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Context and aims

- 1 The recreational use of mountain areas is the origin of frequent accidents, sometimes with very serious consequences. Quantifying and explaining the causes of accidents are key to improving knowledge on this sensitive issue (Soulé, 2018). To this end, since 2015, the Laboratory of Vulnerabilities and Innovation in Sport (L-VIS) has been participating in collaborative action research (CAR) in France (Boutroy & Soulé, 2018), involving parties from several spheres: the Petzl Foundation (Petzl is a French climbing and caving equipment company), the online community Camptocamp (C2C) (aimed at those who practice mountain sports), stakeholders from the public sector (mountain rescue services and the National Observatory of Mountain Safety, SNOSM¹) and the non-profit sector (sports federations), and professionals (guide organizations).
- 2 At the end of 2015, this collaborative project resulted in the launch of an online system to collect participatory testimonials on accidents and incidents occurring during the practice of mountain sports: the SERAC database.² This open-source platform employs an approach of the voluntary sharing of accidents and near-misses experienced in the mountains, based on the premise that the input of amateurs and “ordinary” practitioners is a fertile source of knowledge for improving risk prevention. However, this input requires sufficient contextualization of and level of detail in the testimonials, which is why the submission form is structured in several sections that aim to encourage the fullest possible accounts.³ The development of the SERAC database arose as part of a wider dynamic to optimize the study of data provided by the interventions

of specialist rescue services, which led to the observation that it was necessary to involve numerous parties around the issue of accidentology in mountain sports. Today, this dynamic revolves around setting up experience feedback systems, of which SERAC is an example.

- 3 The objective of this article is to describe the three main stages of this social innovation ‘in the making’ (Hoholm & Araujo, 2011). Taking a process studies approach, it aims to examine the trajectory of an innovation in the process of stabilization, rather than an already completed product or the formalized structure that underpins it. We aim to show how the involvement of a growing number of stakeholders and increasing support is transforming research practices, as well as the type of knowledge produced, on risks related to alpine practices, particularly by evolving into a ‘freer’ model.

Theoretical framework

- 4 Our analysis is rooted in the sociology of science and technology (SST) (Latour, 1989), which argues that scientific knowledge is shaped and solidified by its links to a range of social, financial, temporal and material resources. It only becomes ‘true’ when, overcoming controversy, it is diffused and appropriated in increasingly wide and heterogeneous networks (Latour & Callon, 1990). The production of knowledge about mountain sports practices and accidents is thus not just a reflexive and theoretical process; it involves the use of technical systems and the recruitment of various non-material entities (Vinck, 2006), whose agentivity can frame and reconfigure human action (Latour, 2003). It is also shaped by a unique mountain environment made up of the interaction of human and non-human elements that are deeply intertwined and interdependent. In our case, this might be, for example, elements linked to where the practice takes place and advances in technical mountaineering equipment, as well as software, the submission form for collecting incident reports, how data is recorded (testimonials, diagrams, graphs) and how it is diffused. The website architecture of *camptocamp.org*, the host platform for SERAC, its requirements and the routines of its users contributed to the design of the form to collect testimonials as well as the scope of its dissemination. In terms specifically of accidentology, high-mountain sports environments –considered as a system emerging from the interaction between human and non-human elements– have particular properties such as uncertainty (linked to the extreme diversity and lability of the elements) and irreducibility of risk. The possibility of ‘domesticating’ them through infrastructure is low or inexistent (Salim *et al.*, 2019). The conditions of the weather and terrain (the quality and stability of the snowpack, glacial or rocky terrain, snow cover, etc.) fluctuate. These environments consist of non-human elements in interaction with sports practitioners –themselves subject to subjectivity, variability and various symbolic and cultural attachments– creating complex, changing and unstandardized situations.
- 5 Moreover, the sports culture in which alpine activities take place is singular: it is inseparable from risk, and the stakes are very high in terms of impacts and lethality. Physical engagement lies at the very heart of the practice –an inescapable corollary of the activity that is minimized by managing danger at every moment. The philosophy of mountain sports arises from the paradox between this conscious exposure to risk and its meticulous management to reach the target objective in the safest possible way. The mountain environment is both a physical and social space of risk confrontation that is

tolerated –even sought after– and which requires the management of threats (individual, collective, community and institutional). An understanding of this environment is necessary to ensure that its specific characteristics are taken into account in any approach to accidents, as well as the research methods used and the preventive recommendations made.

- 6 The alpine environment is in fact a ‘micro-world’ (in the sense of Strauss, 1992) that possesses specific codes, as well as institutions with expertise in technical training, the analysis and prevention of risks, and rescue for accident victims. Riven with historical rivalries and tensions (between sports federations, professional organizations, rescue services, etc.), these parties have “different interests, contest each other, and make or break alliances to achieve the things they want” (*op. cit.*, 277). This state of affairs, combined with territorial, socio-economic, legal and corporatist issues, generates a certain ‘policy of secrecy’, as well as forms of conservatism and battles for legitimacy between professional spheres. This makes it difficult to initiate dialogue around the sensitive issue of safety and to get different stakeholders to cooperate.

