenarios.

The project has also considered the post-project exploitation and sustainability of the project's results. With the expiration of the project's timeline, the crucial question of how to maintain momentum and ensure the continued adoption of the solutions was addressed. The strategies put forward, such as the continued engagement with stakeholders, ongoing monitoring, and feedback promise a sustained impact of the project.

Furthermore, the LASH FIRE project's potential impact on the Safety of Life at Sea (SOLAS) Convention was considered. The project's solutions contribute towards the aim of the convention, i.e., to specify minimum safety standards in construction, equipment, and operation of ro-ro ships. By influencing future amendments to the SOLAS Convention, the project's outcomes can shape maritime safety regulations globally.

In conclusion, the LASH FIRE project has successfully achieved its goal of enhancing fire safety on ro-ro ships. The project's results are promising, with considerable potential for exploitation and long-term sustainability. As we move beyond the project's lifespan, it is the collective responsibility of the project partners, stakeholders, regulatory bodies, and the maritime industry to implement, adapt, and innovate upon these solutions. The journey towards safer and more sustainable ro-ro shipping continues, and the LASH FIRE project has significantly contributed to this ongoing effort.

9 ANNEXES

Main authors of the chapter: Reza Karimpour, MAG

9.1 ANNEXE A - LASH FIRE Guideline - Improvement In Current Signage And Marking Standards /Conditions

The improvement in current signage and marking standards proposed in these guidelines should inform industry actors and regulators on how to enhance the management and containment of fire. Ship operators and crews can use these guidelines as a reference resource. The guidelines are targeted towards newbuilt and existing ro-ro cargo, ro-pax and vehicle carriers. These three types of ships have been selected to represent most of the ro-ro ships in the world fleet.



https://lashfire.eu/media/2023/07/D6.1-Improvement-in-current-signage-and-marking-standards-conditions_digital.pdf

9.2 ANNEXE B - LASH FIRE Guideline - Guidelines For Crew-Centered Fire Safety Design
Paying respect to the crew's practical needs during fire safety design will translate into effective action when a fire occurs. This guide is intended to help the shipping company fulfil that goal in a ship newbuild project.



https://lashfire.eu/media/2023/07/D6.1-Improvement-in-current-signage-and-marking-standards-conditions_digital.pdf

9.3 ANNEXE C - LASH FIRE Two- Pager Information Sheets

Mechanical ventilation in case of fire in closed ro-ro spaces

To use mechanical ventilation during a fire in a closed ro-ro space, it is important to be aware of both the opportunities and risks.

IMPORTANT FACTORS TO CONSIDER

Before considering using mechanical ventilation during a fire scenario, consider these factors!

Size of fire: This guideline is valid for fires up to 30 MW (equivalent to a single car burning). If the fire exceeds 30 MW, the correct process of shutting off the ventilation and closing the dampers is not challenging.

Location of fire: The placement of the fire in relation to supply exhaust fans will affect how fans can be used.

Surrounding cargo: Take into account the risk of fire spread to adjacent cargo with the usage of ventilation.

Available equipment: Reversible fans and temperature sensors can be helpful for a successful fire ventilation strategy.

Ventilation set-up: Consider if the fan configuration onboard can create the desired airflow in the space.

Mechanical ventilation in case of fire in closed ro-ro spaces.

Facts and Myths About Fires in Battery Electric Vehicles

The passenger car vehicle fleet is going through a major change in terms of the energy used for propulsion. Petrol and diesel are exchanged for alternative fuels, not least batteries.

A rapid growth is seen in the sales of electric vehicles in major markets such as China and Europe. In 2020, 4% of new passenger vehicles sold globally were electric vehicles. Sales are predicted to increase exponentially and could meet sales benchmark values of >80% in 2030.

Lithium-ion (Li-ion) batteries

Li-ion batteries can be found in a variety of formats and chemistries which enable them to be used in a variety of different applications, from mobile phones to battery electric vehicles (BEVs).

Fire hazards

New technologies naturally raise a large interest in the public and as new energy carriers make their way into the market, some misconceptions will naturally also make their way to the public.

BEVs are not more hazardous than internal combustion engine vehicles (ICEVs), but the risks of Li-ion batteries differ to those of conventional fuels.

