FIRE-RES

Innovative technologies & socio-ecological-economic solutions for fire resilient territories in Europe

D5.11 - IA 5.8 BRIEF: USING INNOVATIVE TOOLS FOR TRAINING SCHOOLS CERTIFICATE EW ICS TRAINING PROGRAMS

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Abstract:

The pilot course focused on advanced tools, practical skills and theoretical knowledge essential for managing extreme wildfire events and aimed to improve the skills and knowledge of Incident Commanders and Fire Analysts. The training included theoretical sessions, practical exercises and simulations involving the use of decision support tools. Feedback from participants provided insights for improvement, emphasising the importance of practical application of knowledge. The outcome outlines recommendations to ensure that future training programmes remain relevant, engaging and effective, ultimately improving the preparedness and effectiveness of Incident Commanders and Fire Analysts in protecting lives, property and natural resources during extreme wildfire events.

Key words: Extreme Wildfire Events, Training, Incident Commander, Fire Analyst

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1. INTRODUCTION

Extreme Wildfire Events (EWE) pose significant challenges to firefighting operations, requiring specialized skills and advanced decision-making capabilities. Incident Commanders (IC) and Fire Analysts (FA) play crucial roles in managing these complex situations, ensuring effective coordination, strategic planning, and the application of advanced tools and technologies. This deliverable aims to provide a comprehensive overview of the training, tools, and methodologies essential for enhancing the capabilities of IC and FA in the context of EWE.

The training program, developed within the framework of the FIRE-RES Project, focused on new tools and equipment for specialized fire analysis and incident command. It included a mix of theoretical sessions, practical exercises and simulations, covering a wide range of topics such as decision support tools, operational decision-making, information management, and the roles and responsibilities of IC and FA.

This deliverable will detail the course structure, content, and outcomes, providing insights into the effectiveness of the training and the feedback received from the participants. It will also highlight the key areas for improvement and propose recommendations for future training programs to ensure that IC and FA are well-prepared to handle the increasing frequency and intensity of EWE.

By enhancing the training and capabilities of IC and FA, we aim to improve the overall response to extreme wildfire events, ultimately contributing to better protection of lives, property, and natural resources.

2. AIM AND OBJECTIVES

This deliverable reports on the pilot course for Incident Commanders and Fire Analysts in Extreme Wildfire Events held from September 30th to October 4th, 2024, at the Escola Nacional de Bombeiros (ENB) Specialized Forest Fire Training Centre in Lousã, Portugal.

The primary objective of this pilot course was to evaluate the effectiveness of a training program designed to update IC and FA with the knowledge and skills necessary to effectively analyse and manage EWE situations. The course involved a combination of theoretical presentations, case studies, practical exercises, and virtual reality simulations, focusing on collaboration, decision making, and the use of various support tools relevant to EWE scenarios.

This report details the course programme, training materials, evaluation results and feedback from both trainers and trainees. The report also covers the use of advanced tools and technologies, such as decision support systems and virtual reality simulations, to provide practical, hands-on experience.

The objectives of this deliverable are:

- Provide a comprehensive record of the course, including its organization, content, and delivery.
- Assess the extent to which the course achieved its objectives in terms of knowledge transfer, skills development and participant satisfaction.
- Analyse the feedback from trainees and trainers to identify the strengths and weaknesses of the course.
- Propose specific recommendations for future iterations of the course to enhance its effectiveness and impact.
- Share insights and lessons learned from the pilot course to inform future training programs.

The information gathered will be used to refine the training program for future replications, ensuring its continued effectiveness in preparing IC and FA for the challenges posed by EWE.

3.PILOT COURSE

The pilot course for Incident Commanders and Fire Analysts, within the framework of FIRE-RES Task 5.4 - Tools and equipment to use in training for specialized analysis' teams and incident commanders focused on EWE, was organised by Escola Nacional de Bombeiros together with Catalan Fire and Rescue Service (CFRS), Tecnosylva (TSYLVA) and Autoridade Nacional de Emergência e Proteção Civil (ANEPC).

Figure 1. Participants of the Pilot Course. Source: ENB

3.1. Date, location and programme

The pilot course was held from September 30th to October 4th, 2024, at the facilities of the ENB Specialized Forest Fire Training Centre, located in Lousã, Portugal.

The training programme implemented in this course corresponds to the programme developed within the scope of FIRE-RES Project Deliverable D1.2 (Reis, *et al.*, 2024).

3.2. Trainees

The training programme requires a minimum of 8 and a maximum of 12 trainees, half of whom must be IC and the other half FA. Since the course aims to update IC and FA with the knowledge and skills necessary to effectively analyse and manage EWE, the trainees must be experienced in performing these roles and be certified, if this certification exists in their country.

The services and agencies invited to nominate trainees for the pilot course resulted from a consensus between the partners involved in Task 5.4. Each service/agency had to nominate a pair of trainees to play the role of IC and FA. The selection criteria for the trainees were defined by each participating organisation. After the selection, the list of trainees was sent to the course organisers.

The following partners of the FIRE-RES Project were invited to nominate trainees: CFRS, ANEPC, the Xunta de Galicia (XUNTA), the Södertörn Fire and Rescue Service (subcontractor of NIBIO) and Waldbrandteam (subcontractor of Wageningen University). All the partners nominated a pair of trainees to attend the course. However, XUNTA informed us a few days before the course that they would not be able to send the trainees to the course because they had been mobilized to assist with the fires in Bolivia. Due to the short notice, it was not possible to replace these two trainees.

In addition to those trainees, the partners decided that it would be important to involve one organisation that met the necessary requirements, but was not part of the project consortium, to obtain an evaluation of the course by people who were not as familiar with the work carried out in the project. Thus, the Tuscany Region (Italy) was invited to participate via the company D.R.E.Am. Italia, due to its extensive experience in forest fire fighting and training.

Table 1. List of trainees (unidentified)

Organisation	Trainee name	Role
ANEPC	Trainee 1	IC
	Trainee 2	FA
CFRS	Trainee 3	IC
	Trainee 4	FA
D.R.E.Am. Italia	Trainee 5	IC
	Trainee 6	FA
Södertörn FRS	Trainee 7	IC

	Trainee 8	FA
Waldbrandteam	Trainee 9	IC
	Trainee 10	FA

3.3. Trainers

The trainers involved in the course are part of the Project's partner organizations and are qualified as operational and wildfires trainers.

Despite the quality of the trainers, it was necessary to call in an expert in meteorology applied to forest fires. Hiring a researcher from the Netherlands Institute for Public Safety (NIPV), as a meteorologist and wildfire specialist, was essential to ensure the quality of the course content and to provide the participants with technical and scientific knowledge on the subject, but at the same time with a very practical view on the application of this knowledge in an operational context. The appointment of the trainer was agreed with the various partners involved.

Table 2. List of trainers (unidentified)

Organisation	Trainer name	Role
ENB	Trainer 1	Trainer
	Trainer 2	Trainer
	Trainer 3	Trainers' coordinator
ANEPC	Trainer 4	Trainer
	Trainer 5	Trainer
	Trainer 6	Trainer
CFRS	Trainer 7	Trainer
TSYLVA	Trainer 8	Trainer
NIPV	Trainer 9	Trainer (Invited expert)

3.4. Support staff

The preparation and delivery of the course involved support staff to arrange all logistical issues related to transfers, venue, accommodation and meals, to ensure the performance of roles during the exercises, and to ensure the design and delivery of virtual reality scenarios.

Table 3. List of support staff (unidentified)

Organisation	Participant name	Role
ENB	Participant 1	Support staff - VR operator
	Participant 2	Support staff
ANEPC	Participant 3	Support staff
CFRS	Participant 4	Support staff

3.5. Course schedule and facilities

The course workload comprises a total of 34 hours, distributed over a period of five days, according to the table in Annex 2.

On 29 September, a working session was held with the trainers and support staff involved in the course, to review the preparations, the course timetable and the tasks assigned to each person in the course organisation. On the same day, a working dinner was held, to break the ice and promote interaction between all participants.

The Specialised Training Centre in Forest Fires was established on March 1st, 2004 and is located at the Lousã Aerodrome. ENB provides all the specialised training in forest firefighting for firefighters and other agencies at this centre.

Figure 2. ENB Specialised Training Centre in Forest Fires. Source: ENB

3.6. Equipment and hardware

In the delivery of the training course, various equipment and hardware were utilized to support learning and enhance the overall training experience. TV screens and video projectors were employed to display presentations, visual aids and real-time demonstrations to the entire group. These displays were particularly effective in presenting complex data like maps, meteorological information and decision-support outputs, which facilitated group analysis and discussion.

This equipment was an integral part of the simulations, especially when displaying scenarios created using Virtual Reality (VR) software. The VR integration provided a powerful tool to illustrate EWE scenarios in detail, allowing trainees to analyse situations in real time. The use of large screens for VR scenarios and showing videos was particularly effective in promoting collaborative discussions, as it allowed all trainees to visualise, interpret and discuss situational dynamics as a group, enhancing the immersive and practical aspects of the training.

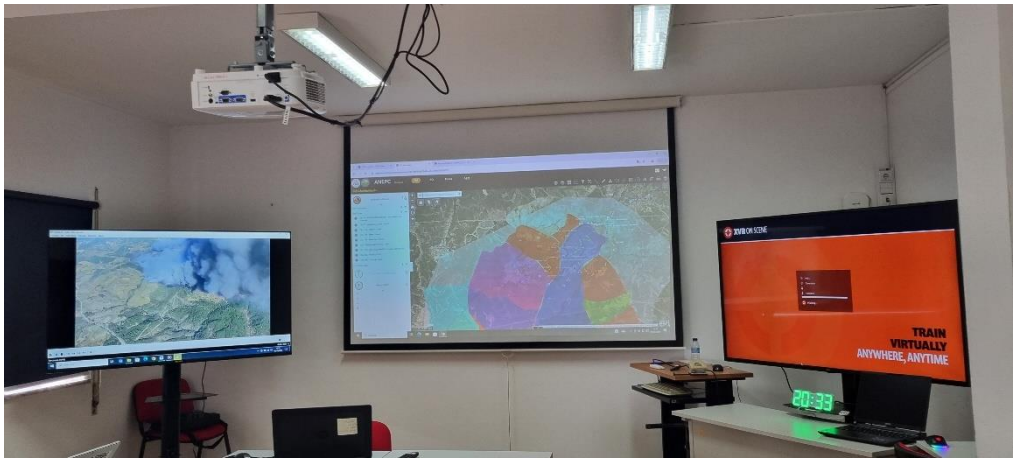

Figure 3. Training room equipped with projection system and televisions. Source: ENB

Trainees brought their own laptops, which allowed them to access digital training materials and specialized software relevant to their roles. This setup ensured participants could fully engage in exercises and simulations on familiar devices, facilitating a smooth learning experience.

Whiteboards were also used, providing a space for trainers to map exercises, illustrate key points and capture group insights during brainstorming sessions.

3.7. Tools and software

During the Incident Commanders and Fire Analysts training course, various tools and software applications were employed to enhance trainees' understanding of fire behaviour, decision-making processes and operational coordination in EWE. These tools provided participants with hands-on experience in analysing data, running simulations and making informed decisions, all of which are critical in real-world emergency scenarios.

One of the primary tools utilized was the fire behaviour simulator FireSim from Wildfire Analyst (WFA), which allowed trainees to model and predict fire progression under various conditions, using scenarios and exercises prepared by TSYLVA. This software enabled participants to visualize fire spread, considering variables such as fuel types, topography and weather. By simulating these dynamic conditions, trainees could observe how different factors interact and influence fire behaviour.

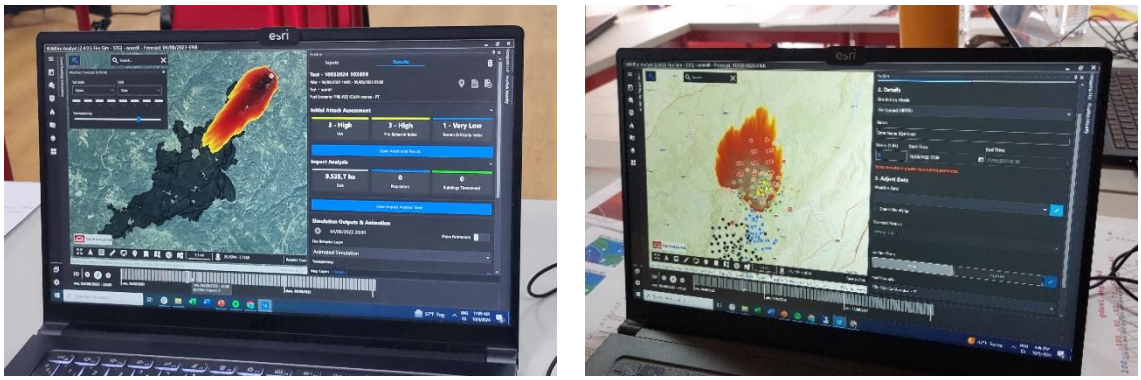

Figure 4. FireSim fire behaviour simulator. Source: ENB

3.7.1. FEB Monitorização

Another tool highlighted in the course was the FEB Monitorização software. This operational tool used by ANEPC, whose main objective is to support the analysis and operational management of wildfire events, allowed the trainees to integrate real-time information into their decision-making processes, reflecting the data-driven approach used in operational settings.