- 7 In short, the specific characteristics of the environments where alpine sports are practiced, in relation to a unique sports culture and safety institutions, will be the focus of our analysis, which takes an original approach to exploring mountain accidentology.

⁴ The creation and then socialization of the SERAC tool is thus considered as an innovation and understood as a process of construction of a socio-technical network (Akrich *et al.*, 1988) in which the innovators aim to involve other agents (human and non-human) through different operations: problematization, generating interest, translation and enrolment (Callon, 1986). In this context, the genesis of the SERAC platform, part of a wider project of improving accidentology, can be perceived as the rise of ‘open-air research’ (Callon *et al.*, 2001), carried out jointly by non-scientists, and in this respect very different from science restricted to the usual confines of academic or industrial laboratories. Our analysis seeks to “understand the ecology of the conditions of the production of knowledge” (Vinck, 2006) as well as its transformation/appropriation.

Method

- 8 This article presents the reflexive and collective analysis of four researchers⁵ involved since 2012 in the development of SERAC and the exploratory production of knowledge this incident-collection tool has allowed. The issues to be addressed were co-identified with the other project stakeholders, placing the project in the framework of CAR since the investigation has both practical and scientific relevance (Lefrançois, 1997). Such an approach requires a continual effort to identify intersecting and shared interests. From the creation of the testimonial submission form to the periodic drafting of analytical reports, ‘mutual adjustments’ had to occur between stakeholders (Gonzalez-Laporte, 2014).
- 9 This retrospective analysis, carried out after the fact by observer participants, uses the descriptive terminology of SST. It gives an account of the laborious development of the network of stakeholders who consolidated, modified and occasionally undermined SERAC. This contextual account of accidentology ‘in the making’ is reinforced by the fact that the tool is still in development: the scientific practices and knowledge produced are still very unstable. A non-idealized account, it is based on the many

exchanges (during meetings, round tables, seminars and interviews) and actions (the collection and processing of data) in which we participated over time. It focuses on the gradual involvement and enrolment of stakeholders, without ignoring the controversies or resistance of certain among them, nor the bifurcations or transformations of this still unfinished project whose development has been far from linear. The compromises, tests and transformations of the project are discussed in order to illustrate how disparate elements were associated in a network and to assess the knowledge that emerged from this assembly.

From conventional research to an open-air, open-source laboratory

The problematization phase (2012–2014): moving from factual accident statistics to collecting incident testimonials

- 10 In 2012, our initial aim, supported by the Petzl Foundation (a corporate foundation), consisted of collecting (sometimes with difficulty), analysing and consolidating all existing quantitative knowledge about the ‘facts’ surrounding mountain accidents. In order to render alpine accidentology more reliable (notably by optimizing the use of data from public services on mountain rescue operations), it was necessary to frame, negotiate and adapt the enquiry to institutional requirements. This initial phase, presented in a report available online,⁶ made it possible to bring together a network (at that point fragile) of the key stakeholders in mountain safety around a sensitive subject, allowing the emergence of the idea that publicizing and sharing statistics was a common concern in the area of accident prevention. This relative success then made it possible to obtain financial and social support to undertake a new programme: to develop primary and more qualitative knowledge on the dynamics and contexts of accidents. The end of this problematization phase (Callon, 1986) led to the identification of the relevant actants (in the sense of Latour) to involve in a project to collect incident testimonials: pre-existing models (the North American Alpine Near-Miss Survey, qualitative feedback approaches used in mountain organizations as well as in other sectors), tools (submission forms, software), organizations (C2C, federations, associations), resources (funding, doctoral research), mountain sports practitioners, etc.
- 11 The action research approach adopted at this stage was deliberately participatory and involved questioning different stakeholders in the attempt to provide them with added value in the form of knowledge restitution (reports, conferences, specialized media articles, etc.). However, it did not yet include the next step of truly integrating stakeholders to co-construct knowledge. Faced with the duality between the production of scientific knowledge and the perspective of deliberate change (Lewin, 1947 cited by Liu, 1992), the reticence of certain institutions, and a lack of experience with CAR, in this initial phase we remained in a conventional research posture, although this was modulated by the interest of the stakeholders on the ground and their need for practical knowledge. The approach remained rather traditional: the collection of pre-existing ‘facts’ on accidentality, the academic work of ‘purification’⁷ to produce new data, and the restitution of these ‘results’ consolidated to support preventive measures. The project was still situated in an incipient participatory

approach, in which conducting research remains ‘external’ to the social sphere where it is received. Interest in the project from various important institutions in this micro-world (public authorities, sports federations, professional organizations, foundations, C2C communities of practitioners of mountain sports, etc.) nevertheless grew. While the involvement of stakeholders in the field in the choice of data collection and analysis methods remained limited at that stage, it gradually increased as the research evolved (Gonzalez-Laporte, 2014).