Facts and myths

The objective of this short communication is to respond to some of the common misconceptions regarding BEV fires.

A detailed answer to each statement and a complete reference list can be found in the report (<https://lashfire.eu>). Below each statement, a reference to the relevant section in the report is found.

Facts and Myths about fire in battery electric vehicles.

<https://lashfire.eu/2-pagers-information-sheet/>

Mechanical ventilation in case of fire in closed ro-ro spaces: To use mechanical ventilation during a fire in a closed ro-ro space, it is important to be aware of both the opportunities and risks. Ventilation is of great importance for the fire growth rate, intensity and fire duration in ro-ro spaces. This guideline aims at giving the person responsible for manual firefighting tactics an understanding for how mechanical ventilation can be used during the early phase of a fire event. The guideline is based on

different types of studies. Computation fluid dynamic (CFD) study, model scale testing, in-situ visits, survey and interviews with personnel working with fire safety on board ships. The guideline is relevant for closed ro-ro spaces on board ro-ro passenger ships and ro-ro cargo ships. Mechanical ventilation can be used to change the conditions in a space so that heat or fire gases flow in a desired direction. Fans are already used by professional firefighters in land-based operations. The usage of mechanical fire ventilation is an active tool, which needs to be adjusted to and during the specific fire scenario.

Facts and Myths About Fires in Battery Electric Vehicles: The passenger car vehicle fleet is going through a major change in terms of the energy used for propulsion. Petrol and diesel are exchanged for alternative fuels, not least batteries. A rapid growth is seen in the sales of electric vehicles in major markets such as China and Europe. In 2020, 4% of new passenger vehicles sold globally were electric vehicles. Sales are predicted to increase exponentially and could meet sales benchmark values of >80% in 2030. Lithium-ion (Li-ion) batteries Li-ion batteries can be found in a variety of formats and chemistries which enable them to be used in a variety of different applications, from mobile phones to battery electric vehicles (BEVs). Fire hazards New technologies naturally raise a large interest in the public and as new energy carriers make their way into the market, some misconceptions will naturally also make their way to the public. BEVs are not more hazardous than internal combustion engine vehicles (ICEVs), but the risks of Li-ion batteries differ to those of conventional fuels. Facts and myths The objective of this short communication is to respond to some of the common misconceptions regarding BEV fires. A detailed answer to each statement and a complete reference list can be found in the report (<https://lashfire.eu>). Below each statement, a reference to the relevant section in the report is found.

9.4 ANNEXE F - LASH FIRE Final Video Transcript

Although fires on road ships and ferries are rare, sometimes they can be quite substantial. To ensure safety in the future, we need to examine the causes of these fires and the factors that enable their growth. This way, we can find ways to improve conditions. We're currently transporting more cargo than ever before, which includes new types of vehicles such as electric and gas-driven cars.

Fortunately, numerous stakeholders are dedicated to improving fire safety. In the LASH FIRE project, we've combined our efforts with a simple goal in mind: to keep people and cargo safe both now and in the future. LASH FIRE has explored the entire fire protection chain, from ignition to evacuation, and tested our solutions in real-life settings. We've also evaluated them in terms of cost-effectiveness.

To know the kind of cargo we are transporting, and if it contains anything that could cause a fire, LASH FIRE has devised a solution that scans to identify what cargo we are carrying on our ships. This solution, the screen portal, can spot vehicles and detect hot spots. This technology could potentially be installed at every terminal.

To monitor if there's a fire risk when reefers (refrigerated trailers) are connected and when electric vehicles are being charged, LASH FIRE has developed a monitoring solution. All the electrical connections to charging EVs and powered reefer units are constantly checked by energy meters, insulation fault locators, and insulation measurement units. If a deviation or anomaly is detected, the unit can be disarmed either manually or remotely. One significant benefit of this solution is that an alarm is raised before any actual damage occurs or a fire situation arises onboard.

If a fire still happens, it's essential to detect and visually confirm it as quickly as possible. We have tested a range of fire detection systems in laboratories and onboard ships. For closed areas, we found video fire detection to be practical and affordable. For open spaces with plenty of ventilation, linear

heat detection is the most promising technology. This system uses a sensor cable to monitor the entire length of the deck, resulting in faster fire detection and less maintenance compared to conventional smoke detectors and heat sensors. To visually confirm and locate fires, we found video analytics and thermal cameras to be particularly helpful. Thermal cameras can identify heated areas and visualize developing fires undetectable by other sensors.