A key feature of FEB Monitorização is its ability to integrate data feeds from multiple sources into an intuitive, user-friendly interface. This includes satellite imagery, remote sensing data, and on-the-ground reports from field personnel. The software displays this information in real time, allowing users to view dynamic changes in fire conditions and monitor the proximity of fires to vulnerable areas, such as populated zones or critical infrastructure.

FEB Monitorização also has mapping and visualization tools that help incident commanders and fire analysts observe the progression of fires on detailed geographic maps. These tools provide a clear spatial overview, which is essential for planning containment strategies and allocating resources efficiently. By overlaying live data on topographical and vegetation maps, users can assess how various environmental factors are likely to impact the fire's behaviour and make informed tactical decisions accordingly.

Figure 5. FEB Monitorização APP. Source: ENB

3.7.2. Virtual Reality Software

A key component of the simulations involved the use of commercial virtual reality (VR) software, which presented the trainees with immersive and realistic scenarios, according to the software's capabilities for this type of event. By displaying VR-generated scenarios on large screens, trainees were able to view complex fire events in a virtual environment, allowing them to collaboratively analyse unfolding situations. VR simulations provided a realistic training context in which trainees could apply theoretical knowledge and make operational decisions.

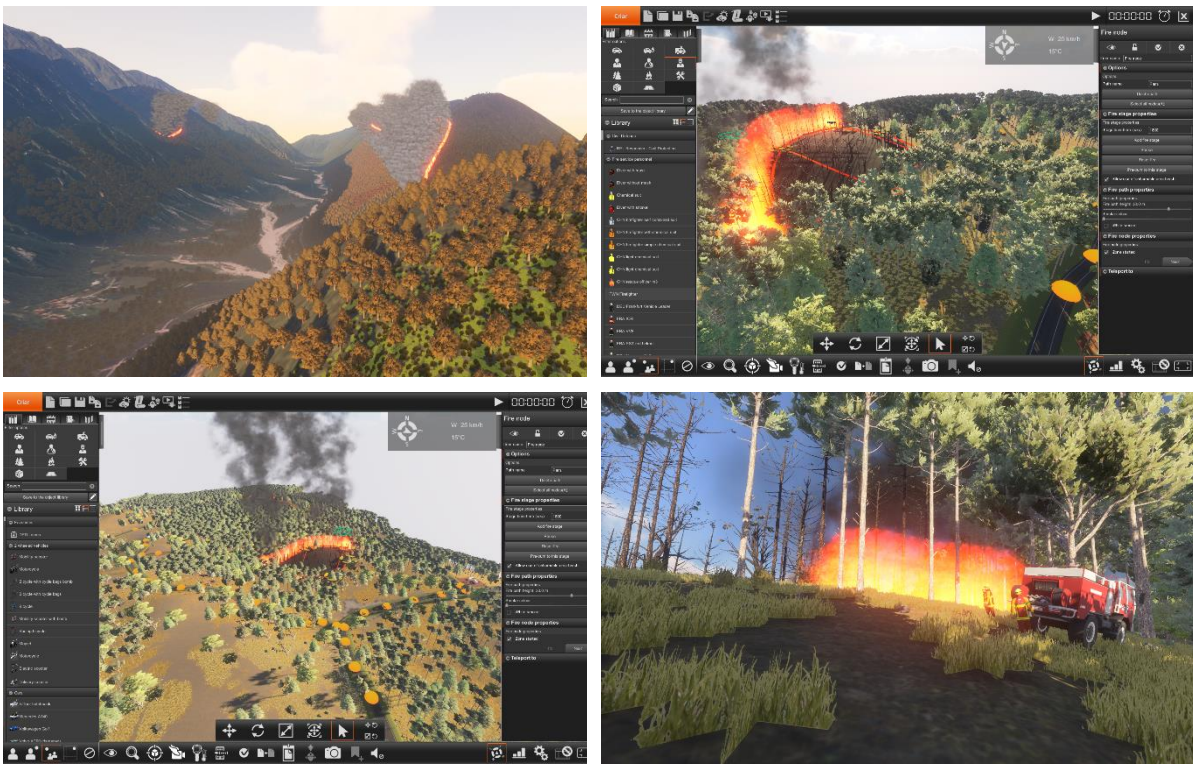

Figure 6. Virtual Reality Scenarios (XVR). Source: ENB

This technology added depth to the exercises, helping trainees to better understand spatial relationships and fire dynamics, ultimately reinforcing practical skills that are difficult to replicate in traditional classroom environments.

In addition to the VR scenarios, XVR software was used to create breaking news videos that simulated live media coverage of the fire. These videos served as a realistic component of the training simulations, providing trainees with the additional context and urgency they would often face in real-world incidents where media coverage impacts public perception and response dynamics. Breaking news videos were shown during the exercises to reflect the pressure and complexity of dealing with real-time information that can influence both internal decision making and external communication strategies.

Figure 7. Breaking news videos produced in virtual reality. Source: ENB

3.7.3. Videos and photos

Videos and photos were also used throughout the course to complement the theoretical content and improve understanding of key concepts. By showing real examples of fire events, these visuals provided context and clarity.

Figure 8. Video of one of the flanks of the fire. Source: ENB

Photos and videos were also effective in highlighting visual signs of fire behaviour, such as smoke plumes and fire spread patterns, which are essential in fire analysis.

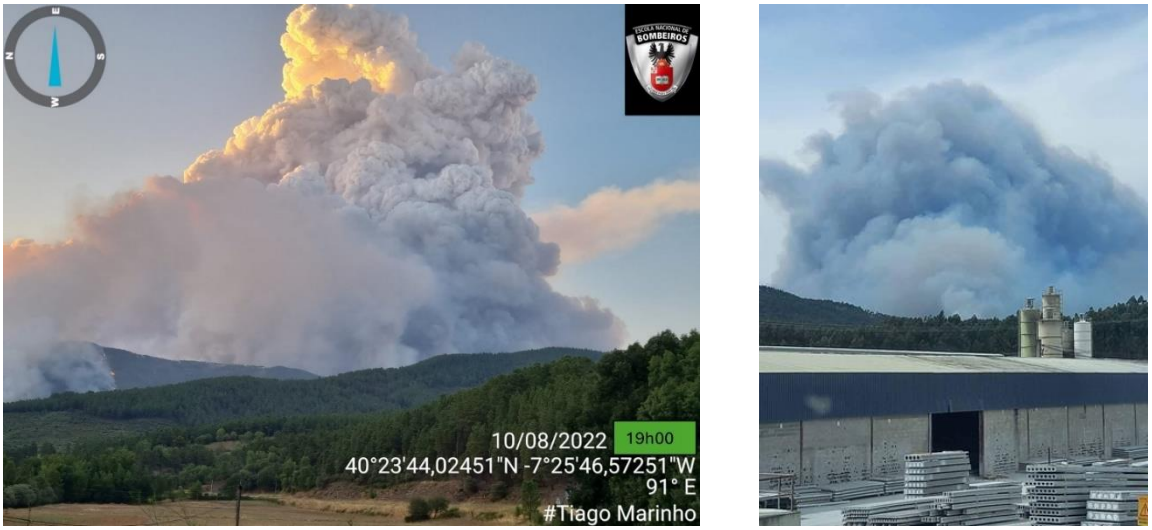

Figure 9. Photos of the fire's smoke column. Source: ENB

Collectively, the integration of these tools and software applications created a comprehensive, interactive training experience. The fire behaviour simulators, FEB Monitorização software, VR scenarios and multimedia content reinforced a data-driven approach to EWE management.

3.8. Course delivery

Day 1 – Welcome and Introductions

The opening session of the course was held by the President of ENB, who welcomed all the participants and expressed the hope that this pilot course would contribute to a more qualified response to fires with the potential for EWE.

Figure 10. Opening session of the course. Source: ENB

This was followed by a general presentation of the FIRE-RES project and the tasks for which ENB is responsible.

Figure 11. Presentation of the FIRE-RES Project. Source: ENB

Participants introduced themselves, mentioning their previous training and operational experience, as well as their expectations regarding the course. All trainers and support staff also introduced themselves. The objectives of the course and the expected outcomes were briefly summarised. Logistical details of the course were discussed.

Day 1 – Case Studies

Each team presented a case study with the aim of sharing experience and knowledge on the role of IC and FA in EWE, with a particular focus on coordination and decision making.

The country context was addressed in each presentation, in particular the Wildfire Management System, IC and FA Roles and Responsibilities and IC and FA Competencies. The teams presented the following case studies:

- Italy – Bozzano, 2022
- Spain – Santa Coloma de Queralt, 2021
- Portugal – Fundão, Silvares, 2024
- Sweden – Trängslet, 2018
- Germany - Brandenburg, 2022 & Harz Mountains, 2022/2024

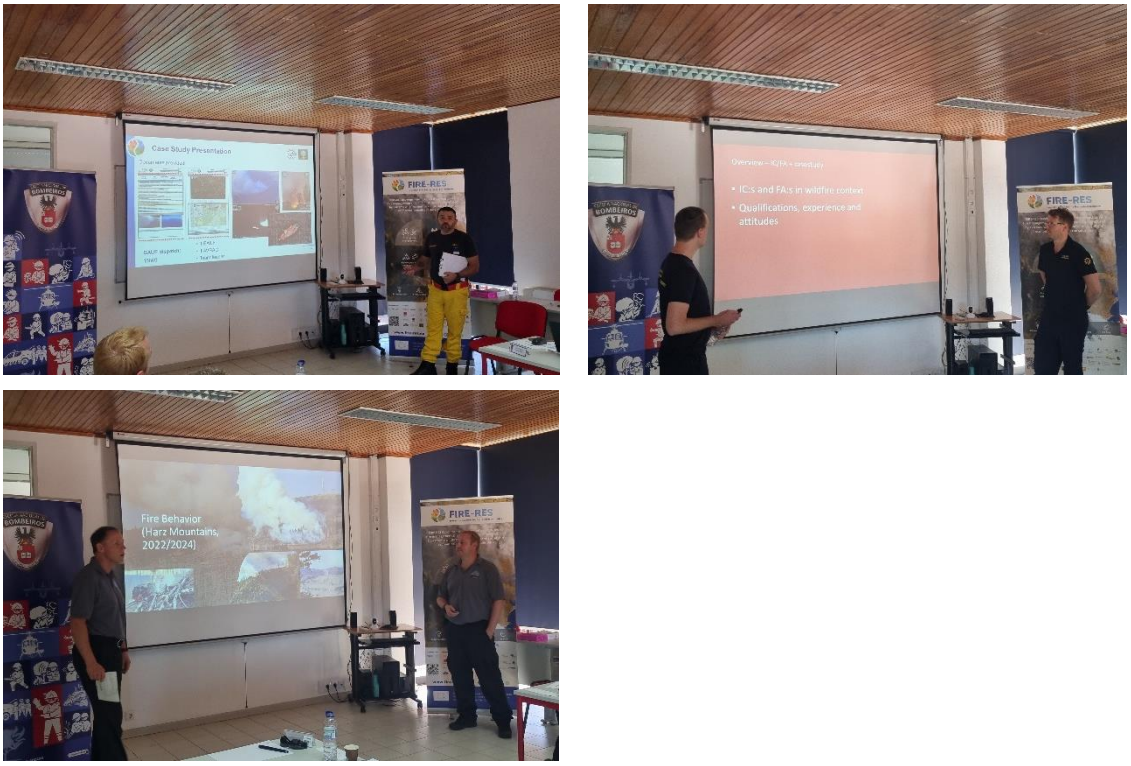

Figure 12. Presentation of Case Studies. Source: ENB

Trainees had the opportunity to ask questions after each presentation, to clarify doubts, obtain more information and share different experiences.