The exploration phase (2015–2019): the prototype and the first stakeholder enrolments

- 12 For the researchers, generating interest in the project involved trying to define an exclusive relationship with and between alpine stakeholders, from the joint (re)definition of the issues, based on a shared goal, to the modalities of collaboration around a study aim. The network crystallized around a collective with complementary skills (researchers –including a doctoral student dedicated to the project– see box, the Petzl Foundation, C2C) who, taking inspiration from and adapting previous tools, negotiated and slowly prototyped a data collection tool: the structure of the submission form, the items it would include, its user interface, where it would be hosted, how it would be accessed, etc. The drafting, proposal and acceptance of a doctoral project on the broader issue of alpine sports accidentology was another result of this progressive enrolment around a common issue.
- 13 To involve new stakeholders, it was necessary to carry out translations (Akrich *et al.* 2006) via successive transformations of the SERAC tool in order to link heterogeneous issues. For example, by allowing SERAC to be adapted so it could be used as a service by a sports federation (for its own activities or for safety considerations), as a means of establishing the federation as a spokesperson for innovation to its members and managers. Such actions imply compromises, or even controversies. Thus, as researchers we progressively accepted concessions vis-à-vis conventional research practices concerning the SERAC tool: renouncing direct academic exploitation, abandoning the exclusivity of data use, streamlining the form for collecting testimonials (even if this sacrificed more detailed contextual or socio-demographic data), prioritizing simplified reports that could be disseminated to the public in open access online, and so on. In particular, there were long debates before allowing public comments on testimonials posted on SERAC, in line with the community conception of C2C. One of the issues was the aim to differentiate the platform from competing alternatives being developed at the same time (such as the feedback platform launched by the French Federation of Mountaineering and Climbing, FFME, in 2015). It was also necessary to encourage the participation of independent alpine sports practitioners to give their testimonials and develop the habit of sharing their near-misses and accidents online: by increasing the visibility of the form on the C2C site (via a promotional banner and a link in the main menu) and the intervention of moderators to promote the tool and encourage the use of its forum. To launch the SERAC platform, accident testimonials previously submitted on C2C were translated into the new database.
- 14 During the design stage of SERAC and the first analyses, the project was strongly influenced by non-human agents, such as analytical feedback models used in the industrial sector (search for failures and deviations from established procedures, a fault

tree of events using Storybuilder software,⁸ for example). This is an indicator that the scientific programme around SERAC retained the goal of objectifying reality, producing fundamental knowledge in the aim of clarifying, modelling and compiling incidents in order to identify risk factors and recurrent sequences. To a certain extent, this aim of gaining scientific legitimacy was congruent with the expectations of the institutions and the sponsor, who sought to base concrete preventive recommendations on an objective approach. This stage resulted in the publication of a second report in 2017, based on the first 184 testimonials submitted to SERAC.⁹

- 15 This initial processing of qualitative data using a quantitative approach seemed to set the tone for subsequent analyses, which required only the accumulation of new testimonials in order to produce quantitative advances in accidentology. In this respect, the network and the action research, mainly influenced by the researchers, tended towards a form of positivism (Gonzalez-Laporte, 2014). The need to further deploy SERAC, to deepen the analysis of accidents, and to make better use of existing data from public mountain rescue services, led to the development of a doctoral project, which started at the end of 2018. At that stage, the project was torn by an epistemological duality, caught between an expectation to produce fundamental knowledge and a desire to collectively construct practical knowledge. While the project aimed to be collaborative and in situ, it struggled to distance itself from a research posture based on the conventional scientific method: data collection via a participatory process, the external analysis of this data, and the production of knowledge that is ultimately handed over to the social sphere in the hope it will be adopted and translated into preventive measures.
- 16 The resulting doctoral project involved compromises. The research undertaken required access to data from rescue services, centralized by the SNOSM, for the purpose of refined statistical analyses. Yet the SNOSM was reluctant to disseminate raw information to alpine sports practitioners; historically, its information was provided only for prevention campaigns or to respond to media requests. It had long maintained a policy of confidentiality, pulled in opposing directions by the dual objective presiding at its creation: to advance accidentology in mountain sports in order to support prevention campaigns, but also to avoid alarmist interpretations by the media and the general public (Soulé *et al.*, 2015). As a result, the knowledge held by the SNOSM remained little published outside of a limited circle of institutions. Allowing access to this data, thereby making the doctoral project feasible, was thus a gesture of openness regarding this sensitive data, making it possible to collaborate with new stakeholders. Through the SNOSM, the support of the ENSM (and its board of directors) and the rescue services had to be obtained. At this stage of project development, the issue of trust was essential, aided by the researchers' social and cognitive proximity to other stakeholders (one researcher is a high mountain guide, and the doctoral student also became an aspiring alpine guide –see box). From an institutional point of view, the perspective of ambitious scientific exploitation of statistics proved persuasive in a global context of pressure to make the most of funding granted by public authorities.
- 17 While alpine organizations were initially curious, doubtful or even critical spectators of a research project consisting of 'observing' their practices, they became an integral part of the project, or at least inclined to collaborate. The creation of this engagement was a laborious process, but benefitted from a favourable context considering risk in the mountains, and notably the recurrent concern of its financial and social impacts.

