Article

Patterns of Learning: A Systemic Analysis of Emergency Response Operations in the North Sea through the Lens of Resilience Engineering

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Abstract: Crisis-induced learning (CIL), as a concept, has an ancient history. Although the academic literature offers a range of sophisticated approaches to address CIL, it is still not quite clear how we learn, how we know we have learned, and what challenges and opportunities are involved in the CIL process. To address these questions and navigate ways forward, we need to use a specific real-world subject to capture contextual issues involved in a crisis cycle, which affects the learning process. In this paper, we uncover patterns of learning by exploring contextual issues involved with "actual scenarios" related to three COVID-19 episodes (emergencies) between August and December 2020. To analyze the study's findings, we use three different themes from the DARWIN Generic Resilience Management Guidelines: (1) supporting the coordination and synchronization of emergency-response operation activities, (2) managing adaptive capacity, and (3) developing and revising procedures and checklists. Looking into these "real scenarios" seems fruitful for understanding patterns of learning, and it results in several learning recommendations. Among others, this study reveals how the uncertainty involved in emergency-response operations creates cognitive demands for emergent problem-solving.

Keywords: crisis-induced learning; resilience engineering; case studies; adaptive capacity

1. Introduction

Emergencies and crises put organizations in situations where they stretch their operational boundaries [1,2], particularly in dealing with what Boin et al. [3] describe as the transboundary crisis. Crisis offers a window of opportunity for policy reforms, institutional overhaul, and even leadership revival [4]. This is what we can infer as "crisis-induced learning" [5–7], a clear-cut opportunity to adapt [8] (p. 126) as leverage points for making critical changes [9]. A considerable stream of research on crisis management and its related topics has attempted to draw transferable lessons across organizations and domains. This research includes investigating product-harm crises [10], refugee crises [11], and attention toward how individual professionals draw lessons from previous disasters [12,13]. In the past two years, the COVID-19 crisis has imposed epic unexpected challenges on everyday life, as well as industrial operations. It has challenged organizational structures and cultures, together with the day-to-day operations of individuals and institutions [14].

Dealing with emergencies promptly requires access to verifiable information [15] and the capacity to process information by seeing the invisible [16]. Sensemaking in a complex situation with highly uncertain outcomes is a challenging task. Challenges include communicating about uncertainties and establishing and maintaining common situational awareness across organizations. The actors involved in operations might have different

priorities, goals, opinions, strategies, and political agendas on how a situation could be managed and how the emergency management system could be improved [17].

The handling of the COVID-19 pandemic and related emergency-response operations (EROs) highlights how uncertainty, time pressure, and escalating consequences reinforce the need for continuous adjustment of emergency-response plans. The goal of such an adjustment is to ensure an effective and safe management of new and reshaped threats in highly dynamic and unforeseen scenarios [18]. In this setting, resilience and its engineering (design) in systems are considered to be proactively capable of managing EROs [19–21]. From an operational perspective, Chandler [22] points to resilience as an "inner attribute" of a system under study (p. 8) which, in any safety-critical operations, can only be affirmed during actual scenarios [23].

In this study, we looked closer at "actual scenarios" related to three different COVID-19 episodes (emergencies) between August and December 2020. We explored adaptive practices in a second emergency-response organization, the Operator's Association for Emergency Response (OFFB), a leading Norwegian organization that provides emergency management services used by several oil and gas operating companies on the Norwegian continental shelf.

Our research question was as follows: which patterns of learning emerge from EROs? We answered this question by investigating the multiple varieties of work domain as informed by frontline operators in OFFB, through eight in-depth interviews with key agents involved with the abovementioned three cases. We applied DARWIN Generic Resilience Management Guidelines (DRMGs) [24] and their Concept Cards (CCs) as a roadmap to gather and analyze our data. In many respects, DRMG could be considered an advanced maturity model (MM), aiming to assess an organization's ability for continuous improvement. By assessing risk management practices and their effectiveness, MM allows an organization to enhance the planning of actions that lead to the desired outcomes [25]. However, existing MMs are built on a rather limited number of indicative attributes, with a narrow focus on capturing the relationships between identified attributes. For instance, the OECD Enterprise Risk Management Maturity Model [26] covers eight areas of concern, namely strategy, governance, culture, risk identification, analysis, evaluation and treatment, review and revision, communication and reporting. The DRMG has a broader perspective, as it goes beyond risk management activities, attempting to facilitate organizational resilience in the operational context. It includes thirteen resilience-related capability cards (CCs) organized in eight themes at different maturity levels. It covers coordinating distributed activities during operations, managing adaptive capacity, assessing resilience capacity, developing and revising procedures, and stakeholder involvement [24]. The DRMG guideline has been well supported by empirical evidence since its development. It has been applied, for instance, in the context of infrastructure systems' simulations [27]; air traffic management and healthcare [28]; and the critical infrastructure within a Swedish Regional Medical Command and Control Team [29]. In an ERO context, a study related to a disaster medicine management system [30] applies DRMG to analyze observed behaviors in the crisis management team. The authors used CCs to map expected associations between contextualization and operationalization of resilience concepts through a top-down approach.

We explore our cases through three different themes from DRMG: (1) supporting coordination and synchronization of ERO activities, (2) managing adaptive capacity, and (3) developing and revising procedures and checklists. Our analysis of empirical findings links resilience engineering (RE) practices in larger emergency management contexts, providing a case for the applicability of RE's tools and concepts in such domain. Moreover, lessons learned from EROs provide insights that will facilitate the implementation of new approaches and ER measures, modification of processes, and conducting policy reforms. The resilience concept has been defined and used in various ways and in several scientific and practical fields in recent decades. The remainder of the paper is organized as follows. Section 2 presents previous contributions on learning from crisis and resilience in EROs. This

section offers evidence on the need to adopt a systemic perspective, justifying the research dimension of this work. Section 3 describes our methodology, including materials used in this research. Section 4 presents the case studies, which refer to three previous COVID-19 emergencies in offshore operations. Section 5 discusses the findings in larger organizational management contexts, and Section 6 provides conclusions and future research directions.