Day 1 – Collaboration between the IC&FA

With the aim of building a common understanding around the work of IC & FA, a group brainstorming activity was carried out, to identify things to do and avoid for each of the roles. After this work, each group presented the results of their work and there was room for discussion.

Figure 13. Brainstorming activity. Source: ENB

Day 2 – Updating the role of the Incident Commander

The lesson addressed the crucial responsibilities of the Incident Commander (IC) in incident management, specifically within the context of extreme wildfire events (EWE). Trainees identified key activities and tasks performed by the IC, including operations management, logistical support, planning, resource allocation, and ensuring the safety of personnel. The lesson emphasized the concept of coordination and its significance in collaborating with other agencies to enhance response efforts. Participants explored potential adversities and pressures in managing EWE, such as those from stakeholders, politicians, and the media, and discussed effective strategies for handling these challenges. Additionally, the lesson highlighted the importance of priority setting, illustrating how it relates to command and control, the development of a course of action, and resource allocation during incidents.

Figure 14. Presentation of the role of the IC. Source: ENB

Day 2 – Role of the Fire Analyst

The lesson focused on the critical role of the Fire Analyst (FA) in wildfire management by first engaging trainees in discussions about the necessity of having a FA, the specific challenges their organizations face, and their strategies for planning and addressing wildfire incidents. It covered the strategical reasoning process in wildfires, emphasizing how FA utilize their analytical skills to assess situations and support decision-making. Trainees identified the essential capacities and responsibilities of the FA in responding to wildfires, including their various positions within the Incident Command System (ICS). The lesson highlighted the importance of top-down safety in the fire analysis process and explored the unique challenges that FAs encounter, particularly in the context of extreme wildfire events (EWE). Finally, participants discussed the competencies and tools that FAs need to adapt to evolving EWE conditions, underlining the necessity for ongoing skill development to enhance operational effectiveness.

Figure 15. Presentation of the role of the FA. Source: ENB

Day 2 – Operational decision making & Information Management

The lesson centred on the critical role of information management in rural fires, particularly during extreme wildfire events (EWE). Participants identified the importance of collecting and managing information to enhance operational decision-making processes, discussing various types of data that need to be gathered for effective analysis. The lesson emphasized the steps involved in the information management process and the distinction between useful information and noise. Trainees learned about the transformation of data into information and ultimately into knowledge, as well as criteria for validating scenarios for short-term forecasts. The difference between primary and secondary sources of information was explained, with practical examples provided to illustrate this distinction. Additionally, the lesson covered the operational decision-making process, highlighting the fundamental aspects of time and uncertainty, their interrelationship, and the crucial steps involved in decision-making and subsequent action.

Figure 16. Presentation of ODM & IM. Source: ENB

Day 2 – Operations Management

The lesson focused on the structure and functioning of the Operational Command Post (OCP), outlining its missions and internal organization. Participants defined the OCP and explored the various cells within it, identifying their specific tasks and emphasizing the critical role of communication and internal procedures in ensuring effective operations.

The lesson also addressed the three action levels—strategic, tactical, and operational—defining each and associating specific tasks with them. Trainees learned about the interdependencies among these levels and the communication channels that facilitate coordination between them. Additionally, the organization of the Theatre of Operations was discussed, highlighting the significance of effective organization and the essential nature of command and control in managing operations efficiently.

Figure 17. Presentation of Operations Management. Source: ENB

Day 3 – Decision support tools – Meteo

The lesson provided an in-depth exploration of Meteorology in relation to wildfires, focusing on the reciprocal effects between the two, based on FIRE-RES Project Deliverable D1.4 (Castellnou, *et al.*, 2024). It began with an introduction to the impact of wildfires on Meteo and vice versa, emphasizing the importance of basic principles and the inherent uncertainty in these interactions. Trainees learned to forecast the possibility of EWEs by understanding boundary layer processes, interpreting Skew-T diagrams, and utilizing basic meteorological indices like CAPE, CIN, and the Haines index. The lesson also covered the integration of meteorological conditions with expected fire behaviour and introduced EWE prototypes. Participants were also taught how to read initial signs for EWE chances, make detailed forecasts, use satellite data for nowcasting EWE occurrences, and access various open-source meteorological websites to build their forecasts while managing uncertainty.

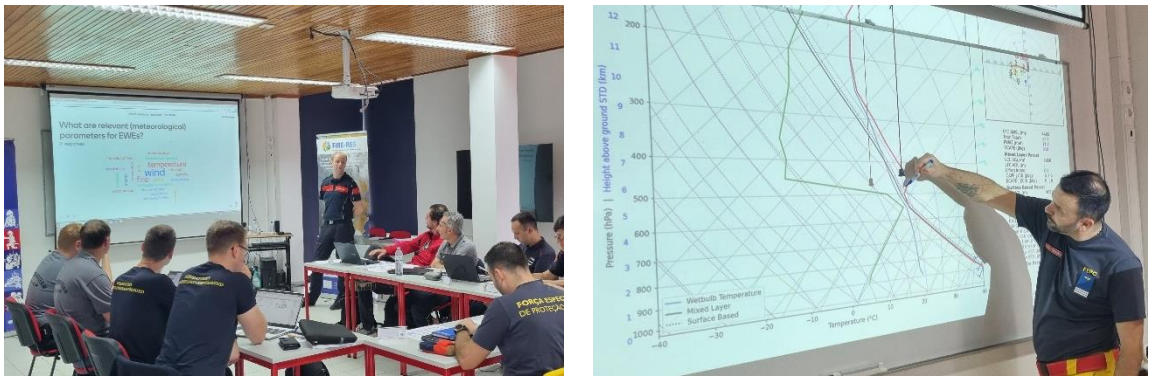

Figure 18. Presentation of Meteorology. Source: ENB

Day 3 – Decision support tools – Polygons

The lesson focused on the methodology surrounding fire potential polygons and their application in decision-making related to EWE. Participants were introduced to the fire potential polygons methodology, which involves assessing and mapping areas based on fire behaviour, or specifically their susceptibility to spread and the fire management opportunities, as it is compiled in FIRE-RES Project Deliverable D1.3 (Arilla, *et al.*, 2023). To reinforce this knowledge, the lesson included practical exercises aimed at adapting the fire potential polygons methodology to enhance decision-making. The session concluded with a joint discussion, allowing trainees to share insights and reflections on the exercises, fostering collaborative learning and deeper understanding of the methodology's practical implications.

Figure 19. Presentation of Polygons. Source: ENB

Day 3 – Decision support tools – FEB Monitorização

The lesson focused on the FEB Monitorização platform, introducing its key features and objectives aimed at enhancing operational efficiency. It began with a general presentation of the platform, followed by a detailed explanation of how it operates and interacts with various entities concerning data sharing and communication. The trainees were introduced to the types of geographic data available on the platform, emphasizing their operational significance in real-time decision-making. A practical demonstration showcased the editing and geoprocessing tools available for data analysis and management, highlighting their relevance in the field.

Additionally, the functionalities of mobile applications, such as QuickCapture and Field Maps, were explained, illustrating how they facilitate data collection and monitoring in real-world scenarios. The lesson concluded with an application exercise that allowed trainees to apply their newfound knowledge in a practical context.

Figure 20. Presentation of FEB Monitorização. Source: ENB

Day 3 – Decision support tools – Simulators

The lesson provided a comprehensive overview of the role of fire behavior simulators in operational environments. It began by discussing how fire simulations are utilized by fire agencies, such as CAL FIRE, for various purposes, including enhancing situational awareness, informing prepositioning strategies, guiding initial fire response, and supporting extended attack operations. The lesson then introduced various fire modeling outputs and discussed the Initial and Extended Attack Assessment Indexes, which serve as critical tools for decision-making in fire management. Trainees analyzed the interplay between weather conditions and EWE, delving into convective processes that influence fire behavior. Finally, the lesson covered the adjustment and calibration of fire simulations to ensure their effectiveness in real operational environments, providing trainees with the skills necessary to apply these simulations in their respective roles.

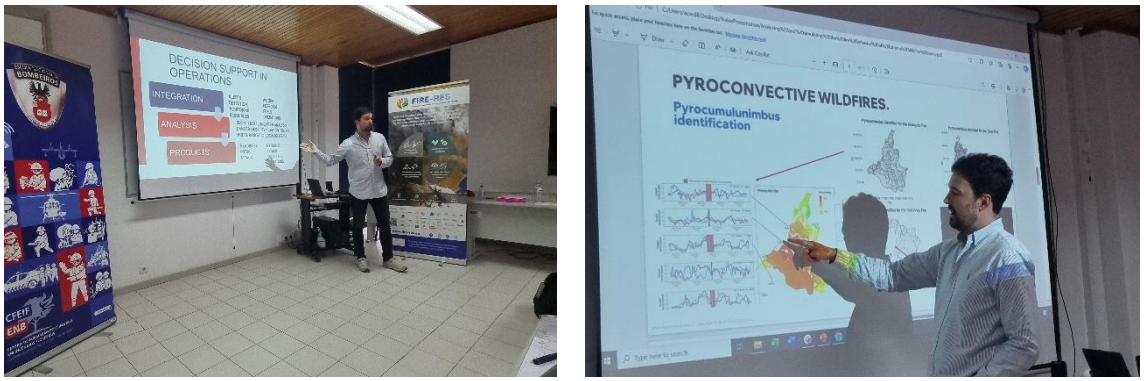

Figure 21. Presentation of Simulators. Source: ENB

Day 4 – Forest Fire Scenario Simulation 1

All the exercises were conducted according to the exercise guides produced in Deliverable 1.2 - New training to develop skills and capabilities for Incident Commanders and Fire Analyst to new EWE management challenges (Reis, *et al.*, 2024), of the FIRE-RES Project.

The first simulation exercise was based on the fire that occurred on August 4th, 2023, with the beginning in the municipality of Proença-a-Nova, district of Castelo Branco, in the

Center of Portugal. The exercise began with an initial IC briefing, conducted by a trainer, providing the trainees who will be taking on the IC role with the relevant information.

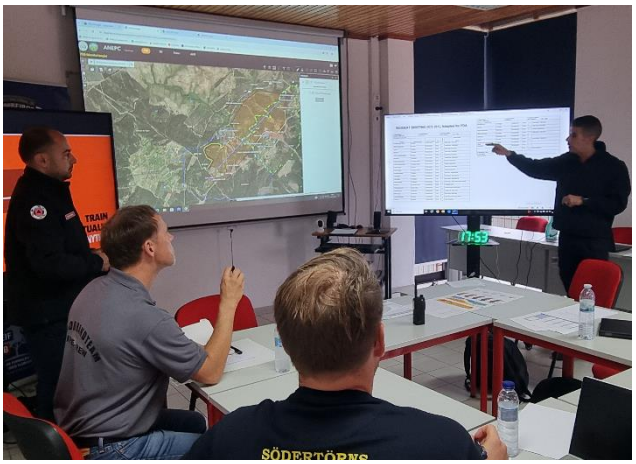

Figure 22. Exercise 1 - Initial briefing from the IC. Source: ENB

The exercise continued with the FA arriving at the Operational Command Post (OCP) and receiving a briefing from the IC. This initial briefing covered critical aspects such as the current status of the fire, operational strategies, allocated resources and evacuation plans. The IC then outlined the FA's responsibilities for the upcoming operational period, which included analysing fire behaviour, proposing emergency scenarios and advising on firefighting options and strategies.

Over a 60-minute period, the FA was expected to conduct a thorough analysis using various data inputs such as weather forecasts, fire behaviour models and real-time observations. The aim of this analysis was to identify firefighting opportunities and prioritise actions. The trainer facilitated this collaboration by providing key inputs, including images of smoke plumes and fire behaviour, weather forecasts and simulations from the National Command.

As the exercise progressed, new variables were introduced to simulate changing conditions that could affect decision making. The FA used tools such as potential polygons to assess areas of homogeneous fire behaviour and firefighting opportunities. After updating the IC with new findings and priorities based on these changes, the IC drafted the first Incident Action Plan (IAP) and organised a briefing with sector commanders.

Towards the end of the exercise, the IC made operational decisions based on the FA's analysis and produced a tactical plan that outlined objectives, priorities and timelines. Finally, each team presented their scenarios and action plans to the class, highlighting the operational situation, action objectives and potential evacuation needs, thus concluding the exercise.