Once the stakeholders had been identified and their methods in terms of accidentology understood, the next step was to change the approach in order to make it relevant, indeed necessary, to their respective objectives and inclinations. This involved emphasizing the shared expertise within the network, highlighting a two-fold need: (1) to make quantitative information on rescue operations more reliable, better exploited and more widely circulated; and (2) to learn from incidents without significant physical impacts, which often escape any type of analysis, and reinterpret them to create a source of collective knowledge.

A mountain guide/researcher as ‘intermediary’

In the mountain environment, technical expertise, experience and qualifications (sports-related or professional) are central to credibility (Boutroy & Soulé, 2018). The sensitive nature of accidentology, combined with institutional, symbolic and legitimacy issues specific to the micro-world of alpine sports, make this a context in which the acceptance of a researcher is challenging. In our case, the background of the doctoral student in the research team underlines the importance of ‘intermediaries’ (in the sense of Hennion, 2013) in the production of knowledge and innovative tools, as CAR requires a shared culture between researchers and stakeholders in order to promote mutual understanding (Narcy, 1998).

Between 2012 and 2014, the future doctoral student joined the project as an intern. With a significant level of amateur alpine experience, her first role was as a spokesperson (Akrich *et al.*, 1988) for sports practitioners. From 2015 to 2018, while seeking funding for her thesis, her integration into the ‘alpine environment’ intensified: in 2016 she joined the French National Women’s Mountaineering Team (ENAF) of the FFME, and in 2017 she passed the qualifying exam for high-mountain guide training. The ENSM and the National Association of Mountain Guides (SNGM) accorded their trust in this mountaineer, who in 2018 joined the profession as an aspiring guide. The opportunities for informal exchange made possible by shared practice (in mountain refuges or during training courses, etc.) stirred interest in the project and aided collaboration. The PhD student collaborated with SERAC,¹⁰ which on several occasions solicited her expertise in experience feedback, and participated in the SNGM mountain safety conference, the ENSM guide recycling training group, the general assembly of the French Federation of Alpine Clubs (FFCAM), etc. All these occasions provided opportunities to promote the innovation tool and to emphasize its potential and importance in terms of knowledge.

Yet an ‘intermediary’ is not simply someone who facilitates links within a network of parties, or “the interface between two *known* worlds: he or she constructs worlds by trying to put them in contact” (Hennion, 2013, p. 47). Recognized by the other stakeholders, the student became their representative: being their spokesperson (for mountaineers, researchers, professionals, sports federations, accident situations, etc.) was not so much a question of representing them faithfully, but “to prevent acting as if they weren’t there” (*ibid.*, p. 53). As such, the question of the proximity of the researcher to the study objective or the practitioners is not posed in terms of scientific or axiological neutrality, but in

terms of the awareness of the stakeholders one represents and who are participants in the production of a research tool.