In anticipation of new regulations that may require fire detection on weather decks, we've identified suitable technologies by testing various systems under different weather conditions over a year. Flame detectors with triple IR technology have shown excellent detection capabilities and durability. These detectors provide quick fire detection and have had no false alarms in our studies. Video flame detection systems have also performed very well.

Once a fire has been confirmed in the cargo space, it's crucial to activate the extinguishing system as quickly as possible. However, human factors and design issues can slow down this process. To assist in this situation, we've developed a training course designed to mimic real fire scenarios, including decision making, communication practices, and practical activation. This course is paired with a process called a "reflection, evaluation, and change process," which systematizes the conversion of training experiences into workplace improvements.

We've also focused on the integration of a well-designed system to support efficient decision-making during a fire scenario. To this end, we've developed a prototype digital fire control center (DFC). The DFC is a touch interface that amalgamates different types of information, like heat spread and smoke spread, access to safety system controls, and provides a timeline of events. This integration makes it easier for the fire chief to understand the situation and make decisions, thereby saving time in a firefighting scenario.

In a normally packed cargo space containing vehicles, refrigerated trailers, and electric cars, we've tested the ability of a drenching system to control fire in all types of cars. From our series of fire suppression tests, we found that an electric car fire is not more challenging for a drenching system than a gasoline-powered car fire. To address the delay in activating the fixed carbon dioxide system, we developed a supplementary sprinkler system that activates early during a fire. It keeps the fire under control long enough for the carbon dioxide system to be discharged, thereby reducing fire damage and improving the effectiveness of the carbon dioxide system.

If a fire occurs on the weather deck, it's hazardous and challenging for the crew to manually fight the fire. To improve this situation, we've developed fire monitor system concepts that can discharge water or foam from a distance towards the fire. These can be remotely controlled or autonomous. The advantage of an autonomous system is that it activates early during a fire and starts to control it as quickly as possible.

We've also seen that using fans in the early phase of a fire can reduce the amount of smoke in a closed space. This improves visibility and assists manual firefighting. However, the application of ventilation depends on the ship's specific conditions. If a fire is close to an exhaust duct, active fans can decrease the smoke density and improve visibility. We've produced guidelines to increase crew members' understanding of the risks and effects of using ventilation during a fire.

When it comes to manual firefighting of electric cars, the approach is not much. When it comes to manual firefighting of electric cars, the approach is not much...When it comes to EV fires, if they can be controlled, crew can manage the post-fire situation using water from a traditional fire hose to cool the batteries. It's important to note that this may not be as simple when the vehicle deck is crowded. In this case, we can use passive boundary water cooling devices. These can be placed around the

burning vehicle to minimize fire spread to neighboring cars. During the post-fire phase, we can use a fire blanket or a portable cooling device to protect against potential re-ignition. This approach is not very different from handling a fossil fuel car fire, apart from the risk of re-ignition. It is critical to be prepared for possible thermal runaway fire events from the battery.

9.5 ANNEXE G - LASH FIRE Traing Video/Course on SEABLY - Transcript

Introduction

Alternative-fueled vehicles (AFV) represent different types of hazards compared with vehicles with traditional fuel such as gasoline and diesel with internal combustion engines. Do our usual methods, equipment and training work or do we need to do something more to be safe?

Hands-on firefighting training on AFV shall empower all relevant personnel to act in the case of fire, making sure that crew actions are supported by sufficient competence. The Lash Fire project is proud to present a series of training videos for effective manual AFV firefighting. First out is an introductory movie setting the context for the coming five movies that will address the following topics:

- Fire team protection,
- Manual firefighting, electric cars,
- First Response,
- Post-fire stage, and
- Manual firefighting, gas vehicles.