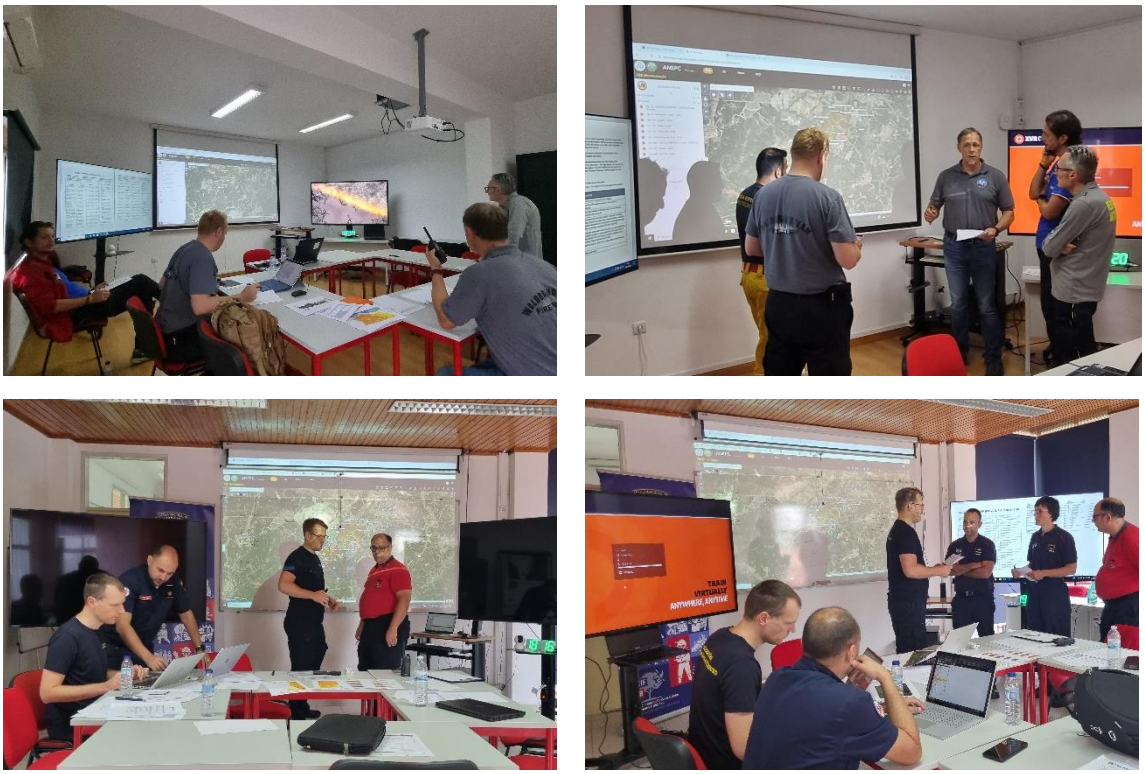

Figure 23. Simulation exercise 1. Source: ENB

At the end of the exercise, a debriefing was held with both trainees and trainers participating in the discussion. Participants identified positive aspects of the exercise, highlighting successful strategies, teamwork and effective communication demonstrated during the simulation. The evaluation also focused on areas for improvement and potential changes that could improve future exercises.

Figure 24. Exercise 1 debriefing. Source: ENB

Day 4 – Forest Fire Scenario Simulation 2

The second simulation exercise was based on the fire that occurred on August 6th, 2022, with the beginning in the municipality of Covilhã in Serra da Estrela, district of Castelo Branco, in the Center of Portugal, and which progressed to the municipalities of Manteigas, Belmonte, Guarda, Celorico da Beira and Gouveia.

Figure 25. Simulation exercise 2. Source: ENB

Day 5 – Forest Fire Scenario Simulation 3

The third simulation exercise was based on the fire that occurred on July 17th, 2022, with the beginning in the municipality of Murça, district of Vila Real, in the North of Portugal, and which progressed to the municipalities of Valpaços and Vila Pouca de Aguiar.

Figure 26. Simulation exercise 3. Source: ENB

Day 5 – Course evaluation and closure

The closure session focused on evaluating the relevance and effectiveness of the training course, emphasizing the key takeaways and lessons learned throughout the sessions. It facilitated discussions on the importance of the course content and its potential applications within the trainees' professional contexts, encouraging them to reflect on how the knowledge and skills gained could enhance their performance in real-world situations.

Additionally, trainees were asked to provide feedback on various aspects of the course by completing questionnaires, including programme, content, pedagogical methods, tools used, organisation and overall effectiveness.

Figure 27. Course evaluation and closure. Source: ENB

3.9. Trainees' performance assessment

The assessment of the trainees was conducted through two comprehensive observation grids: the Incident Commander Assessment Sheet and the Fire Analyst Assessment Sheet. These tools were designed to evaluate the performance and competencies of each trainee in their respective roles during the incident management simulation. The grids

provided structured criteria, enabling evaluators to observe specific skills, decision-making processes, and teamwork dynamics effectively.

The Incident Commander Assessment Sheet is a structured evaluation tool designed to assess the performance of Incident Commanders during wildfire incident management, based on reference literature (FEMA, 2017; FEMA, 2018). It focuses on key competencies in information gathering, objectives and action planning, communication, command and control, and evaluation and review.

The Fire Analyst Assessment Sheet is focused on key competencies related to meteorology, fire positioning, fire behaviour, fire spread patterns, tactical planning, and scenario awareness, based on AFAN (2021). This tool assesses the FA ability to interpret meteorological data, analyse fire dynamics, and contribute to the decision-making process in wildfire incidents.

At the end of both grids is the Incident Command and Fire Analyst Assessment Sheet, which assesses the collaboration and effectiveness of both roles in managing a wildfire incident. This assessment emphasises the importance of cooperation, shared understanding, situation monitoring and effective communication between the IC and FA.

Overall, the dual assessment approach allowed for a holistic evaluation of the trainees, highlighting their strengths and areas for improvement. Feedback gathered from these observations will serve as a vital resource for enhancing future training programs, ensuring that both IC and FA are well-equipped to handle real-world challenges in wildfire management and emergency response. This structured assessment process ultimately aims to foster greater proficiency and readiness among the trainees in their respective roles.

All trainees successfully passed the assessment, demonstrating proficiency in the competencies required for their specific roles as IC and FA within the training course. Using role-specific observation grids, the Incident Commander Assessment Sheet and Fire Analyst Assessment Sheet, evaluators observed each trainee's ability to apply course concepts in the simulation exercises.

Incident Commanders showed strong abilities in gathering and processing critical information about fire conditions, resource availability, and safety considerations. Each IC effectively established clear, actionable objectives and created incident action plans that aligned with priorities and minimized risk exposure. Communication skills were well demonstrated, as trainees conveyed updates and changes in the action plan with clarity and ensured that all involved teams remained informed. Additionally, the IC excelled in command and control by strategically positioning resources, maintaining operational oversight, and regularly evaluating the effectiveness of ongoing actions against their objectives.

Fire Analysts demonstrated competence in analysing meteorological data and using it to predict potential changes in fire behaviour. They accurately mapped fire perimeters, created fire potential polygons, and identified areas of significant risk based on fire spread patterns and atmospheric influences. The FA effectively supported decision-making by providing Incident Commanders with timely insights and recommendations, leveraging real-time data to anticipate critical shifts in fire behaviour. They showed proficiency in tactical planning, identifying and adapting tactical objectives in response to evolving fire scenarios, and collaborating closely with the IC to ensure a unified understanding of situational priorities.

The assessment outcomes indicate that trainees are well-prepared to perform their roles in managing wildfires, having demonstrated a strong understanding of operational coordination, analytical skills and decision-making under pressure. This successful assessment reflects the high level of engagement and commitment shown by the trainees throughout the course, ensuring their readiness to handle the complexities and challenges presented by EWE scenarios in a real-world setting.

3.10. Course evaluation

The evaluation of the course by the trainees was carried out through the application of two questionnaires in the final part of the course:

- Post training questionnaire.
- Satisfaction evaluation sheet.

The results of the two questionnaires are presented below.

3.10.1. Course programme

Regarding the objectives of the course, 75% of the trainees classified them as “clear” and “very clear”. Only 25% of trainees classified the objectives as “confusing”.

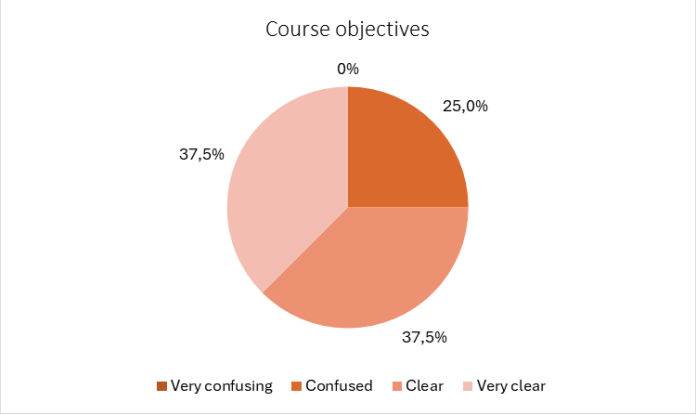

Figure 28. Evaluation of the course objectives

As for the course content, all trainees considered it “adequate”.

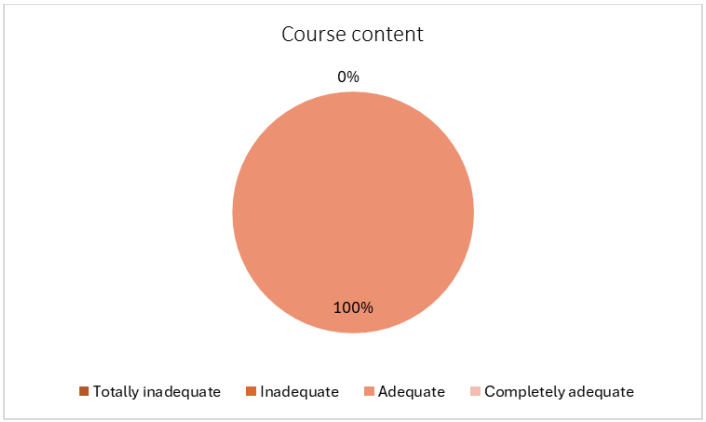

Figure 29. Evaluation of the course content

Regarding the activities, exercises and work carried out during the course, 75% of course participants considered them “sufficient” and 25% classified them as “insufficient”.

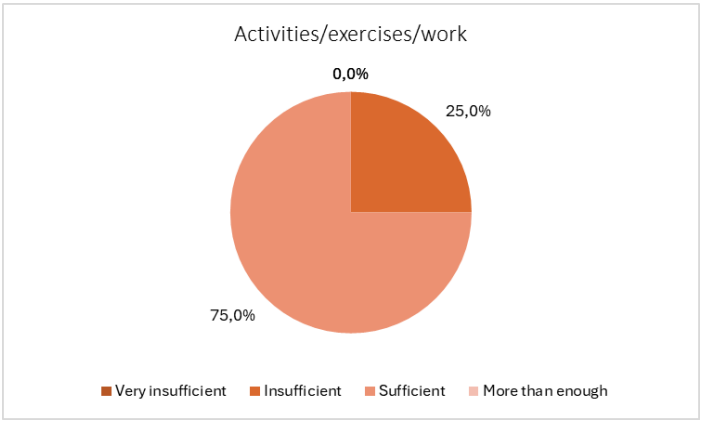

Figure 30. Evaluation of the course activities/exercises/work

Overall, while the course objectives and content were well received, the activities and exercises need to be improved to better meet participants’ expectations.

3.10.2. Course evaluation

The vast majority of trainees (63%) reported that the course “fully matched” their expectations. A further 25% of graduates reported that the course “matched” their expectations, while 12% of trainees rated the course as “not matched”, suggesting that there were some areas where the course fell short of their expectations.

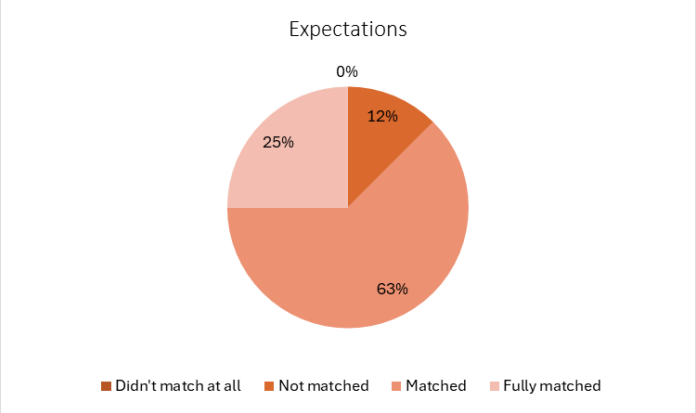

Figure 31. Evaluation of the trainees' expectations

Regarding trainee satisfaction, 75% of trainees were "satisfied" with the course and 25% were "very satisfied", suggesting a high level of satisfaction with the content and delivery of the course.