2. Theoretical Background: Patterns of Learning and Learning Barriers

The scientific literature introduces several patterns of learning. For instance, Wears and Webb [31] differentiate between situational versus fundamental learning, and Popper and Lipshitz [32] distinguish between structural and cultural learning. The former pattern (structural) has its focus on institutionalized structural arrangements to gather and process information. The latter pattern pays attention to the cultural issues that affect organizational learning capacities, such as norms, shared values, and rituals. We also have emergent learning, which occurs as a benign by-product of solving immediate problems as they arise [11]; simple, double-, and triple-loop learning [33,34]; quadruple-loop learning [35]; concurrent learning [36]; and learning from others, which is the interpersonal transfer of knowledge in use [37]. Related to concurrent learning, Steiro and Torgersen identify five distinct factors for enhancing learning capacity. These are (1) having a common ground about the basic contextual assumptions (i.e., about people, relations, and teamwork), (2) space, (3) dedication (i.e., giving of themselves), (4) making processes transparent and addressing problems as early as possible, and (5) reflection.

Nevertheless, the focal point of learning in any of these patterns is to create and transform knowledge, both declarative and procedural [38], as well as perceptual skills [39]. Transforming knowledge, in turn, enhances the capacity to meet future challenges. Adaptive capacity and willingness to change are the key elements in embracing such opportunities. Referring to "knowledge dynamics", Patriarca et al. [40] point to foundational knowledge-conversion activities and knowledge-conversion drivers. Through these elements, the authors describe how knowledge is created and transformed between different entities in the system under study. Knowledge transformation takes place in seven different ways, two of which are socialization activities, (i.e., converting tacit-to-tacit knowledge between different agents) and reification (i.e., converting tacit knowledge to action). Knowledge transformation enhances individuals' capacity and cognitive ability to "see and see beyond" the visible pattern of events, predict future tasks, and visualize them [16]. Both socialization and reification are aspects of samhandling and concurrent learning. The Norwegian notion of samhandling reflects social interaction [41] and is considered as a nuance of resilience [42]. As a mindset, samhandling represents a way of working and a form of learning, which, together, enhance the adaptive capacities of the operators at the sharp end to meet and/or develop the skills needed to tackle the challenges in dealing with turbulent situations. In a warfare context, samhandling is closely related to the German concept of *auftragstaktik*. After the severe defeat of the Prussian army against Napoleon Bonaparte in the 1806 battle of Jena–Aurstedt, the Prussians needed to change their mindset about adapting to turbulent situations and challenges on the battlefield. Graf Helmuth von Moltke the Elder came up with the concept of auftragstaktik. Auftragstaktik encompasses the following concepts: "individual initiative, independent decision-making, and thinking leaders reaching tactical decisions on their own accord" [43]. It concerns the importance of decentralization and local autonomy and initiatives in adapting centrally formulated policies and procedures [44]. Moreover, the commander has to address "what" and "why" issues founded on a trusting relationship between the commander and his/ her subordinates. The subordinates must understand the mission's intent to act independently on "how" the mission should be accomplished [45]. This resonates well in a Scandinavian setting based on social norms and egalitarian values. It is also linked to the doctrine of strategic agility, which is driven by intention-based leadership [46–48]. Strategic agility searches for flexibility as a formal base for improvisational action [49] and "adjusting

adapting performance", which in turn enhances the ability to cope with complexity in a dynamic operational context [50].

Learning from crisis is an aspect of resilience. From the RE perspective, learning from failures and successes [51], in the context of individuals working together and making sense of their experiences [14], is at the heart of understanding the operational context. It is about recognizing what is needed to support a safe adaptation, leading to desirable outcomes. Understanding what worked well in the emergency-response process, what did not work as planned, and what aspects of emergency plans should be changed enhances the organization's ability to sustain operations during EROs [52].

The learning process requires a search for brittleness, addressing operational variability, trade-offs, and re-prioritizations. It provides insights to develop the skills needed to meet future challenges and anomalies [1]. Lessons learned enhance a system's ability to achieve a higher level of resilience through an anticipatory style, planning, and adapting to changes in advance of unwanted events [53]. In a study of a real-time operational drilling center that was conducted under normal operations, organizational learning stood out as one of the most important factors in enhancing resilient operations [54]. Participation in developing solutions to emergent problems—what is termed co-generative learning—is important [55,56]. Duffey and Skjerve [57] argue that the main source of organizational learning is the ability to seize the experiences gained from situations and interactions between personnel and have them implemented at an organizational level.

When it comes to elements that might challenge a CIL process, several empirical and conceptual studies have demonstrated that crisis management often plays out in a highly politicized landscape [58–60]. In this landscape, those who stay in power—the decision-makers—tend to apply defensive strategies to protect their positions, even in situations where the existing power distribution disturbs the adaptive pattern of actions and alignment of the organization with the environment [61]. Politicization of learning from a crisis often leads to counterproductive consequences. On the one hand, as Boin et al. [3] state, when emerging threats have not been given sufficient attention by the authorities, they are not included on the political agenda. On the other hand, the political agenda illustrates the appetite for change and, thus, the motivation for learning. Moreover, the classical study of Simon [62] provides an understanding of limited rationality at the organizational level. Simon's seminal work displays how preprogrammed responses and patterns of action are encoded in the organizational structure and how they tend to reinforce less mindful behavior, which affects the power distribution in the organization. These attitudes could be related to what Power and Alison [15] refer to as decision inertia. Besides power and politics, sociopsychological and information-processing activities affect learning from crisis. Karl Weick [63] introduces "bricolage" as a phenomenon, that is, to use any available resources to perform the immediate task. Reflecting on bricolage during a crisis implies using several resources to create a common situational understanding [53]. However, this can be hampered if there is too much focus on centralized decision-making.

As managing crises has a dynamic nature, so does learning from them, as it is not usually a linear and straightforward process. It is rather a challenging process faced by several obstacles. Table 1 summarizes some of the learning barriers that are relevant for the scope of this study.