Attracting Interest (Ongoing Since 2019): Changing the Programme

- 18 The network that was gradually created around SERAC and the doctoral project has recently entered a new phase of attracting interest, which nevertheless remains fragile. New stakeholders (SNGM, FFCAM) have adopted the proposed model of experience feedback and adapted and disseminated it. Some of the enlistments are institutionalized, governed by registration (membership letters or conventions, etc.), others are based on a more collaborative approach similar to donations. These enrolments are, however, reversible, and require sustained work (in particular by the doctoral student) to maintain the established network. The enlistment of the practitioners is incomplete, as is the formalization of the emerging knowledge and its 'public'.
- 19 The very principle of experience feedback, and more broadly the dynamic of making accidentology a knowledge issue, is little by little gaining popularity within institutions. In the wake of SERAC, many organizations (professional associations, federations, etc.) are now encouraging and seeking to exploit incident reports from their members. In this way, the 'creation of safety' is progressing in mountain environments, and these initiatives are shifting the boundaries. The tools produced are not always convincing and/or adopted, due to a lack of expertise or time devoted to implementing these systems, and/or to the analysis and dissemination of the data collected by these means. While these parallel systems of experience feedback weaken the network created around SERAC, at the same time they testify to the enthusiasm for an experience-based feedback approach (which is itself an innovation, beyond the specific tool of SERAC). For example, as mentioned previously, the FFME launched its own experience feedback tool in 2015, but without any lasting momentum.¹¹ In contrast, a partnership was initiated with the FFCAM in 2019 to adapt SERAC to the federation's expectations and needs. In 2018, the SNGM organized the first Alpine Safety Conference, with the aim of tackling the particularly high accident rate and exposure to accidents in the profession. The association created its own experience feedback system, largely inspired by the rationale and architecture of SERAC, but remained affiliated to the network. Less and less resistant to collaborating with amateurs (in particular C2C), the SNGM included the doctoral student at its second Mountain Safety Conference in 2019 (co-organized with FFCAM) and in its Experience Feedback Processing Group (GREX). While imitation generally has pejorative connotations and is considered antithetical to innovation, in fact it is an essential tool in many innovative processes (Godin, 2017).
- 20 In terms of contributors, enrolment remains insufficient: although the submission of testimonials is stable, the rate needs to be increased. By mid-2020, the SERAC database had collected nearly 400 incident reports, with 72% concerning mountaineering, in the sense of recreational use of 'wild' mountain areas (lacking infrastructure): 162 in ski mountaineering and ski touring, 53 in alpine rock climbing or adventure terrain, 59 in snow, ice or mixed mountaineering, and 7 in ice climbing. The other testimonials mainly concern climbing with one or more pitches (n=88) and, to a much lesser extent, hiking (n=16). The level of detail in the testimonials as well as their number creates

challenges: within the accounts on mountaineering, for example, 45% are too allusive to be used for secondary exploitation (e.g. the mention of only one contributing factor to the event).

- 21 It is therefore necessary to encourage some of the tens of thousands of C2C members to become contributors, not only accepting to share their experiences of alpine incidents, but to flesh out their descriptions. Beyond the small number of contributors who are really active on the forums,¹² this engagement involves a reversal of the view of accidents and near-misses, which are often a sensitive subject and are sometimes tinged with feelings of guilt: the challenge is to persuade practitioners to expose them publicly in order to better understand them rather than shunning them, keeping them quiet or concealing them. Previously, exchanges about experiences were often shared exclusively between experienced mountaineers (professional or not) and/or limited to circles of friends. Starting from the hypothesis that contributors lack recompense in respect to their 'gift' to the community when they share a testimonial, and to convince them of the concrete interest of these contributions, the choice was made to exploit the information in multiple ways, including through 'intermediary' knowledge yet to be finalized (adapted from Vinck, 1999). This outreach work to bring SERAC to the public has accelerated since 2019.

Multifaceted outreach to practitioners and professionals		
Media	Year	Title
Petzl Foundation website & Camptocamp ¹³	2019–2020	Analysis of SERAC testimonials: alpine rock climbing and adventure terrain
		Analysis of SERAC testimonials: snow, ice or mixed mountaineering and ice climbing
		Analysis of SERAC testimonials: ski touring
<i>Vertical</i>	2020	The accidentology of mountain sports (no. 77)
<i>Montagnes Magazine</i>	2020	Accidentology: an initial analysis for alpine rock climbing and adventure terrain ¹⁴
	2020	Accidentology: an initial analysis for snow, ice and mixed mountaineering and ice climbing ¹⁵
	2020	Accidentology: an initial analysis for ski touring ¹⁶
<i>AlpineMag</i>	2020	Accidents in snow and ice mountaineering: an analysis of SERAC testimonials ¹⁷
<i>La Montagne et Alpinisme (FFCAM)</i>	2021	What is the purpose of experience feedback in ski touring? Insights and results from the SERAC database ¹⁸
<i>Neige & Avalanche (ANENA)</i>	2021	Ski touring: falls, a neglected risk in prevention? A cross-analysis of mountain rescue data (PGHM) and SERAC experience feedback