As mentioned in the video above. The main reasons behind the topic of alternative fuel vehicles (AFVs) becoming a serious safety concern are the enormous growth of the AFVs fleet, the potential fire risks of these vehicles and a high uncertainty on the associated fire characteristics. The document below, created by EMSA, helps provide guidance for the safe carriage of AFV's in ro-ro spaces of cargo and passenger ships. EMSA Guidance :

<https://res.cloudinary.com/seably/raw/upload/784f5bc85b123c46a7.pdf>

Protection Suit

All vehicle fires emit hazardous gases. One component often mentioned in electric cars is hydro fluorides (HF), which occur in higher concentrations in these vehicles compared to fossil fuel cars if the battery is on fire. Hydro fluorides bind easily to water, this means the drencher system or any other source of water such as a fire hose or boundary cooling device, washes out large parts of HF gases.

” If an electric car is on full fire, jet flames can occur without warning.”

Remember:

1. Firesuits should be worn in accordance with the instructions. This will protect well from all vehicle fire gases including those of lithium-ion batteries, such as hydro fluoride. When possible, dress with an assistant.
2. Having the trousers rolled down over boots makes it quick and easy to put both on.
3. Make sure that the hood is smoothed down over your shoulders and chest.
4. Both the coat zip and the hook and loop fastening should be secured all the way up to the throat and the collar strap fastened.

5. The assistant should take the weight of the breathing set whilst you put your arms through the straps.
6. The air cylinder valve should be open, but you should breathe outside air and not from the cylinder.
7. When fastening the face mask straps, begin with the two near your chin. Pull them at the same time to avoid the mask twisting on your face. Tighten the remaining straps in a similar manner.
8. Take two or three breaths from the cylinder to check air flow is OK and that the mask is well sealed.
9. Leave the cylinder valve open but return to breathing outside air until all team members are properly dressed and you are all ready to begin firefighting operations. Only then begin to breathe from the cylinder.
10. Lastly, put on your helmet and gloves.
11. A final check should be made by the assistant or teammates to check that no bare skin is left exposed including the face, neck, throat and wrists.
12. The mask's neck strap must go directly against the skin of your neck, not over the hood or coat collar.
13. After bringing your hood up over your head, the assistant must make sure that all the face mask straps are tucked away inside the hood.

First Response

The first response is the instant action made by any person or crew member at the initial scene of a fire. The very first action should be to inform the Bridge. When doing so, think of the following questions:

- Who are you?
- Where are you?
- What is on fire?
- Where is the fire?
- What are you going to do?

Fire Fighting Methods

Water is an excellent coolant and fire-extinguishing agent; it also applies to fires in electric cars. The fixed drencher system is an excellent tool, it is highly efficient at containing and reducing fire spread in the cargo space and exposes the crew to little or no risk. In most cases, the drencher suppresses a lithium-ion battery fire and prevents it from spreading to adjacent vehicles.

When firefighting, remember:

- Approach with a wide cone of water, alternate with the click setting as felt necessary and if possible at an angle of approximately 45 degrees measured from the centre line of the vehicle.
- Keep a safe distance because of the risk of jet flames.
- Water should arrive at the vehicle on fire for cooling or suppression, try to avoid straight jets. Water droplets have a better cooling capacity.
- If a lithium-ion battery is violently active, protect adjacent cars.
- Extinguish fires in adjacent cars to prevent further spread and after that, suppressed the primary car fire.

- Lastly, make attempt to cool or suppress the battery itself, if needed. Repeat as required.
- Continue cooling or change to a wider angle for protection during backward movement.

Manual Fire Fighting of Gas Vehicles

If a pressurized gas tank is located in the vehicle that is on fire or is close to it, it is highly valuable to cool the tank to prevent gas release or explosion. Normally it takes many minutes of flame exposure until a gas tank becomes a risk object, this means that there is time to establish water application. This may be done manually with hoses or with passive cooling devices.

Post Fire

One of the special characteristics of a lithium-ion battery is the risk of reignition after the fire has apparently been extinguished. There is a risk of reignition until all the energy in the battery has been depleted. Re-ignition could occur after a long time, several hours or even days. It is therefore important to monitor and cool an extinguished electric car fire until it is safely returned to port. This should be done even if there is no evidence of a fire in the battery.

10 Indexes

10.1 Index of Figures

Figure 1 Management structure & Exploitation task.....	10
--	----

10.2 Index of Tables

Table 1 List of LASH FIRE Project Deliverables	16
--	----

Table 2 Summarised potential exploitations.....	27
---	----