Table 1. Learning barriers.

Categories	Barrier
Power and politics	- Inflexibility, inability to adapt, overemphasis on performance at the expense of learning, reliance on rational decision-making, and narrow definitions of what constitutes success conspire to undermine learning in contemporary organizations. A refusal or inability to acknowledge how political agendas shape learning creates additional dilemmas [52]. - The political dynamics and the issue of centralization tendencies: employment of a top-down command-and-control style [8] (p. 140) may weaken the ability to improvise and, hence, the ability to experience emergent learning. - Challenges related to networks in crisis operations: Operations are often involved with multi-organizational, trans-jurisdictional response networks. They require *lateral coordination*, not centralized top-down command and control (ibid: 141). - Inadequacy in enquiry commissions or institutional channels through which a government learns from a crisis and how they filter information and orient lesson drawing [64]. - Lack of authoritative and widely accepted explanations of the causes of crises [65]. - Lack of openness, defensive strategies, and dysfunctional organizational learning pattern [66].
Sociopsychological barriers	- Threat-rigidity theory: Possibility of restrictions in information processing and the constriction of control under threat conditions. Attention to dominant or central cues and a tendency toward emitting well-learned or dominant responses [67]. - Fear: Leaders or organizations that fear for their position and negative publicity are unlikely to encourage open debate and investigate what exactly went wrong in a crisis-management process [8] (p. 130). - Strategic amnesia: manipulation of organizational memory [8] (p. 132). - Failure to hear most of the critical information, seeing through pattern matching, and sensing the limitations of frameworks [55].
Information processing	- Changing the organizational structure: Old organizational structures (e.g., hierarchy, routines, procedures, etc.) should be destroyed before new ones based on learned lessons can be implemented [8] (p. 133). - A normalization tendency gives rise to the notion that "it won't happen around here". It is then easy to forget the risks [8] (p. 26). - Lack of "institutional memory", i.e., having some system to maintain and share the organizational experience available to current decision-makers [68]. - Decision inertia: This appears typical in contexts in which (i) choices are multi-attributable; involve (ii) one-time, irreversible consequences; and (iii) take place in dynamic environments in which (iv) anticipated adverse effects are linked not only to action but also to inaction [15]. - Limited information-processing capacity [67]. - Limited action repertory, lack of adequate response plans, and lack of competence (derived from the mindfulness discussion). - Limited rationality and human preferences in the decision-making process [62].

Dealing with learning barriers (Table 1) requires a continuous awareness of the importance of learning at a strategic level. Thus, the formation of strategy and operational management systems has to be profoundly integrated in organizations. The facilitation

of organizational learning is an essential property in this respect [69]. Expanding on this proposition, one can claim that learning from day-to-day operations is a necessary condition for anticipating potential changes and preparing an adequate response repertoire. The rationale is straightforward: the absence of information of what has happened hampers the required adjustment of strategy content and, thus, distorts an organization's expectations and decisions.

3. Methodology

This explorative study is about crisis-induced learning. We sought to obtain an overview of the knowledge and skills required to deal with emergency-response operations (EROs) related to the COVID-19 pandemic and the existing gap in this matter. We looked closer at the EROs conducted by the Operators' Association for Emergency Response organization (OFFB) in response to the three outbreaks. The OFFB is a second-line emergency-response organization, assisting oil and gas operators on the Norwegian continental shelf. For the purpose of this study, we examined how frontline operators performed their tasks when dealing with COVID-19-related situations. To do so, we applied cognitive task analysis (CTA), investigating critical decision-making and knowledge audit [9] (p. 458), and we addressed patterns of learning in our three cases.

3.1. Three Cases of COVID-19 Outbreaks on the West Phoenix

3.1.1. Case 1: August 2020

Case 1 is related to the West Phoenix floating oil rig (WP), which operates a Seadrill on behalf of the oil company Neptune Energy. Seadrill is a deep-water drilling contractor for the petroleum industry. On 29 July 2020, a Wednesday, a helicopter took off from Kristiansund Airport. On board, among others, was a British citizen who worked on the West Phoenix. At this time, the UK was on the Norwegian COVID-19 green list, and no tests or quarantines were needed. On the oil rig, the British man came into contact with both the day and night shifts. Soon he started to feel unwell. The responsible doctor on the rig decided the man had to go to hospital but did not suspect he was infected with the COVID-19 virus. On Saturday 1 August, at about 2:30 pm, the man was evacuated by helicopter to Molde Hospital, while 126 people were left on the rig. On Saturday, at 8:00 pm, the OFFB received a call from the duty doctor on the WP and was informed that the crewmember at Molde Hospital tested positive for COVID-19. There were 126 people left on the rig, and over the next 12 days, three new cases of infection were detected on board. A total of 46 people were identified as close contacts and were quarantined on the rig. In addition, 15 people without safety-critical tasks were sent to quarantine hotels on land to relieve the herd. The rig was declared infection-free on 13 August.

3.1.2. Case 2: October 2020

Case 2 is related to another COVID-19 incident on the WP rig in October 2021. The same operating company was responsible for the operation. One of the crewmembers showed COVID-19 symptoms and, shortly thereafter, was transported to Kristiansund, which is the nearest city to the rig. This time, the company did not consider the outbreak to be a contingency incident and used a project organization to handle the situation. The OFFB was notified a few hours after the incident and was asked to support the project by executing specific tasks regarding the COVID-19 emergency-response operation. The emergency manager in the second line (OFFB) chose to mobilize an extra resource to handle the situation. However, the second line perceived its management role unclearly, as this approach was not described in the planning phase or practiced in advance. Nevertheless, experiences from the first outbreak (in August) and already established guidelines enabled the actors involved to maintain a good flow of communication, leading to clear expectations regarding specific tasks.