- 22 Other outreach initiatives have been launched, such as the integration of results in the framework of initial and ongoing training of high mountain guides or disseminating information via guest lectures.
- 23 While the enrolment of certain stakeholders remains insufficient or fragile, the network developing around the principle of experience feedback is both expanding and consolidating. It is reaching an increasingly diverse public: contributors to C2C, readers of specialist press dedicated to alpine pursuits, amateur members, professionals, trainers, etc. The nature of the knowledge itself is changing, and the project is evolving epistemologically. Notably, the open-source philosophy embodied by C2C and free access to the SERAC tool and data have contributed to reconfiguring the production of knowledge in a way that is more collaborative and horizontal. After a period of hesitation, the analysis departed from its initial focus, which aimed to identify typical accident trajectories. The diversity of alpine activities; their lack of protocol, requiring continual adaptation of skills; the variability and uncertainty of the environments in which these activities take place; as well as the detailed but unstandardized information collected on SERAC render it impossible to make explanatory generalizations.
- 24 Currently, the main goal is to promote a culture of sharing experiences, then potentially to take advantage of this to advance prevention. The first effect is reflexive: structuring and writing an incident report provides an opportunity to take a step back from one's behaviour and decisions; in other words, it makes it possible to carry out a more or less detailed self-analysis of the situation and one's choices. The aggregation of these reports then constitutes a bank of testimonials that can be consulted, allowing everyone to learn about difficulties encountered and overcome by others, which is conducive to reflection on their own practice. This allows the experience feedback on SERAC to become a tool that aims to "provide the means to reflect on the experience (...), to learn from the consequences, to remember it and to reuse it" (Weill-Fassina & Pastré, 2004). Wallace and Ross (2016) have shown that this type of reflective practice resulted in a lower rate of workplace accidents.
- 25 In our case, from a research perspective, the project has become more descriptive and comprehensive: analyses and summaries are aimed at exploiting this information bank and translating it to encourage its appropriation by alpine practitioners. By grouping together similar scenarios, highlighting –through a deliberately accessible analysis– certain recurring elements of interpretation, the aim is to encourage reflection on certain safety issues without being reductionist. For Wallace and Ross (2016), it is a question of reasoning in terms of 'concrete cases', in which the expert is no longer the one with knowledge of abstract laws, but rather the one with experience of specific cases (Schön, 1983, in Wallace & Ross, 2016). The preventive emphasis is placed first and foremost on the interest of first-person accounts by 'expert' practitioners, and on the power of transposition –indeed identification– of other practitioners with these detailed accounts of real situations. The use of concrete examples tends to give substance to preventive recommendations in an ecological approach (Hage & Reynaud, 2014; Wallace & Ross, 2016) that aims to contextualize human actions in a system of interactions that they form with their natural, material, cultural and social environment (Barbier *et al.*, 2013; Le Moigne, 1977). In a second stage it involves identifying atypical (rather than recurrent) scenarios, as well as the situational dynamics leading to physical engagement in full knowledge of the risks, through which

the practitioner can confront him or herself.¹⁹ Ultimately, the researchers are not only involved in ‘making knowledge known’, but in promoting submissions of experience feedback and an approach of sharing and reflexivity intended to allow others to make knowledge.

- 26 Reflecting the initial epistemological duality, the project is adapting, without completely abandoning the aim of generating fundamental knowledge, to attempt to allow the coexistence of CAR and plural scientific knowledge. While SERAC’s focus is to prioritize the exploitation of the knowledge produced, with the aim of ensuring the continuity of the innovation, the other two strands of the doctoral project take a more conventional approach. The quantitative analysis of SNOSM data is already bearing fruit in terms of identifying accident ‘black spots’: e.g. profiles of particularly high-risk practitioners, the main mountainous areas where accidents occur, the influence of season and types of terrain, etc. (Vanpouille *et al.*, 2021). The last part of the doctoral project will deepen the investigation of relationship to risk and practitioner engagement in full knowledge of the risks. It is guided by the quantitative analysis of the SNOSM data as well as the initial conclusions drawn from SERAC experience feedback. Thus, taken as a whole, the project has a dual objective: a CAR approach and the support of a social innovation; and through this, the production of contextualized knowledge that can be translated into preventive recommendations and the promotion of a more reflexive approach by alpine sports practitioners to their practice. The type of translations that will arise and the form of the knowledge these will impart is still unstable, and their temporality will certainly exceed this doctoral project. The ideal format would adapt to social and material developments in the mountain environment. The social innovation itself, the type of knowledge that results from it, and the doctoral project based on this are here described while it is a work in progress, so the forms they will take are yet to be defined.

Summary of the development of the project and the network

- 27 To avoid a simplistic summary of a process already divided into three distinct phases, this overview focuses on the main transformations in the project and its stakeholders.

	Phase 1: the context & problematization	Phase 2: exploration, attracting interest & prototyping	Phase 3: exploitation of data & reversible enlistment
Objectives & programme	Following the secondary exploitation of third-party data, the emergence of a programme to produce qualitative knowledge (accident scenarios)	Based on the plural skills and resources of stakeholders in the network, the aim is to develop and attract interest in SERAC Participation and the sharing of experience feedback (accidents, incidents) is encouraged	The socialization of the innovation and the promotion of the culture of sharing experiences Creation of a data bank of testimonials that can be consulted; exploitation of the data for preventive advances