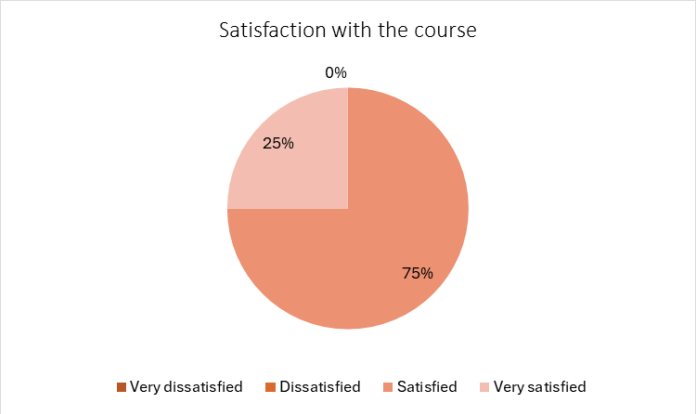

Figure 32. Evaluation of the trainees' satisfaction

Most trainees (75%) were highly motivated, while 25% of trainees had substantial motivation. No trainee expressed low motivation, demonstrating a generally enthusiastic response to the training course.

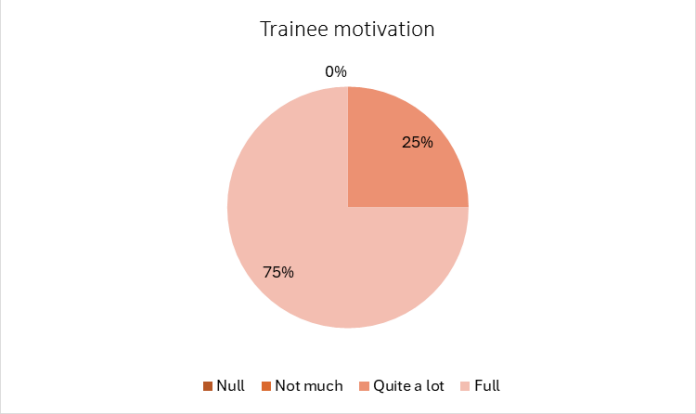

Figure 33. Evaluation of the trainees' motivation

Regarding the applicability of the training, 50% of the trainees rated it as "applicable" and the remaining 50% as "totally applicable".

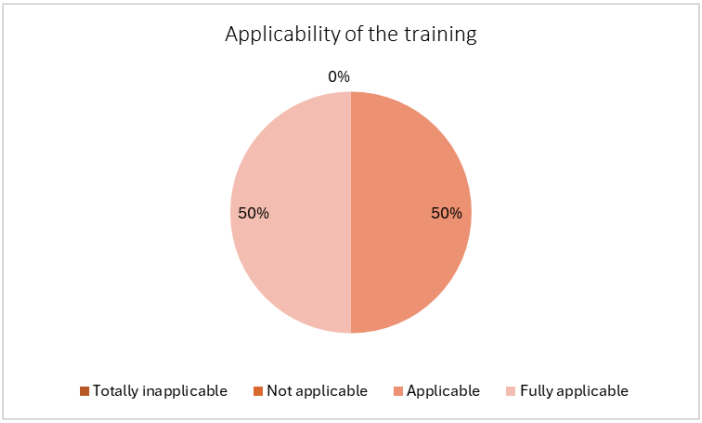

Figure 34. Evaluation of the applicability of the training

Most trainees (56%) rated the topics as “highly relevant”, indicating a very positive perception of the relevance of the course content to their needs and role. A further 33% of trainees rated the topics as “very relevant” and only 11% rated the topics as “moderately relevant”. None of the trainees considered the topics to be “slightly relevant” or "irrelevant".

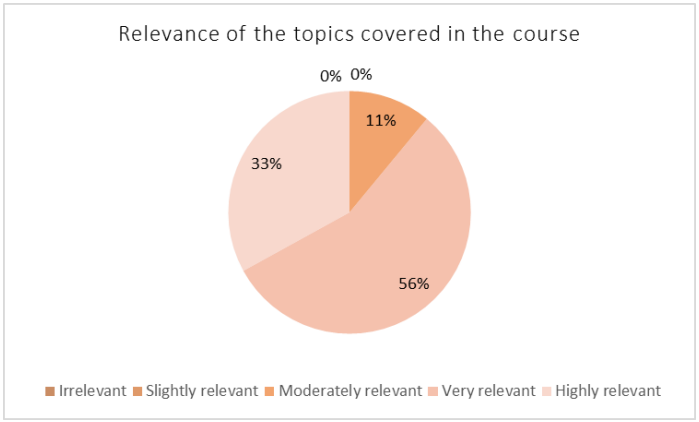

Figure 35. Relevance of the topics

In terms of the usefulness of the topics, most trainees (55%) rated the topics as “very useful” and “extremely useful”, indicating a positive perception of the practical value of the course content. A smaller percentage (34%) of trainees rated the topics as “moderately useful”, while only 11% rated the topics as “slightly useful”, suggesting that the content was of some value but may not have addressed their specific needs or learning objectives.

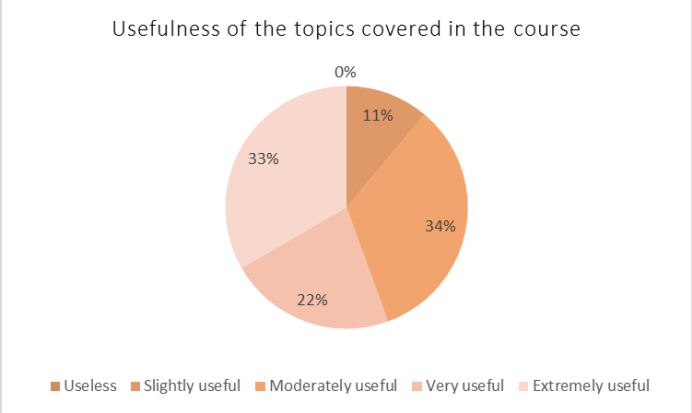

Figure 36. Usefulness of the topics

The evaluation results indicate that the training course was generally successful in meeting participants' expectations and engaging the trainees. Most trainees found the course relevant and useful and were highly satisfied with their overall experience. However, a small percentage of participants felt that their expectations were not fully met, highlighting the need for continuous improvement to ensure that all trainees benefit from the course.

When the trainees were asked about the topics that should be further developed, the vast majority indicated the topic “Decision Support Tools – Polygons” (89%). Trainees found it either challenging or insufficiently covered, indicating a need for more comprehensive content on this tool.

Both “Operational Decision Making & Information Management” and “Decision Support Tools – Meteo” have a significant need for further development according to 67% of the trainees. This suggests that trainees value tools and strategies that support decision making, particularly those that involve information management and meteorological factors.

More than half (56%) of the trainees rated the topic “Collaboration between the IC and FA” as needing development, indicating that the collaborative dynamics between the Incident Commander (IC) and Fire Analyst (FA) could be better integrated or clarified in the course.

The moderate ratings given to “Role of the FA”, “Operations Management” and “Role of the IC” suggest a need for more in-depth coverage of these topics, but not as important as the other topics already mentioned.

The low percentages for “Case Studies” and “Decision Support Tools – Simulators” indicate that trainees consider these elements to be sufficiently covered or less critical.

Only the topic "FEB Monitorização" does not have any requests for further development in future editions of the course.

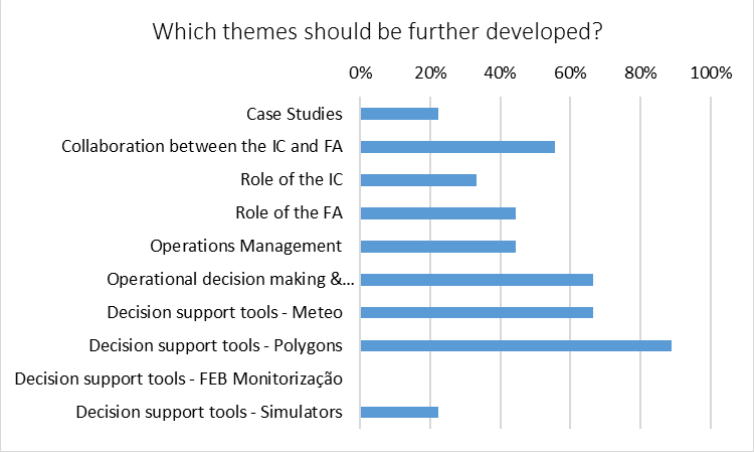

Figure 37. Themes to be further developed

The trainees' responses to the question "Which themes can be less developed?" provide an insight into the areas of the training course they felt could be simplified or reduced. The themes “Operations Management” and “Decision Support Tools - FEB Monitorização” received the highest ratings for potential reduction, at 44% each. This suggests that these topics may have been seen as too detailed or less relevant compared to other subjects that addressed more critical competences. The theme “Role of the IC” was also rated for reduction by 33% of participants. This may indicate that many trainees, particularly those with previous experience, felt that the coverage of the role of the IC was too extensive and could be condensed.

With a moderate percentage, “Case Studies”, “Role of the FA” and “Operational Decision Making & Information Management” were rated as needing to be reduced by 22% of trainees. This may indicate that the topics were considered important but could be shortened to allow more time for practical applications. A minimum percentage of trainees (11%) marked the topic “Decision Support Tools – simulators” for reduction. Themes that were not marked for less development such as “Collaboration between IC and FA”, “Decision Support Tools – Meteo” and “Decision Support Tools – Polygons” highlight their perceived value to trainees.

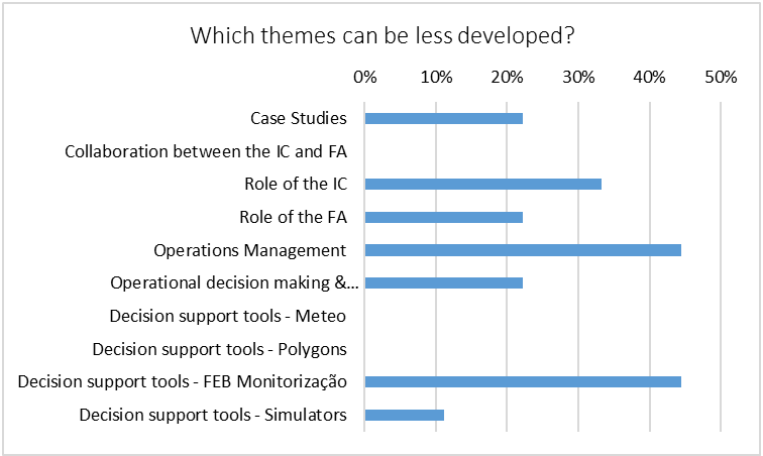

Figure 38. Themes to be less developed

When questioned about the need for additional course themes, 56% of trainees responded negatively.

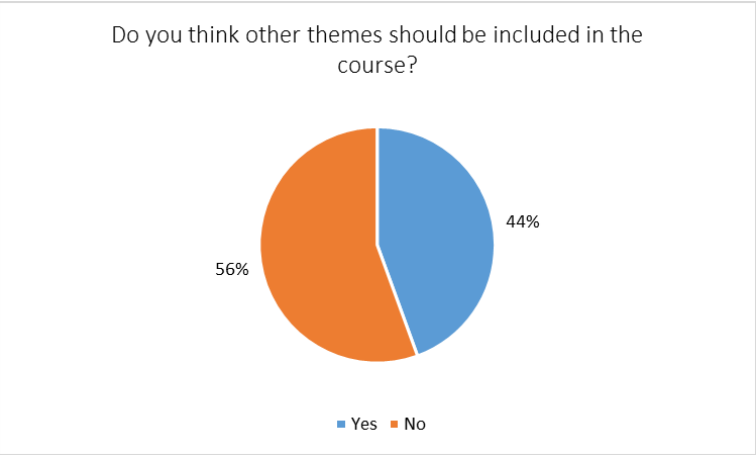

Figure 39. Other themes to be included in the course

Of those who responded affirmatively, the suggestions for other topics to be included in the course were as follows: leadership, communication, decision making in operational rooms, and relationship between firefighting tactics and insights provided by FA.

3.10.3. Relevance of the lessons

Based on the ratings provided by trainees, the analysis of the perceived relevance of each lesson in the training course highlights several key insights into which topics were considered most impactful, and which might benefit from adjustment in future editions.