3.1.3. Case 3: December 2020

The third outbreak occurred on another rig, the West Mira (WM), with another responsible operating company, Wintershall Dea, in December 2020. This time, the OFFB was notified by the operating company about eight hours after the onboard crew became aware of the incident. The OFFB was commissioned to coordinate the reception of personnel, who were transferred to land to be quarantined. The OFFB's activities included coordinating with the municipality, requisitioning transport, and booking quarantine hotels. The OFFB's emergency manager experienced challenges getting in touch with the municipality due to some practical issues (e.g., lack of updated telephone numbers in the emergency plan).

Moreover, the OFFB was commissioned to carry out its actions on New Year's Eve, which made it extra challenging in terms of communication and coordination. The original quarantine hotel was closed at Christmas, but this was not communicated to the organization in advance. At the same time, the procedure for requisitioning infection transport was not following the current practice in the municipality in question. Despite the challenges, the second-line managers (OFFB) fulfilled their tasks. In light of the difficulties experienced, the emergency-planning procedures were revised and improved after the incident's evaluation phase. New planning defines that the emergency-preparedness organization will handle COVID-19 incidents. At the same time, responsibility, notification, mobilization, actions, and lines of communication are clearly specified. Telephone lists and contact information for the actors involved are also updated and verified.

3.2. Cognitive Task Analysis (CTA)

CTA is a set of methods for "identifying the cognitive skills or mental demands needed to perform a task proficiently" [70]. The three main aspects of CTA are knowledge elicitation, data analysis, and data representation [71]. The relevance of these aspects for this study is explained in the following sections.

3.2.1. Knowledge Elicitation

Knowledge elicitation in this work was developed in two phases. Phase 1 was theory-driven, in which we reviewed the relevant literature on crisis-induced learning and resilience crisis management. The second phase was involved with data collection centered on the second-line ER operators' real-world experience. To obtain reliable insights to answer our research question, we used a triangulation of qualitative methods, consisting of ethnographic research, semi-structured interviews, and document analysis.

3.2.2. Ethnographic Research

Generally, one of the first challenges in conducting empirical research is obtaining access to a working environment to undertake fieldwork. In our study, one of the co-authors acted as the emergency manager in the ER operation, dealing with the three cases presented earlier. As an ethnographer, his insights and involvement in EROs were invaluable resources for designing the study and gathering data, being able to communicate with participants with the same terminology and cultural codes, making it easier for the participants to "open up" and share their thoughts. In addition, his observations, which systematically described his experiences of the events and behaviors he encountered [72] (p. 79), provided us with a unique opportunity to understand the working environment and translate our empirical findings through the lens of the study's context. An actual challenge in ethnographic research is the issue of objectivity, given the close relationships that the researcher establishes in the fieldwork. To avoid biases and maintain objectivity, we used various data sources, including evaluation reports and semi-structured interviews, where the questions were asked generally. During the interview, we avoided asking any leading question that may lead to a certain response. In the data-analysis process, co-authors worked closely together in interpreting and analyzing empirical materials and comparing, and enriching perceptions. We ensured that all answers and impressions were included in the analysis and re-evaluated, if needed, to avoid omitted data.

3.2.3. Semi-Structured Interviews

We conducted eight semi-structured interviews (both in-person and online, using MS Teams), collected between October 2020 and April 2021. Our respondents have domain-specific knowledge [9] (p. 455) on ERO and either actively participated in our three cases as emergency managers or supported the ERO from a strategic level. In this way, we used the "purposive" sampling approach, involving participants with adequate expertise in the domain of interest [73]. When we invited the participants via email, they received information about the purpose of the study and interview questions. To increase reflection among them, we asked them to share with us if there were any issues of concern regarding confidentiality. The interview questions included main topics and elements from the study's theoretical background and were inspired by DARWIN Resilience Management Guidelines (DRMGs) [24]. Although we used the DRMGs as a roadmap to develop the interview guide, the survey questions were carefully aligned with the context of this study. In using CCs as the point of departure, we asked our respondents to make comments about the following claims (Table 2).

Table 2. Themes, capability cards, and interview questions.

DRMG Theme	Capability Card	Claims
Supporting the coordination and synchronization of distributed operations	CC1: Common ground	The OFFB had a contingency plan that was relevant and comprehensive for dealing with a COVID-19-related scenario.
	CC2: Establishing networks	The OFFB had established good and well-known strategies, networks, and plans for handling COVID-19 outbreaks.
Managing adaptive capacity	CC3: Enhancing the capacity to adapt	The OFFB had established a high-risk awareness associated with COVID-19 scenarios and a well-developed organizational and management culture that strengthened the company's ability to handle COVID-19-related events.
	CC4: Establishing conditions for adapting plans	The OFFB has good systems for assessing learning effects at all levels of the organization (individual, group, and organization). If necessary, the assessment of learning effects leads to adapting plans and new learning measures. We found that one or more problems could not be solved by following established procedures and plans; therefore, we had to improvise. These experiences have led to learning in the organization.
	CC5: Managing available resources	The OFFB has developed its contingency plans for managing available resources in handling a COVID-19-related scenario, based on legal requirements, industry standards, risk assessments, the involvement of professionals, and experiences.
Developing and revising procedures and checklists	CC6: Systematic management of policies	The OFFB has a well-established system for learning what went well and what can be improved after the handling of the COVID-19 incident. The OFFB has established detailed criteria for how findings from COVID-19 events are to be investigated and analyzed.

During the interviews, the participants were asked to comment on the challenges they faced when conducting their tasks during ERO(s) and on the role of tacit knowledge and experience. Each interview was recorded and transcribed into about 1200–2500 words. After gaining consent from the subjects, we assured them that their information would be treated confidentially. The data were anonymized so that no individual or organization could be identified.

To improve reliability and further verify our notes from the interviews, we returned the transcripts to our participants. This allowed them to give us feedback on their transcripts. Nonetheless, we received a few comments about some specific details provided in the interviews, yet they needed to be removed from the transcripts due to the sensitivity of the information. To increase the validity of our conclusions and obtain an internal triangulation, we gathered supplementary information by attending meetings that involved the EROs in dealing with outbreaks. These data provided a broader understanding of the contextual issues in the operational environment and compensated for missing information.