Epistemological aspect	Lack of experience with CAR: stakeholders little integrated and co-construction tenuous Centrality of a conventional scientific approach	Epistemic duality within the network: expectation of fundamental knowledge versus desire for the collective and pragmatic construction of applicable knowledge Analytical model based mainly on objectification: production of knowledge through comparing incidents to identify risk factors and recurrent event sequences Partial quantification of qualitative material	Standardization of the experience feedback approach in the context of mountain environments Encouragement of reflexivity and self-analysis: departure from initial analytical foundations (generalization based on typical accident trajectories) and increased consideration of perceptions and subjectivity (ecological approach) Encouragement of transposition based on 'concrete cases' and atypical situations Posture of reflexivity and sharing to allow others to make knowledge
Main compromises	Efforts to translate/simplify collected data (online reports) Institutions increasingly accept the sharing of statistics	Redefinition of the question Transformation of the tool to allow the coexistence of multiple concerns Progressive concessions vis-à-vis conventional research practices: renouncing data exclusivity, academic publications, etc.	'Giving back' to contributors through outreach/wide dissemination of results Alternative form of scientific exploitation: writing about the SERAC innovation process, rather than its results

Enrolment and involvement	Identification and use of existing data leading to the increased circulation of information Identification of relevant actants to associate to the project of collecting incident reports Attention and curiosity of stakeholders in the mountain environment aroused Initiation of partnerships with several institutions, but reticence of certain stakeholders, as well as competing data production systems	Increasing and increasingly formalized involvement in the network; growing trust linked to social and cognitive proximity Intermediary and collaboration increasingly accepted –even desired– on the institutional side Decline of competing systems	Doctoral student becomes a spokesperson for multiple stakeholders and collaborates in a number of alpine organizations Experience feedback becomes commonplace in the main community (C2C); encouragement to share testimonials, references to SERAC Enrolment of contributors initiated, but this is somewhat stagnant

- 28 The main outputs of this innovation –neither the content nor the form– were initially envisaged as priorities. The aim now is less to reduce the subjectivity of the testimonials referring to typical situations of risk exposure in the mountains than to probe and harness this subjectivity. In other words, the technical and snow hydrology or meteorological analyses, as well as the attempt at generalized modelling, are now relegated to a secondary position, with the priority on taking into account the experiences and perceptions of the contributors and the reflexivity of the readers in the community.
- 29 The way of considering the concept of risk attests to the transformation of the project. Initially, following the typology proposed by Soulé and Corneloup (2007), the aim was process-oriented and systems-based: the objective was to identify recurrent events, and for each of these, the pattern of the danger (scenarios likely to lead to accidents or interacting factors that are aggravated or mitigated over time). This perspective proved incompatible with the nature of the activities, the environments where they are practiced, and the accounts collected. Moreover, as this interpretive framework is potentially normative in nature, it was rejected in favour of a relativistic approach (Soulé & Corneloup, 2007). The perhaps disproportionate desire to model has given way to a more modest goal that aims to encourage the reflexivity of mountain sports practitioners. Thus, risk is considered as a composite of actual situations and individual experiences perceived in situ.

Conclusion

- 30 Like other collaborative research in the mountains (*Refuges Sentinelles*, for example: see Clivaz *et al.*, this issue), the SERAC project is a sort of open-air laboratory in which part

of the work lies outside the boundaries of ‘academic research’. Doing science collaboratively changes not only how knowledge is produced, but the way of rendering the co-constructed information useful. Influenced by the enrolment of an online community, this project was transformed by the fact that this type of collective is based on “the collection of experiences and the construction of experiential knowledge” that allows “linking the formalized knowledge and personal experience” (Akrich, 2018, p. 20) of practitioners. In this sense, SERAC, and experience feedback more generally, points to what Akrich rightly calls a “community of experience”. This is manifested by a ‘corpus’ type of thinking, according to “the hypothesis that the aggregate of testimonials allows a more encompassing vision of the issues” (ibid. p. 27), a vision that is sufficiently broad and diverse that the individual can adjust his/her own choices, without excluding the possibility of constructing a form of generalization that goes beyond individual experiences. Will the SERAC network stabilize or unravel? Will the knowledge ‘solidify’ and, if so, in what forms and how will it be used? The interest of this case is perhaps precisely that the fate of SERAC and its output remains all the more uncertain in that it must be adopted by the greatest number of people possible. As with any innovation, the success of such a research tool will be proven, or not, when its knowledge has extended beyond its confines.