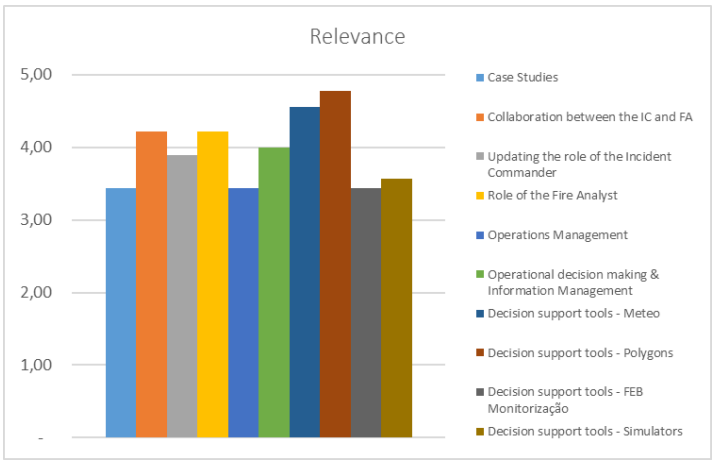

Figure 40. Evaluation of the relevance of the lessons

Trainees rated "Decision Support Tools – Polygons" and "Decision Support Tools –Meteo" as the most relevant topics, highlighting their value for practical application in managing EWE. Additionally, lessons on "Collaboration between the IC and FA" and the "Role of the FA" were rated as highly relevant, emphasising the importance of coordination and specific role functions within EWE scenarios. These high ratings suggest that trainees

found direct, practical tools and collaborative strategies particularly valuable to their training.

The lessons "Operational Decision Making & Information Management" and "Updating the Role of the Incident Commander" received average scores, indicating that while important, they may not be as impactful as other topics. Meanwhile, "Case Studies", "Operations Management", and "Decision Support Tools - FEB Monitorização" were rated as the least relevant, suggesting these areas could be refined to better align with trainees' practical needs.

The "Decision Support Tools – Simulators" lesson received a slightly higher rate than the previously mentioned lessons, suggesting that simulators may benefit from a more engaging or practical approach to increase the perceived relevance to trainees.

3.10.4. Utility of the lessons

The ratings provided by the trainees for the utility of each lesson in the training course revealed that the highest rated topics were "Decision Support Tools – Polygons", "Decision Support Tools – Meteo", and "Operational Decision Making & Information Management". These ratings indicate that trainees found these lessons particularly useful, likely due to their direct relevance and practical application in real-world scenarios. Polygons and Meteo tools seem to stand out as critical resources, probably because they provide technical, data-driven insights that enhance situational awareness and response strategies.

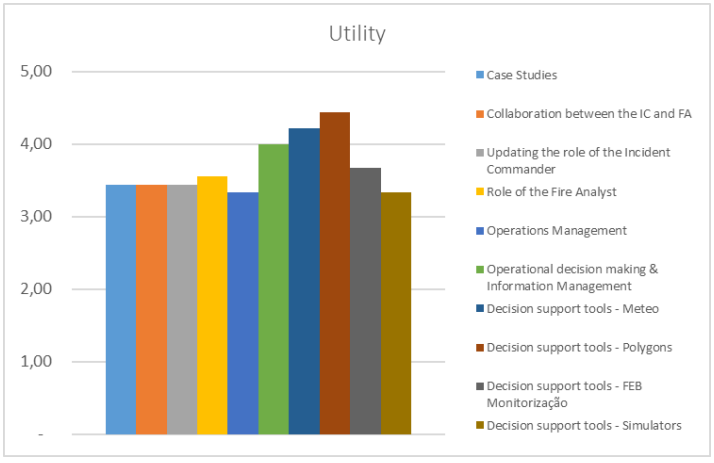

Figure 41. Evaluation of the utility of the lessons

On the other hand, lessons such as "Decision Support Tools – FEB Monitorização", "Role of the FA", "Case Studies", "Collaboration between the IC and FA", and "Updating the Role of the Incident Commander" received moderate scores, implying that while these areas were appreciated, they may not have fully addressed trainees' needs for immediate utility.

In addition, "Operations Management", and "Decision Support Tools – Simulators" received lower utility ratings, suggesting that trainees may have perceived these sessions as less directly applicable to their roles.

3.10.5. Duration of the lessons

Regarding the evaluation of lesson duration in the training course, "Decision Support Tools - FEB Monitorização", "Decision Support Tools – Meteo", and "Decision Support Tools – Polygons" were highly rated, indicating strong interest in these practical, tool-oriented sessions.

Lessons with slightly lower ratings, such as "Case Studies", "Collaboration between the IC and FA", and "Role of the FA", imply that trainees may have felt these lessons could be condensed. "Updating the Role of the Incident Commander" received the lowest score, suggesting that participants thought less time should be allocated to this topic. On the other hand, "Operational Decision Making & Information Management" was rated highly, indicating that its content was valuable and worth the time spent. "Operations Management" and "Decision Support Tools – Simulators" also received moderate scores, indicating they were seen as adequately timed but perhaps could benefit from minor adjustments.

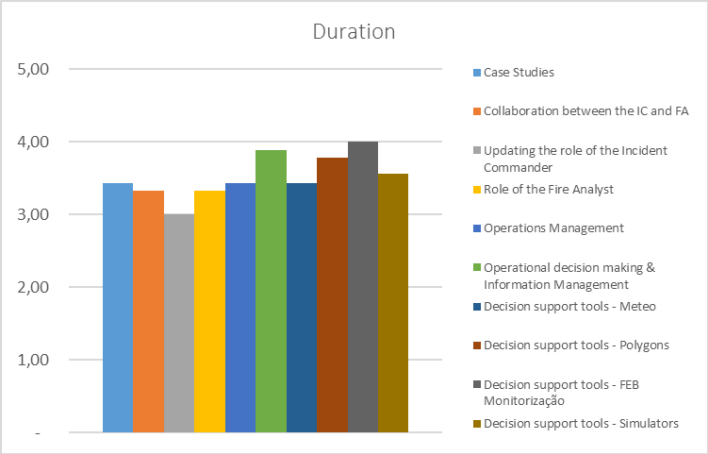

Figure 42. Evaluation of the duration of the lessons

3.10.6. Pedagogical Methods

Trainees considered the pedagogical methods used in the "Decision Support Tools" sessions, particularly Meteo, to be the most effective, meaning that lessons involving brainstorming and exercises are highly valued. "Case Studies" and "Operational decision-making & Information Management" were also found to be effective, showing that practical, scenario-based learning has great value to trainees. Lower scores for the "Collaboration between IC and FA" session suggest that adjustments must be made to involve trainees more effectively in the activities.

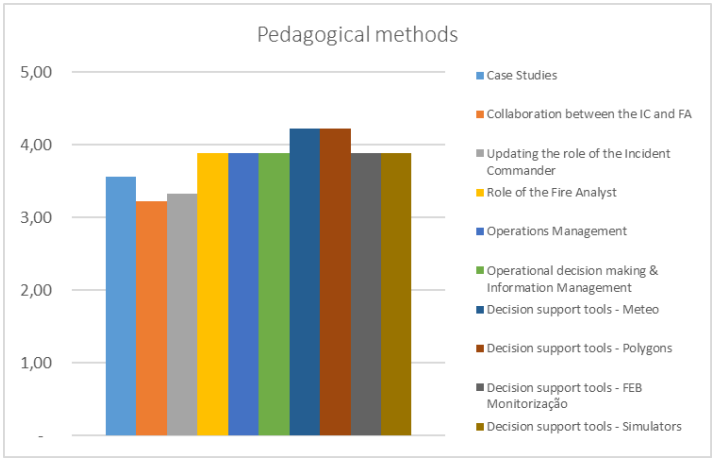

Figure 43. Evaluation of the pedagogical methods used in the lessons

All pedagogical methods were rated above 3.0, indicating that none of the sessions were poorly received, but some methods clearly stood out in terms of effectiveness.

These perceptions suggest a preference among trainees for practical, hands-on tools and scenario-based learning over purely expositive teaching methods.

Overall, the ratings highlight a strong preference among trainees for technical, tool-based learning and immediate operational applications, indicating that future iterations of the course might benefit from increased emphasis on practical exercises.

3.10.7. Organisation of the course

A significant majority of the trainees (75%) were satisfied with the facilities where the course took place, classifying them as “good” or “excellent”. The remaining 25% of trainees rated them as “reasonable”.

Figure 44. Evaluation of the course facilities

Most trainees (75%) rated administrative support as “effective” and “very effective”, indicating a generally positive perception of administrative support. Only 25 % of trainees rated the support as “not very effective”.

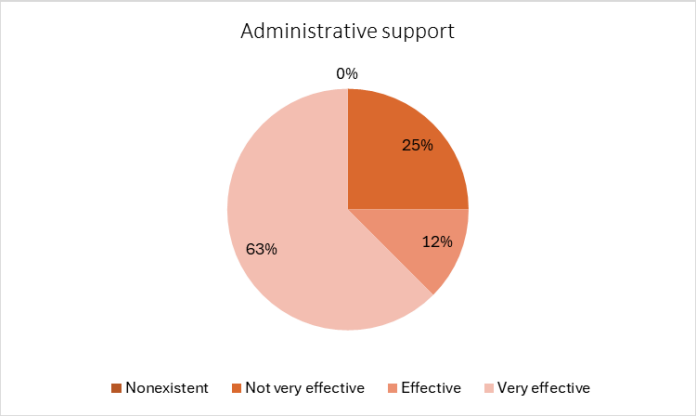

Figure 45. Evaluation of the course administrative support

Half of the trainees (50%) rated the teaching materials as “adequate” and 38% of the trainees rated the teaching materials as “completely adequate”. Only 12% of the trainees considered the teaching materials to be “inadequate” (12%).

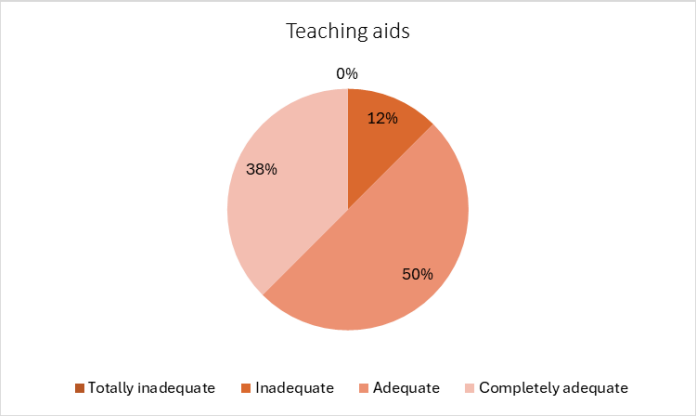

Figure 46. Evaluation of the course teaching aids

Documentation was rated as "adequate" and "fully adequate" by a significant majority of trainees (75%). The documentation was rated as "inadequate" by 25% of trainees, which suggests there may be room for improvement.

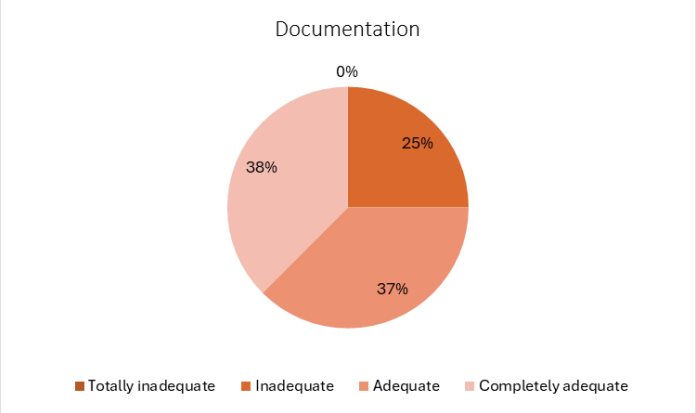

Figure 47. Evaluation of the course documentation

The majority of trainees (62%) found the course equipment and materials provided in the course to be "adequate", and a significant portion (38%) even considered them "completely adequate".

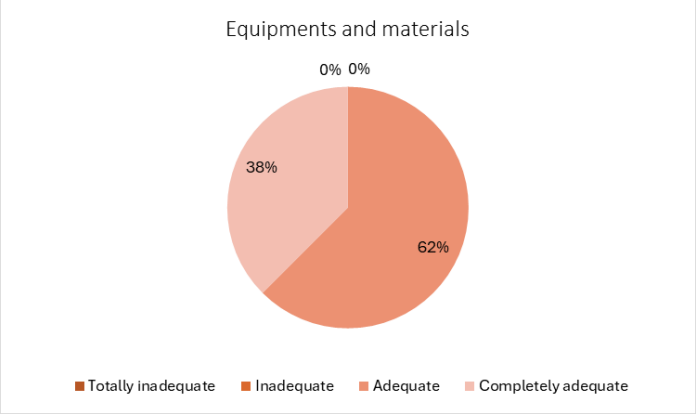

Figure 48. Evaluation of the course equipment and materials

A large majority of trainees (75%) rated the coordination of the course as "adequate" or "completely adequate", suggesting a high level of satisfaction with the way the course was organised and managed. However, 25% of trainees rated the coordination as "inadequate", suggesting that certain areas could be improved to meet the expectations of all trainees.