3.3. Data Analysis

Themes developed by the Darwin Resilience Management Guidelines were used here as a roadmap for categorizing and analyzing data. The DRMG Book is a result of the DARWIN project in Horizon 2020, which received funding from the European Union's Framework Program for Research and Innovation. It includes several topics, contexts, and conceptual issues, referred to as capability cards (CCs). CCs recommend a list of actions or processes that organizations can establish to advance the potential of resilience management. Among DRMG's CCs, we look closer at the themes considered most relevant to this study (see Table 2). The DRMG topics for these themes include establishing networks and promoting common ground for cross-organizational collaboration, as well as information sharing, clarifying roles, and responsibilities for the first theme (i). For the second theme (ii), the topics include establishing conditions for adapting plans and standard procedures during emergencies and effectively managing resources to deal with changing demands in the working environment. Finally, topics for the third theme (iii) are the management of guidelines and policies at a strategic level and educating operational personnel in the process of handling emergencies and disruptions [24] (p. 5). The first step in the data analysis was reading through several evaluation reports developed by involved organizations and the interview transcription and writing reflection memos. We looked at patterns to explain how participants conduct their tasks in response to the study's three emergency situations. Then we highlighted phrases and repeated topics (i–iii themes). After categorizing the data, we further analyzed them based on this study's theoretical foundation (Section 2).

4. Findings

OFFB's ERO evaluation reports and comments from the study's informants indicate that the three events described in the previous section were handled differently in terms of organization, coordination, and resource allocation. A common denominator of the three events was that there were no well-known and detailed plans for how the tasks would be solved at the time of the events. There was also uncertainty in the organization related to roles and responsibilities. Evaluation reports highlight that, during the last two incidents, the emergency-response organization was not mobilized in accordance with the emergency preparedness plan, and the organization of the operating companies did not define the situations as emergency-response incidents. The plan defines how notification of incidents to the second line shall take place. Notification to the second line during the COVID-19 events was carried out in a different way than what is described in the planning and practiced during exercises. In this context, it was necessary for the second line to disregard the existing plans and procedures, show transparency, improvise, and solve the challenges that emerged. Nevertheless, it initially created uncertainty in the OFFB, which was related to the degree of involvement and support activities. The emergency-response organization

interacted with a wide range of co-operatives, including their roles and functions that were not described in the planning. This contributed to finding quick and effective solutions to problems that had not been previously encountered. The actions that were taken were both proactive and reactive. The contact network established before the events proved to be critical. The interview results also indicate that the competence in dealing with pandemic situations is unevenly distributed within the organization. The employees have different educational qualifications and professional backgrounds, and in the COVID-19 context, it is natural that personnel with a health background have the greatest insight. Those interviewed also described that there had been an ongoing learning process throughout the period and that today they felt well prepared to deal with a COVID-19 incident. What follows presents the findings in more detail, combined with a few selected quotes from interviews, organized according to the DRMG themes (Table 2).

4.1. Supporting Coordination and Synchronization of Distributed Operations

The second-line ER operation in the OFFB follows a command-and-control-based management system with a focus on compliance with contingency planning. The ER teams share information with interacting actors during incident management. Several cross-organizational collaboration activities related to our three cases were arranged prior to the COVID-19 pandemic. For instance, Tabletop exercises were arranged, engaging parties involved in the emergency response, such as the operating company, the rig company, the responsible medical doctors, offshore installation managers (OIMs), offshore medics, and other emergency-response personnel from the operational and strategic level on shore, helicopter companies, municipalities, and other responsible authorities. Functional training and exercises were also conducted, as well as subject-specific meetings. The roles and tasks of all involved participants were described and clarified during these activities.

The actions taken by the OFFB were both proactive and reactive. Quick decisions, good communication, and coordination contributed to the prompt handling of the emergencies according to some of the interviewees. They highlighted the importance of "effective and frequent communication" with a wide range of cooperative actors during the incidents:

> "We had regular updates every morning, and we had a system where we got approved the messages that were going out remotely".

> "Kristiansund municipality welcomed our ER team. It was a good and close collaboration with them".

> "Mutual trust and good relations developed in advance had a good effect on samhandling".

> "Conducting regular online meetings provided us a common situational picture".

Our findings also uncover several challenges in coordination activities and tasks. For instance, some of the roles and functions of multiple responding agencies were not clearly described in the ER planning and procedures phase:

> "There were no guidelines for who should notify the airline".

> "Roles and responsibilities within the COVID-19 handling were unclear. There was disagreement related to whether this was an emergency incident or not".

Beyond this issue, a lack of an established protocol for distributing information between the actors involved created uncertainties during the execution of ER process(es):

> "The situation was involved with a high level of uncertainty".

> "The absence of relevant plans led to different handling of the incidents. The strategic management's perception of the situation was decisive for the approach".

Despite these challenges, the experience gained from our case studies confirms that available resources, open and timely communication between the actors involved, and efficient information gathering and sharing advanced a common ground for cross-organizational collaboration in ER operations.

"The absence of relevant plans led to different handling of the incidents. The strategic management's perception of the situation was decisive for the approach".

4.2. Managing Adaptive Capacity

A common feature to emerge while managing the three incidents was the complexity of the situation. In the last two outbreaks, emergency managers in the OFFB faced a new situation in which they had no experience practicing their second-line supportive role:

"We didn't sit down together to discuss how we should handle, organise and use the resources in such an imagined situation".

"The absence of relevant plans led to different handling of the incidents. The strategic management's perception of the situation was decisive for the approach".

"Routines must be developed, both on how to communicate internally and to the press in ambiguous situations, make a balance between reaching stakeholders' factual information while navigating uncertainty, is a challenging task".

"It was different expectation and practice in dealing with outbreaks. The rig had its procedures and routines for internal communication, Neptune had its own- lack of control and interoperability caused uncertainty".