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NOTES

1. The French National Observatory of Mountain Safety (SNOSM) was created in 1996, spurred by the winter sports industry. It is hosted by the National School of Mountain Sports in Chamonix (ENSM), under the aegis of several ministries (Interior, Defense, Youth and Sports). It collects, records, validates, processes and analyses accident data from public and private rescue services (from prefectures of alpine departments) in ski areas or wild mountain areas in France. These statistics have only been reported by all departments and rescue services since 2012. For mountaineering, the SNOSM has been producing annual reports since 2009 and is currently the most exhaustive source of quantitative accident data in France.
2. See <https://www.camptocamp.org/serac>
3. The submission form's sections include the description of the event, the location, the preliminary study of the route, the conditions, the physical preparation and level of expertise, the causes of the event, the organization of the group, the level of attention and evaluation of the risks, schedule management, safety measures and techniques implemented, elements that mitigated the consequences of the event, physical impacts and the wider consequences on the practice.
4. The aim of this article is not to present the knowledge and results acquired. For this, the reader should refer to the reports and articles cited in the text.
5. The diversity of the researchers' profiles and involvement in the process (described in the article) proved essential both to provide distance and to broaden the points of view.
6. https://www.petzl.com/fondation/fondation-accidentologie-livret_FR.pdf?v=1
7. Cleaning, processing, comparing, matching data, etc.
8. Storybuilder is an interface of accident analysis for work safety developed by Bellamy *et al.* (2007) that aims to provide a visual representation of the various contributing factors to an accident (based on a model of fault and event trees).
9. https://www.petzl.com/fondation/Fondation-analyse-SERAC_FR-web.pdf?v=1
10. An article in the trade press describes her significant involvement in the network: “Aspiring high mountain guide and expert mountaineer, notably roped to Lise Billon, Maud Vanpouille is also a doctoral student in alpine sports accidentology at the Petzl Foundation. Her objective: to

identify concrete prevention measures based on experience feedback submitted on SERAC, a platform for sharing experiences of accidents and incidents in the mountains that is hosted by Camptocamp.org.”

11. The site recorded 29 incident testimonials in the year it launched in 2015, followed by a decrease in pace (between 4 and 14 testimonials per year) <https://www.ffme.fr/ffme/securite/retours-dexperience/>.

12. Studies of online collectives have shown that only a minority of members produce the majority of contributions (Orange, 2013).

13. www.petzl.com/fondation/projets/recherche-scientifique-accidentologie-sports-de-montagne?language=fr

14. www.montagnes-magazine.com/actus-accidentologie-premiere-analyse-alpinisme-rocher-terrain-aventure

15. [www.montagnes-magazine.com/actus-accidentologie-premiere-analyse-alpinisme-neige-glace-mixte-cascade-glace?](http://www.montagnes-magazine.com/actus-accidentologie-premiere-analyse-alpinisme-neige-glace-mixte-cascade-glace?fbclid=IwAR34O98IfVwcpEkjUr7vwu0iEvEANooN7GNnM9HaDJjYlUA2xjhwaqfQD24)

[fbclid=IwAR34O98IfVwcpEkjUr7vwu0iEvEANooN7GNnM9HaDJjYlUA2xjhwaqfQD24](https://alpinemag.fr/accidents-alpinisme-neige-glace-analyse-des-recits-serac/)

16. www.montagnes-magazine.com/actus-accidentologie-premiere-analyse-ski-randonnee

17. <https://alpinemag.fr/accidents-alpinisme-neige-glace-analyse-des-recits-serac/>

18. www.ffcam.fr/la-montagne-et-alpinisme.html

19. For example: <https://www.montagnes-magazine.com/actus-accidentologie-premiere-analyse-alpinisme-rocher-terrain-aventure>

ABSTRACTS

The risks associated with the practice of alpine sports are a major concern in mountain environments. Quantifying and explaining the causes of accidents are key to improving knowledge about this sensitive issue. To this end, since 2015, the Laboratory of Vulnerabilities and Innovation in Sport (L-VIS) has been participating in collaborative action research in France involving parties from several spheres: the Petzl Foundation (Petzl is a French climbing and caving equipment company), the online community Camptocamp (aimed at those who practice mountain sports), stakeholders from the public sector (mountain rescue services and the National Observatory of Mountain Safety, SNOSM) and the non-profit sector (sports federations), and professionals (guide organizations). At the end of 2015, this collaborative project resulted in the launch of an online system to collect participatory testimonials on accidents and incidents occurring during the practice of mountain sports: the SERAC database. The development, implementation and growing interest of multiple stakeholders regarding this collaborative approach to sharing experiences mark it as an innovative way to understand and optimize alpine accidentology. Seen through the lens of the sociology of science and technology, the process of social innovation the SERAC database represents is a form of knowledge production that links researchers, communities of alpine sports practitioners and their sporting culture, the alpine environments where they are practiced, and specific safety agencies. This article describes the creation, socialization and evolution of the research project associated with the SERAC database, highlighting the hybrid and uncertain nature of the knowledge produced and how it is inextricably linked with the mountain environment. At its source, the SERAC project has two complementary but also divergent aims: that of collaborative action research to support social

innovation, and the production of contextualized knowledge that can ideally be translated into accident prevention recommendations and a better understanding of risky alpine practices.

INDEX

Keywords: accidentology, collaborative action research, social innovation, alpine sports, risk, risk prevention

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