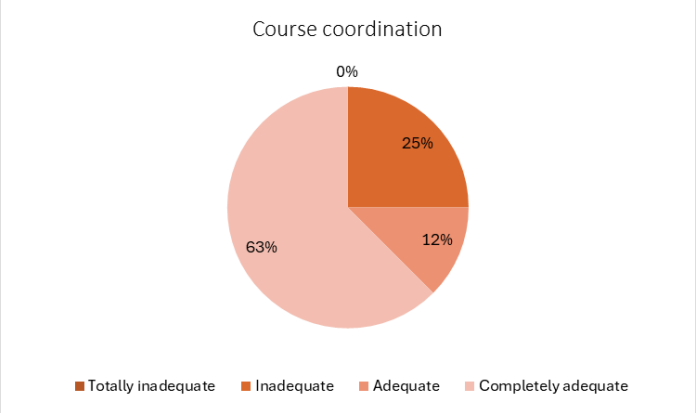

Figure 49. Evaluation of the course coordination

3.10.8. Final comments

The trainees expressed their appreciation for the opportunity to take part in the course, describing it as useful and valuable. They thanked ENB for its logistical support, emphasising the overall positive impact of the course on their learning experience. However, trainees also suggested areas for improvement, particularly regarding the use of PowerPoint presentations that were not fully translated into English. Finally, a request for a more rigorous timetable that could improve the flow of the course and overall effectiveness.

3.11. Feedback from trainers and trainees

The trainees provided extensive feedback on the training course, covering various aspects, including areas for improvement and suggestions for future replications. This feedback highlights both the strengths and challenges of the course, as well as specific areas that could enhance its relevance and effectiveness.

Trainees generally appreciated the case studies as a way to understand the diverse challenges faced by participants, acknowledging the course's effort to bridge different organizational contexts. However, they also noted the difficulty of designing a course to prepare multiple organizations for EWE due to the different levels of experience and realities each participant brings. This diversity was seen as both a strength and a challenge, with trainees expressing the need for tailored content to avoid redundancy and make the course distinct from typical training programs. The sessions on the roles of the IC and FA were seen as too lengthy, with trainees suggesting a shift toward more theory and practical tools relevant to the FA role.

Meteorology was highlighted as topic of interest, but several trainees felt that this session was overly technical and challenging to follow within the given time constraints. More time allocated to this subject would help trainees fully engage with the topic. Additionally, more emphasis on polygons and information management would be beneficial, as the

trainees noted that these topics were crucial but could have been presented with more depth. Some felt that time was spent on general information about IC responsibilities that they were already familiar with, suggesting that focusing on new or advanced content would make the lessons more valuable. Trainees also noted that while the displays and presentations were well-executed, some tools introduced were not accessible outside of Portugal, which limited their practical application for non-Portuguese participants.

Trainees also provided several ideas for expanding the course content to increase its relevance. Topics such as leadership, communication, and decision-making in operational rooms were suggested. There was also interest in a more hands-on approach for the FA role, emphasizing the practical application of theory and tools. Some trainees recommended including content on the "scientific state of the art" to provide a better understanding of current knowledge and gaps regarding extreme wildfire events. Additionally, trainees wanted more focus on actual tactics and how these relate to the FA's outcomes, helping bridge the theoretical aspects with practical applications.

The trainees had several suggestions for enhancing the course structure and methodology. They expressed a desire for more practical exercises, similar to those already included, to enhance hands-on learning. Many felt that these exercises were one of the course's most valuable components and recommended replicating them in additional sessions. There was also a suggestion to make the course more interactive, especially on the second day, to keep participants engaged and allow more collaborative learning.

Trainees suggested providing more preparatory material before the course, such as descriptions of areas and available equipment, to better prepare participants for exercises. Some recommended reducing country-specific content, such as "Wildfire Analyst" and "FEB Monitorização", as these tools may not be applicable to international trainees. Finally, they suggested a two-level structure for groups, allowing participants to work at different levels of complexity depending on their experience.

In addition to their course-specific observations, trainees offered general feedback to improve the course experience. They suggested balancing the workload before the course by ensuring that all participants have access to the course content in advance. This would allow the sessions to focus more directly on hands-on simulations and case studies, which trainees found particularly valuable. Reducing initial administrative tasks and providing exercise material ahead of time would also contribute to a smoother, more focused learning experience. Lastly, trainees recommended that instructors engage more personnel in the exercises to increase realism and provide a more comprehensive understanding of operational dynamics during EWE.

Overall, trainees appreciated the course but emphasized the importance of making content accessible, increasing hands-on and practical learning opportunities, and tailoring the structure to better suit an international and diverse audience. Implementing these suggestions could enhance the course's impact, ensuring it remains both relevant and adaptable to various organizational and geographic contexts.

These findings will certainly be valuable in planning and reviewing future editions of the course, as well as ensuring ongoing alignment with participants' needs and expectations.

4. FUTURE IMPROVEMENTS FOR REPLICATION COURSES

Based on the feedback received from the trainees, several improvements that can be made to future versions of the course have been identified and organised according to key themes:

4.1. Course Content and Structure

- Consider providing a comprehensive outline at the beginning of the course, detailing the objectives and expected outcomes. This can help ensure that all trainees understand the goals from the start.
- Expand on topics like “Decision Support Tools – Polygons” and “Decision Support Tools – Meteo,” which were rated as highly relevant and useful. Dedicate more time to practical applications and integration of these tools within EWE contexts. Provide more in-depth coverage of “Operational Decision Making & Information Management” and “Collaboration between the IC and FA.”
- Condense or simplify topics such as “Operations Management” and “Decision Support Tools - FEB Monitorização” which were rated as less relevant.
- Reduce general theoretical content on FA and IC roles, that trainees are already familiar with, and focus on role-specific advanced applications and tools in the EWE context.
- Consider including sessions on leadership, communication and decision making in operational rooms, as suggested by trainees. Introduce brief updates or case studies on the latest scientific research and findings at EWE to provide a strong theoretical foundation for practical application in incident management.
- Adapt the course programme to include tools and systems that are applicable outside the Portuguese context, ensuring that the content is accessible to all participants.
- Develop additional exercises that simulate EWE scenarios, emphasising the direct application of decision support tools, as these were highly valued by the trainees.

4.2. Course Delivery and Organization

- Optimize the course schedule to balance theoretical and practical sessions effectively and allocate more time for practical exercises and discussions.

- Involve additional personnel in simulation exercises to better mimic real-world operational environments. The inclusion of role-players and support roles could add complexity and enhance understanding.
- Conduct mid-course surveys to gather feedback on the course's progress and make real-time adjustments as needed.

4.3. Pedagogical Methods

- Incorporate more interactive elements, especially on the second day, to maintain engagement.
- Introduce group activities and discussions to foster collaboration and peer learning, making the sessions more dynamic and interactive.

4.4. Course Logistics

- Enhance administrative support to ensure it is effective and meets the needs of all trainees. Implement regular feedback mechanisms to identify and address any administrative issues promptly.
- Ensure that all teaching materials are fully translated into English and are comprehensive. This includes slides, handouts and any supplementary resources.
- Provide detailed and well-organized documentation that trainees can refer to during and after the course.
- Provide preparatory materials before the course, including descriptions of areas and available equipment, to better prepare participants for exercises.

By implementing these improvements, future courses can better meet the needs and expectations of trainees, ensuring a more effective and engaging learning experience.

5. TECHNOLOGICAL READINESS LEVEL

Innovative Action 5.8 started at TRL 3, focusing on conceptualizing and developing a new training program for Incident Commanders (IC) and Fire Analysts (FA) in Extreme Wildfire Events (EWE).

The achievement of TRL 8 for IA 5.8 is grounded in the successful completion of the pilot training program, as detailed in this deliverable. This program implemented innovative methodologies, including virtual reality simulations, for training IC and FA to handle EWE. By integrating practical exercises with advanced simulation tools such as FireSim, the

program provided participants with immersive and realistic training experiences. The pilot course was rigorously designed, assessed, and opportunities for improvement were identified based on detailed feedback from trainees and trainers, ensuring the tools and methodologies demonstrated their readiness for real-world application in operational settings. Furthermore, structured performance assessments using observation grids validated the proficiency of the trainees, underscoring the operational relevance of the training framework.

This structured and feedback-driven approach, along with the use of cutting-edge tools and alignment with project goals, justifies the readiness of the training program to advance to TRL 8.

The outcomes and insights from the pilot course will serve as a foundation for upscaling the training model and possibly implementing this certification at a European level.

6.CONCLUSIONS

Through the comprehensive pilot course organized by Escola Nacional de Bombeiros (ENB) and its partners, significant strides have been made in equipping IC and FA with the necessary knowledge, skills and tools to effectively respond to the increasing challenges posed by EWE. The training program, which combines theoretical knowledge with practical exercises and advanced simulations, has proven to be a valuable platform for enhancing decision-making capabilities, fostering collaboration, and promoting the use of innovative technologies.

Feedback from the trainees has highlighted both the strengths and areas for improvement in the course, providing a clear roadmap for future editions. By addressing these insights, future training programs can be further refined to better meet the diverse needs of participants, ensuring that the content remains relevant, engaging, and applicable across various European contexts. The emphasis on practical application, and adaptability will be crucial in maintaining the effectiveness of the training.

Ultimately, this deliverable aims to contribute to a more robust and prepared response framework for EWE, enhancing the overall safety and resilience of communities. By investing in the development and continuous improvement of training programs for IC and FA, we can ensure that these key personnel are well-equipped to protect lives, property, and natural resources in the face of increasingly severe wildfire threats. The ongoing commitment to excellence in training and the integration of cutting-edge tools and methodologies will be pivotal in achieving these goals.

7. REFERENCES

AFAN, Castellnou, M.; Miralles, M.; Nebot, E., Estivill, L.; Guidelines of fire analyst competencies and skills. AFAN Project (2021).

Alison, L. et al. (2015). Decision inertia: Deciding between least worst outcomes in emergency responses to disasters, Journal of occupational and organizational psychology, British Psychological Society.

Benali, A. et al. (2016). Deciphering the impact of uncertainty on the accuracy of large wildfire spread simulations, Science of the total environment, Elsevier.

Castellnou, M., Bachfischer, M., Miralles,M., Ruiz, B., Stoof, C. R., & Vilà-Gueraude Arellano, J. (2022). Pyroconvection classification based on atmospheric vertical profiling correlation with extreme fire spread observations. Journal of Geophysical Research: Atmospheres,127, e2022JD036920. https://doi.org/10.1029/2022JD036920

Castellnou, M., Prat-Guitart, N., Arilla, E. et al. Empowering strategic decision-making for wildfire management: avoiding the fear trap and creating a resilient landscape. fire ecol 15, 31 (2019). https://doi.org/10.1186/s42408-019-0048-6

FEMA, National Incident Management System, Third Edition, October 2017.

FEMA, Organizational Structure and Elements, March 2018.

FIRE-RES, CFRS, Arilla, E.; Bachfischer, M.; Castellarnau, X.; Cespedes, J.; Castellnou, M.; Castellví, J.; Dalmau, E.; Estivill, L.; Ferragut, A.; Larrañaga, A.; Miralles, M.; Nebot, E.; Pagès, J.; Pallàs, P.; Rosell, M.; Ruiz, B. (2023). Piloting the adaptation of methodology of forest fire potential polygons. Deliverable D1.3 FIRE-RES project. 20 pages. DOI: 10.5281/zenodo.7991283.