According to our informants, the OFFB applies a proactive methodology for implementing emergency preparedness. The working environment has traditionally been a culture of following an organization's standard procedures and plans and adhering to a command-and-control-based management system in compliance with plans. Our findings indicate that, from a cultural point of view, there is little interest in the potential of improvising during EROs. However, improvising and ad hoc solutions were necessary to deal with urgent matters, as the existing description of how to handle pandemics in the ER plan could not be used in handling COVID-19.

"Informal aspect of communication was important. Plans and manuals can never describe all possible eventualities".

Dealing with the outbreaks was, to some extent, reactive and defensive in terms of setting up plans and procedures. This was the result of a high level of uncertainty regarding the role, responsibility, and ER scope of activities and frequent orders from the authorities. Flaws in the ER plan and standard procedures were detected during the incidents.

In the early phase of the pandemic, no offshore testing mechanism had been established. However, as a result of the initiative of the medical doctor responsible for the rig, a chain of creative thinking and actions led to a solution to this challenge within hours. A brand-new PCR testing machine, testing equipment, and an additional nurse were flown out to the rig. These actions were not described in the standard operating procedures or emergency-response plans. An already established network of key personnel and service providers was essential for the operation's success. The infection-control physician in the municipality demanded that all COVID-19 personnel on board the rig be flown to the shore-side for isolation. To arrange helicopter transport of infected personnel from the rig, it was necessary to provide medical assistance for the patients on board the helicopters. Nurses were hired for this purpose, and this task was not described in any plans. Moreover, the procedures related to the reception and care of employees who were sent to the mainland for quarantine were described in a separate plan. The reception and care services were not established in Kristiansund before the first incident. This challenge was solved by hiring a nurse from the medical service provider to the quarantine hotel while the municipality took care of the isolated patients. Again, improvisation and collaboration between the parties involved solved the problems.

4.3. Developing and Revising Procedures and Checklists

We asked our respondents how well suited the planning and operational procedures to be used during the emergency-response incidents were. During the interviews, participants described the planning as incomplete, with insufficient detail:

"We had plans and procedures, but these were insufficient to deal with of COVID-19. So, we had to improvise".

One of our informants claimed that the OFFB had not established its own indicators to be monitored in relation to the COVID-19 situation. The evaluation from previous incidents was used in the improvement processes. As a result, routines were established for a shorter period (e.g., daily and weekly), and the monitoring of information related to COVID-19 was periodic. Specific strategies and plans for dealing with outbreaks were prepared and updated continuously in interaction with the operating companies and municipalities involved. Eventually, the OFFB established a best-practice document to deal with pandemic-related incidents.

5. Discussion

This section presents patterns of learning that emerged from EROs related to the three COVID-19 outbreak cases. The theoretical background provided us with a lens to give meaning to and discuss our empirical findings. Note that the scope of this study only covers some details from the operational context in the study's three cases. In a recently published paper [74], authors apply the Functional Resonance Analysis Method (FRAM) as a systemic approach to analyze emergency-response operations for the same three cases of COVID-19 outbreaks. They explain, verbally and graphically, nuances of action and interconnectivity between them and emerging adaptations leading to developing and modifying an emergency plan. In this study, we go a step further and coin several instances of two learning patterns, emergent versus planned learning (see Figure 1). For ease of presentation, possible feedback effects on learning sources and stances are not shown.
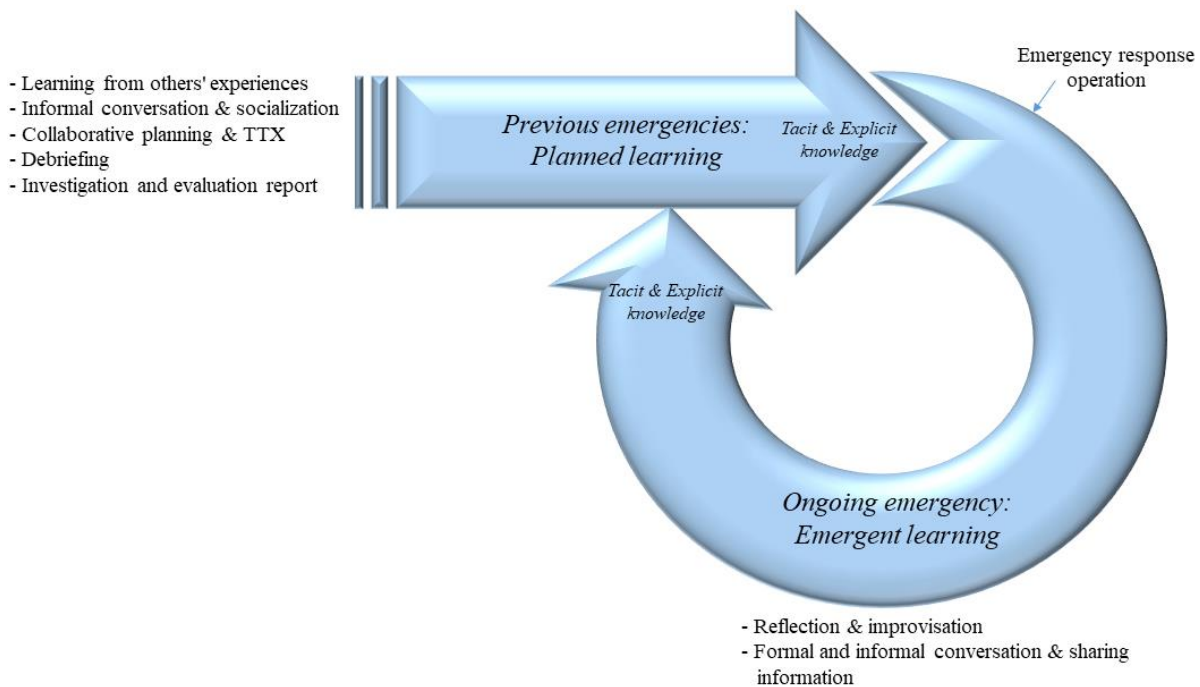

Figure 1. Pattern of learning, sources, and stances.

While the ongoing emergency in Figure 1 refers to the present moment and current situation, the time aspect related to the previous emergency is open to interpretation. Tacit knowledge in Figure 1 refers to experiences that promote "know-how" knowledge, for

instance, in creating a trustful relationship, sharing information, and communication. The explicit knowledge indicates codified facts regarding standard procedures and emergency-response plans.

5.1. Emergent Learning: Reflection and Improvisation

Emergent learning, here, is about changes observed during the process of creative problem-solving as new understanding, approaches, and behavior unfold. The findings in Section 4 present several instances of transparency, flexibility, improvisation, and adaptation while conducting tasks during the execution of the EROs. These elements are related to mindful decision-making and strategy agility. An important factor in the agility theory (Section 2) is the ability to change systematically but rapidly [49]. Accordingly, during three outbreaks, individual skills, knowledge, and the capacity to collect the correct information—so-called situational awareness—were used as a basis for learning. The ERO mission was solved by being able to limit infection on board, while infected and close contacts were flown to shore. These experiences can be compared to "sense-in-the-making" learning [75]. The organization accumulated knowledge during interactions with others and while using previous experiences from similar situations. Employing improvisation and adaptation to solve problems encountered during the events are instances of emergent learning.

The emergency management strategy in the OFFB is based largely on a command-and-control mindset. The ERO actions are derived highly from routine and are automated, following the emergency-response plan, regarding selected DFU (defined hazard and accident situations). Several of the DFU scenarios in the OFFB's emergency plan are expected to be less complex. In such scenarios, command-and-control-based management can work well, as there are not as many high demands on cognitive capacity or sociocultural skills during an ERO. The challenges arise when one encounters more complex situations than described in the plans, as OFFB experienced during the pandemic events.

According to the threat rigidity theory, a high level of uncertainty and time pressure leads to a narrowing of control and restriction in the flow of information processing [67]. An operational pattern based on a strong command-and-control strategy can lead to inflexibility in the emergency-response organization. An impaired ability to improvise prevents the organization from experiencing emerging learning during events [8] (p. 140). Rake and Bøhm [75] draw on the research direction Naturalistic Decision Making and allude to the importance of the emergency manager's broad approach to making decisions. Experienced decision-makers must be able to use their previous experience and draw parallels to the situation they are in when decisions are to be made. To enhance emergent learning capacity and to avoid tunnel vision, it is more important to enhance emergency managers' ability to broadly appraise operational and tactical problems than to think of specific situations and focus on a single goal or point of view [76]. Such an approach during competence-enhancing training and exercise activities can help to strengthen important resilience characteristics in an organization.

Emergency managers at the OFFB explain that the flexible approach during the pandemic events initially had a short-term learning effect in the organization. Time will tell whether the emergent learning effect will be long-lasting and lead to a more resilient mindset in more areas than COVID-19 only.

5.2. Planned Learning

The idea behind planned learning is by no means novel. On the contrary, it is strongly linked to the classical work of Ajzen's planned behavior theory [77], reflecting on how "people are willing to try, of how much of an effort they are planning to exert, to perform the behaviour". In a broad sense, this study considers performing a behavior to be a deliberate measure taken to learn, where learning is the focal point, for instance, evaluation processes, debriefing, informal conversation, and exercise activities. Relevant empirical findings from the study's three cases are considered as each aspect of the planned learning is discussed below.

5.2.1. Debriefing

After the incidents, the individual emergency manager was responsible for debriefing those involved in the OFFB, as well as attending a joint debriefing session with all the emergency-response organizations involved. Capability card CC6 (Table 2) addresses the crucial role of systematic management of policies in developing and revising procedures and checklists (DRMG theme). In this regard, the OFFB's member companies and interacting actors were invited to an "experience transfer" meeting. The main message was to highlight how important collaboration, flexibility, creativity, and initiative had been to solve challenges that were not described in the planning framework. The main points of the debriefing process were writing a report, recording findings in quality systems, and communicating learning points. After the events, evaluation reports were written, which formed the basis for sharing learning. The evaluations after the incidents were conducted in accordance with the best-practice document. The OFFB's emergency-response personnel have good training in evaluating and analyzing incidents and exercises. The findings indicate instances of what Rasmussen points to as a generative safety culture [78] in terms of having an arena to voice one's opinion and a drive for continuous learning. Emergency managers describe that the learning focus in operations has been aimed at identifying what went wrong or could have been handled better according to the plans. Identified findings after exercises and incidents must be registered in the quality system and analyzed before measures are decided on and communicated out in the organization. This process complies with the quality standard ISO 9001-2015, on which OFFB is certified. The learning processes consist mainly of corrective measures on identified deviations similar to the process Argyris describes as single-circuit learning [33]. The fact that there was a shift toward also safeguarding positive experiences was reflected to a lesser extent in the quality system.

5.2.2. Collaborative Planning and Tabletop Exercises

The training activities aim to enhance the emergency manager's capacity to deal with incidents in accordance with ER planning. Another goal of training activities is to promote common ground for cross-organizational collaboration in ER operation, which is indeed aligned with one of the 13 capability cards in the DRMG (see Section 3.3)—in particular, CC3—establishing networks. To spread learning throughout the organization and check that the necessary changes were reflected in the revised plan, tabletop exercises with COVID-19 as the topic were carried out. As a result of a collaborative planning process between the actors involved, scenarios for exercise were developed. These scenarios aimed to enhance the capacity of the organizations involved to "collaborate", "communicate", and "share information" in rapidly changing environments, as described in the scenarios. In line with the DRMG theme, supporting the coordination and synchronization of distributed operations (Table 2), the findings showed that collaborative activities facilitated interaction and joint relationship efforts, which increased the teams' flexibility and creativity. This manner of promoting a common ground (CC1 in Table 2) corresponds to the principle of "bricolage" [63]. The conclusion after the outbreaks was that interaction generated learning possibilities for the ER organizations involved [41].

The individual emergency manager was responsible for identifying learning points. However, this requires mindful behavior, with support at the strategic level (leaders) to continuously assess the existing status of the system. It also requires awareness of the learning barriers (Table 2) in terms of openness, flexibility, and willingness to change in the organization [79]. Failure to recognize isomorphic properties, the rigidity of core beliefs, and ineffective communication hamper planned learning [80].