FIRE-RES, CFRS, Castellnou, M., Nebot, E., Estivill, L., Miralles, M., Rosell, M., Valor, T., Casals, P., Duane, A., Piqué, M., Górriz-Mifsud, E., Coll, L., Serra, M., Plana, E., Colaço, C., Sequeira, C., Skulska, I., Moran, P. (2022). FIRE-RES Transfer of Lessons Learned on Extreme wildfire Events to key stakeholders. Deliverable D1.1 FIRE-RES project. 119 pages. DOI: 10.5281/zenodo.10260790

FIRE-RES, CFRS, Castellnou, M.; Nebot, E.; Saavedra, J.; Miralles, M.; Estivill, L.; Rosell, M.; Tapia, G.; Alegría, D.; Medina, V.; Arilla, E.; Bachfischer, M.; Castellarnau, X.; Cespedes, J.; Castellví, J.; Dalmau, E.; Estivill, L.; Ferragut, A.; Larrañaga, A.; Nebot, E.; Pagès, J.; Palacios, A.; Pallàs, P.; Rosell, M.; Ruiz, B. (2024). Testing key inputs for atmospheric data analysis using new knowledge and expertise on EWE. Deliverable D1.4 FIRE-RES project. 66 pages. DOI: 10.5281/zenodo.11385129

FIRE-RES, ENB, Reis, V., Catarino, V., Marinho, T., Cunha, P., Soares, P., Silvestre, M., Fraga, D., Mota, C., Nebot, E., Estivill, L., Rossell, M., Cardil, A., Mendes, M. (2024). New training to develop skills and capabilities for incident commanders and fire analysts to new EWE management challenges. Deliverable D1.2 FIRE-RES project. 345 pages. DOI: 10.5281/zenodo.14194225

Frie, L., Alexander J. (2013). How the experts make decision during a bushfire. AFAC and Bushfire CRC Conference. Melbourne.

Haines, D. A. (1988). A lower atmospheric severity index for wildland fire, National Weather Digest, Vol 13, No.2:23-27.

Instituto Português do Mar e da Atmosfera (IPMA). IPMA no apoio ao Sistema Nacional de Proteção Civil – Componente Fogos Rurais, Lisboa, 2021.

Karim, H. et Comfort, L. K. (2014), Dynamic decision process in complex, high risk operations: The Yarnell Hill Fire, June 30,2013, Safety Science, Elsevier.

Laurence, A. et al. (2013), Immersive Simulated Learning Environments for Researching Critical Incidents: A Knowledge Synthesis of the Literature and Experiences of Studying High-Risk Strategic Decision Making, Journal of Cognitive Engineering and Decision Making, Vol 7, nº 3.

Mchugh, C. et al. (2015). Strategic Operations Planning – How the strategic operations planner can help, USDA Forest Service Proceedings.

Ministério da Administração Interna, Autoridade Nacional de Emergência e Proteção Civil, Despacho nº4067/2024, Regulamentação do Sistema de Gestão de Operações, Lisboa, 15 de abril de 2024.

Molina, D. et al. (2011). La Figura operativa del analista de compendios forestales en España, ResearchGate, Spain.

Pacheco, A. et al. (2015). Cohesive fire management within an uncertain environment: A review of risk handling and decision support systems, Forest Ecology and Management, Elsevier.

Pau Costa Foundation (2015). Students Dossier – Wildfire Simulators for Prevention Management.

Technosylva (2016). Wildfire Analyst Version 2.8 PRO User Manual, Leon.

Tedim, F.; Leone, V.; Amraoui, M.; Bouillon, C.; Coughlan, M.R.; Delogu, G.M.; Fernandes, P.M.; Ferreira, C.; McCaffrey, S.; McGee, T.K.; Parente, J.; Paton, D.; Pereira, M.G.; Ribeiro, L.M.; Viegas, D.X.; Xanthopoulos, G. (2018). Defining Extreme Wildfire Events: Difficulties, Challenges, and Impacts. Fire 2018, 1, 9. https://doi.org/10.3390/fire1010009

Van Wagner, C.E. (1987). Development and Structure of the Canadian Forest Fire Weather Index System, Canadian Forestry Service, Forestry Technical Report 35 OTTAWA.

Wilson, J.P., Gosiewska, S. (2014). Multi-agency gold incident command training for civil emergencies, Disaster Prevention and Management, Vol. 23, No. 5.

Annexes

Training program

FIRE-RES
Innovative technologies & socio-ecological-economic solutions for fire resilient territories in Europe

Task 5.4 – Tools and equipment to use in training for specialized analysis' teams and incident commanders focused on EWE

Training Program

Title: Incident Commanders and Fire Analysts in Extreme Wildfire Events (EWE).

General objective:
To provide trainees with the technical and operational knowledge and skills to enable Incident Commanders (IC) and Fire Analysts (FA) to update their collaborative work in EWE.

Specific objectives:
At the end of this course, trainees will be able to:

- Identify operational procedures and best practices for collaboration between IC and FA in EWE across different countries.
- Identify the evolving roles and responsibilities of IC and FA in the context of EWE.
- Apply decision-making, information management and command and control principles to manage the complexity of EWE.
- Use a variety of decision support tools, including meteorological tools, polygons, operational tools, and fire behaviour simulators to analyse and effectively manage EWE.
- Apply knowledge and skills in simulated EWE scenarios.

Syllabus:

- Case Studies.
- Best Practices.
- Roles of IC and FA.
- Operational Decision Making and Information Management.
- Operations Management.
- Decision Support Tools.
- Forest Fire Scenario Simulations.

Training methodologies: Case studies, brainstorming, lectures, simulations.

Dates: 30/09/2024 to 04/10/2024.

Course duration: 34 Hours.

Venue: ENB - Specialized Training Centre in Forest Fires (Lousã - Portugal).

Number of trainees: Minimum of 8 and maximum of 12.

Trainees profile:

- Current Incident Commanders and Fire Analysts (certified in their country to perform these functions, if applicable).
- Employees of forestry services, fire and rescue services and civil protection agencies.
- English fluent.

Selection criteria: To be defined by the service/agency.

Evaluation: Performance evaluation through observation of simulation exercises.

Certification: A certificate of attendance will be issued at the end of the course.

Bibliography:

AFAN, Castellnou, M.; Miralles, M.; Nebot, E., Estivill, L.; Guidelines of fire analyst competencies and skills. AFAN Project (2021).

Alison, L. et al. (2015). Decision inertia: Deciding between least worst outcomes in emergency responses to disasters, Journal of occupational and organizational psychology, British Psychological Society.

Benali, A. et al. (2016). Deciphering the impact of uncertainty on the accuracy of large wildfire spread simulations, Science of the total environment, Elsevier.

Castellnou, M., Bachfischer, M., Miralles,M., Ruiz, B., Stoof, C. R., & Vilà-Gueraude Arellano, J. (2022). Pyroconvection classification based on atmospheric vertical profiling correlation with extreme fire spread observations. Journal of Geophysical Research: Atmospheres,127, e2022JD036920. https://doi.org/10.1029/2022JD036920

Castellnou, M., Prat-Guitart, N., Arilla, E. et al. Empowering strategic decision-making for wildfire management: avoiding the fear trap and creating a resilient landscape. fire ecol 15, 31 (2019). https://doi.org/10.1186/s42408-019-0048-6

FEMA, National Incident Management System, Third Edition, October 2017.

FEMA, Organizational Structure and Elements, March 2018.

FIRE-RES, CFRS, Arilla, E.; Bachfischer, M.; Castellarnau, X.; Cespedes, J.; Castellnou, M.; Castellví, J.; Dalmau, E.; Estivill, L.; Ferragut, A.; Larrañaga, A.; Miralles, M.; Nebot, E.; Pagès, J.; Pallàs, P.; Rosell, M.; Ruiz, B. (2023). Piloting the adaptation of methodology of forest fire potential polygons. Deliverable D1.3 FIRE-RES project. 20 pages. DOI: 10.5281/zenodo.7991283.

FIRE-RES, CFRS, Castellnou, M., Nebot, E., Estivill, L., Miralles, M., Rosell, M., Valor, T., Casals, P., Duane, A., Piqué, M., Górriz-Mifsud, E., Coll, L., Serra, M., Plana, E., Colaço, C., Sequeira, C., Skulska, I., Moran, P. (2022). FIRE-RES Transfer of Lessons Learned on Extreme wildfire

Events to key stakeholders. Deliverable D1.1 FIRE-RES project. 119 pages. DOI: 10.5281/zenodo.10260790

FIRE-RES, CFRS, Castellnou, M.; Nebot, E.; Saavedra, J.; Miralles, M.; Estivill, L.; Rosell, M.; Tapia, G.; Alegría, D.; Medina, V.; Arilla, E.; Bachfischer, M.; Castellarnau, X.; Cespedes, J.; Castellví, J.; Dalmau, E.; Estivill, L.; Ferragut, A.; Larrañaga, A.; Nebot, E.; Pagès, J.; Palacios, A.; Pallàs, P.; Rosell, M.; Ruiz, B. (2024). Testing key inputs for atmospheric data analysis using new knowledge and expertise on EWE. Deliverable D1.4 FIRE-RES project. 66 pages. DOI: 10.5281/zenodo.11385129

Frie, L., Alexander J. (2013). How the experts make decision during a bushfire. AFAC and Bushfire CRC Conference. Melbourne.

Haines, D. A. (1988). A lower atmospheric severity index for wildland fire, National Weather Digest, Vol 13, No.2:23-27.

Instituto Português do Mar e da Atmosfera (IPMA). IPMA no apoio ao Sistema Nacional de Proteção Civil – Componente Fogos Rurais, Lisboa, 2021.

Karim, H. et Comfort, L. K. (2014), Dynamic decision process in complex, high risk operations: The Yarnell Hill Fire, June 30,2013, Safety Science, Elsevier.

Laurence, A. et al. (2013), Immersive Simulated Learning Environments for Researching Critical Incidents: A Knowledge Synthesis of the Literature and Experiences of Studying High-Risk Strategic Decision Making, Journal of Cognitive Engineering and Decision Making, Vol 7, nº 3.

Mchugh, C. et al. (2015). Strategic Operations Planning – How the strategic operations planner can help, USDA Forest Service Proceedings.

Ministério da Administração Interna, Autoridade Nacional de Emergência e Proteção Civil, Despacho nº4067/2024, Regulamentação do Sistema de Gestão de Operações, Lisboa, 15 de abril de 2024.

Molina, D. et al. (2011). La Figura operativa del analista de compendios forestales en España, ResearchGate, Spain.

Pacheco, A. et al. (2015). Cohesive fire management within an uncertain environment: A review of risk handling and decision support systems, Forest Ecology and Management, Elsevier.

Pau Costa Foundation (2015). Students Dossier – Wildfire Simulators for Prevention Management.

Technosylva (2016). Wildfire Analyst Version 2.8 PRO User Manual, Leon.

Tedim, F.; Leone, V.; Amraoui, M.; Bouillon, C.; Coughlan, M.R.; Delogu, G.M.; Fernandes, P.M.; Ferreira, C.; McCaffrey, S.; McGee, T.K.; Parente, J.; Paton, D.; Pereira, M.G.; Ribeiro, L.M.; Viegas, D.X.; Xanthopoulos, G. (2018). Defining Extreme Wildfire Events: Difficulties, Challenges, and Impacts. Fire 2018, 1, 9. https://doi.org/10.3390/fire1010009

Van Wagner, C.E. (1987). Development and Structure of the Canadian Forest Fire Weather Index System, Canadian Forestry Service, Forestry Technical Report 35 OTTAWA.

Wilson, J.P., Gosiewska, S. (2014). Multi-agency gold incident command training for civil emergencies, Disaster Prevention and Management, Vol. 23, No. 5.

Course schedule

Type	FIRE-RES Task 5.4		Designation	Incident Commanders and Fire Analysts in Extreme Wildfire Events (EWE)
Week	30-09-2024	to 04-10-2024	Course number	1 ----

H	Day 1		Day 2		Day 3		Day 4		Day 5	
09:00 10:00			3. Updating the Role of the Incident Commander (IC) in EWE scenarios	T	7. Decision support tools - Meteo	T	11. Forest fire scenario simulations	S	13. Forest fire scenario simulations	S
10:00 11:00				T		P		S		S
11:00 12:00	Welcome and Introductions	T	4. Role of the Fire Analyst (FA)	T	8. Decision support tools - Polygons	T		S		S
12:00 13:00		T		T		P		S	14. Course evaluation Course closure	T
	- meal break -		- meal break -		- meal break -		- meal break -		- meal break -	
14:00 15:00	1. Case studies	P	5. Operational Decision Making and Information Management	T	9. Decision support tools - FEB Monitorização	T	12. Forest fire scenario simulations	S		
15:00 16:00		P		T		P		S		
16:00 17:00		P	6. Operations Management	T	10. Decision support tools - Simulators	T		S		
17:00 18:00	2. Collaboration between the IC & FA	P		T		T		S		

Lesson type/Hours			Total hours of the course	
T	Theoretical	16	T	16
P	Practical	7	P	7
SP	Simulation	11	S	11

FIRE-RES