5.2.3. Informal Conversation

Another important part of the planned learning that took place was sharing experiences and reflections discussed in informal conversations among employees of the OFFB. Emergency managers point out that this was a very important part of learning in the aftermath of the incidents. The talks allowed for two-way communication and an opportunity

to discuss in depth the issues the parties had faced. Here, updated plans were tested against more generic scenarios related to infection situations offshore. Following the incidents, the organization prioritized improving on what did not go well during the incidents and decided to take measures to prevent emergency personnel from facing the same problems during the next COVID-19 situation. This patten of learning is covered by CC6 (Table 2), the systematic management of policies. However, our findings indicate that there was less focus on how to learn from situations where one had to show openness and improvise beyond what is stated in the plan. How this type of learning, i.e., emergent learning, can be transferred to other situations has also not been an issue in planned learning activities. The OFFB has not used any systematic methods to measure the effect of emergent learning after pandemic events. At the same time, changes have been observed in how the emergency-response organization handled the three incidents as a result of experience transfer and the development of planning.

5.2.4. Learning from Others' Experiences

The study's three cases occurred in the last six months of 2020. The events came in the aftermath of the COVID-19 outbreak on the Hurtigruten MS Roald Amundsen ship at the end of July of that year. The Hurtigruten case became front-page news in the Norwegian media and occupied TV channels and social media for several weeks. This outbreak led to suspended operations and a police investigation. The ship's management was heavily criticized for poor handling of the situation. Several sources had informed the shipping company of the COVID-19 outbreak aboard the MS Roald Amundsen from 29 July 2020. On the same day, the Norwegian Institute of Public Health recommended the passengers be notified and further COVID testing be conducted on two crewmembers. However, the company neglected to apply infection-control measures or notify passengers on board, the crew, or relevant public authorities about this. For weeks, Hurtigruten was heavily criticized, among other things, for allowing employees to work on board MS Roald Amundsen while they were in quarantine.

The study's first case occurred immediately after the outbreaks of infection on the Hurtigruten ship, and the experience of the incidents was used by the OFFB while handling them. For instance, it was decided that personnel on board should not be sent from the offshore platform to the mainland until reception centers on land were organized and clarified with the municipality on site.

5.3. Learning Barriers

In a learning-based organizational structure, hierarchy, procedures, and routines should be broken down before new learning-based structures are introduced [8] (p. 133). During document studies and interviews, it has emerged that the OFFB's organizational structure is built around a command-and-control philosophy. Establishing conditions for adapting plans (CC4 in Table 2) highlights the importance of flexibility and improvisation ability in managing adaptive capacity. Our findings indicate that the organization is measured and assessed against compliance with plans, procedures, and performance requirements. However, emergency managers believe that the cultural expectation of following a plan and meeting performance requirements can inhibit the learning process that takes place during incident management. Related to the capability card CC6, here we address a need for a constitutional and transparent space as an organizational support system to maneuver relative to the ER plans and the OFFB's standard procedures.

Prior to the incidents, the OFFB had established a broad network and carried out several cooperative activities with the actors involved. These networks were also used to coordinate the response during the COVID situations. Crisis management involves multi-organizational networks and requires good cooperation and coordination [61,81]. A centralized top-down-style management system might hamper flexibility and adaption. It also might lead to over-planning, thus suppressing the variability and uncertainty involved in EROs (see quotations from interviews in Section 4.2).

Kayes [82] believes that stretching political governance can create inflexibility, which in turn inhibits learning. If the strategic focus of management is aimed at performance, and the criteria for what is good event management are narrowly defined, this may come at the expense of the learning processes. On the other hand, good adaptability, flexibility and the ability to make adjustments along the way will promote learning processes. The basic conditions for interaction and learning during emergency-response incidents, described by Steiro and Torgersen [83] as "samhandling" under unpredictable conditions, a deeper form than collaboration, hinge on complementary skills. Evaluation reports with feedback from participating actors, together with event logs and own experiences, formed the basis for the analyses of the events. However, it is important to note that good and safe communication is crucial since the emergency-preparedness manager has been part of the handling.

The OFFB has established KPI (Key Performance Indicator) values to assess ER operations. As is common to all performance indicators, it measures quantifiable values or the degree of compliance with plans and procedures. None of these KPIs contains elements of the emergency-response personnel's cognitive assessments or internal and external interaction. Emergency management is linked to both cognitive and sociocultural abilities. Less focus on sociocultural aspects restricts the capacity to reflect on the working environment and, thus, reification, i.e., translating tacit to explicit knowledge [40]; thus, it hampers the ability to learn.

6. Conclusions

Three emergency cases consisting of "real scenarios" that occurred within a given period during the COVID-19 pandemic established some learning patterns and knowledge to be derived from the lessons learned. These cases provide valuable insights into an organization's ability to learn and adapt. They also demonstrate the interplay between planned and more informal ways of learning, which can also help to create a bricolage of emergency responses. From the academic side, the findings indicate the effect of collaborative activities on joint emergency-response operations (EROs) beyond a single organization in reaching goals. The application of DRMG in the three emergency cases demonstrates ways of exploring emergency responses in a resilient manner. While this study used DRMG as a tool to investigate three specific cases, in the same way, it could be applied proactively to study the resilience characteristics of an emergency management system and identifying improvement potentials. Furthermore, the results show that managing the complexity involved with an ERO requires that all involved agencies adopt a transparent approach to joint decision-making built on a trusting relationship. So, developing a holistic theoretical framework as a "lens" to explore joint-relationship efforts seems promising for further studies. Regarding the context of the study, studying emergencies over time might reveal more aspects of emergency responses and enable both patterns of learning and disruptive patterns of learning. This means that a commitment to both planned and emergent learning should be established. The planned aspect of learning is easier to institutionalize, whereas the emergent aspects need to be fostered and nurtured by management.

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