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Safety issues and strategies for outdoor activities

A general model based on guided mountaineering preparation*

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Abstract. This paper examines an issue that has been little explored in ergonomics: safety in outdoor activities. Drawing on an analysis of guided mountaineering preparation, the paper focuses on studying and modelling feedback from professionals. Our premise is that preparation can be analyzed as a process of constraint satisfaction aimed at constructing manageable situations. This proposal is explored through a qualitative study conducted with mountain guides. Data were collected from 17 semi-structured interviews and 10 full days of filmed field observations, followed by individual and collective confrontation. The analysis focuses mainly on identifying the constraints of the preparation and the types of variables related to them. Five main types of variables which can be generalized were defined. A descriptive model was then produced, and safety issues were identified, along with corresponding strategies to improve safety.

Keywords: Safety, Outdoor Activity, Small businesses, Mountain Guides.

1 Introduction

Guided mountaineering belongs to the category of outdoor activities, which are a relatively unexplored subject in ergonomic studies. Yet the safety issues they raise are interesting for two reasons at least.

Firstly, they belong to service activities [1]. In these activities, the relationship between professionals and beneficiaries constitutes a specific type of collective work aimed at the coproduction of service and safety [2]. Although some studies have examined safety issues in service activities (mostly in healthcare), understanding how safety is constructed in interaction with the beneficiaries requires further examination.

Secondly, they are mainly small businesses. Safety models and theories result largely from analyses of large industries, which place great emphasis on enhancing safety. Small businesses and large industries are governed by very different risk management strategies [3]:

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- Large industries are often characterized by a high level of safety, achieved mainly by complying with the recommended standards and procedures, or even by excluding risks where possible ('controlled safety').
- Small businesses are characterized by a low level of safety resulting from the need to take risks (exposure to risk is inherent in the economic model) and achieved mainly by the expert skills of actors ('managed safety').

This fundamental distinction reveals the importance of creating new safety models and theories for application to small businesses.

For these reasons, analysing outdoor activities would be an opportunity not only to address the safety issues associated with this type of activity, but also to advance research in the field of service activities and small businesses.

1.1 Objectives

Recent studies have examined guided mountaineering [4], but none focused on how guides prepare an alpine tour. Yet the literature shows that the preparation has a major influence on the way situations will be managed in the field [5]. Our objective is to propose a general model of preparation based on the analysis of feedback from guides.

For this purpose, we focused on service interactions to address safety issues. We examined how these interactions enable guides to construct 'manageable situations', i.e. situations seeking to provide solutions adapted to available and future resources [6].

1.2 Questions

According to Falzon [1], service activities can often be seen as akin to design. Since design activities can be approached as a process of constraint satisfaction [7], we raised the following questions: Could guided mountaineering preparation be analyzed as a process of constraint satisfaction? Could we produce a descriptive model of the preparation and identify safety issues and corresponding strategies based on this analysis?

2 Methods

In the constraint-based approach to the design process, a constraint is defined as a condition to be satisfied. According to Darses [7], it can be understood as a mental representation of a relation between variables. This approach then assumes that the solution process is a progressive reduction of a *search space* through the formulation of constraints to describe the problem and its possible solutions.

Guided mountaineering preparation could then be seen as a problem to be solved by formulating specific constraints. These are not fully specified in the beginning and must be defined by the guide during the preparation. The solutions that satisfy them then constitute *manageable situations*. To identify how the guides perceive these solutions, we carried out a qualitative analysis, as described in the following two sections.

2.1 Data collection

Data were collected from 17 semi-structured interviews with guides with varying characteristics (age, seniority, gender, origin, etc.). The interviews revolved around risk management during the preparation and execution phases (30 questions and an average duration of 1.25 hours). Data were also obtained from 10 days of filmed field observations, followed by four individual confrontations and five collective confrontations [8].

2.2 Data analysis

Initial coding was used to isolate all the statements describing the preparation activity. Two hundred and thirty-three statements were extracted. From this data set, we conducted coding steps: a) to identify statements where constraints are expressed; b) to identify and classify types of variables linked to these constraints. For instance, the statement *'The more dangerous the conditions, the more I only accept expert clients, otherwise I cancel'* is understood as a condition to be satisfied (a constraint) that links the clients' skills (variable 1) to the environmental conditions (variable 2).

Identifying these types of variables enabled us to produce a model of the constraints, which was then used to illustrate the safety problems encountered.

3 Results

Of 233 statements, 194 (83%) are identified as expressing constraints. This validates the proposal that preparation can be approached as a process of constraint satisfaction.

3.1 Five main types of variables mentioned when expressing constraints

Five main types of variables identified from our analysis are presented below.

1. **Working environment** (weather, other groups, available tools...) offered by the context, e.g. environmental conditions of the route: *"The window of good conditions for climbing the Mont Blanc is very short"* (Guide 3).
2. **Professionals' limits** (resources, experience, objectives...), e.g. guide's capabilities: *"A client asked me to climb Dru's Ridge. I said: 'I'll find you another guide, I'm not trained for that'"* (Guide 4).
3. **Beneficiaries' limits** (resources, experience, skills...), e.g. clients' capabilities: *"If I consider that the client does not have the required technical level, it's up to me to say we won't go"* (Guide 16).
4. **Beneficiaries' goals** (objectives, demands...), e.g. clients' expectations: *"We can come across clients who only want to climb Mont Blanc"* (Guide 3).
5. **Projects** (intrinsic difficulties, dangers...), e.g. route' characteristics: *"Because of dangers, I don't go on certain routes, whoever the clients"* (Guide 16).

The first four types of variables are dynamic: each can vary significantly, even during preparation.

The fifth can be considered as static: alpine routes, for instance, will keep their intrinsic characteristics during the activity, although they may change over the years.

Evaluating these variables, linking them together, and instantiating them is an important part of preparation. For instance, the guides interact with clients, other guides, and hut wardens; they rely on past experiences and meta-knowledge, and consult weather forecasts and climbing guidebooks, among other things.

For all these variables, there are constraints limiting the set of values. For example, if the beneficiary wishes to carry out a particular project (e.g. climbing Mont Blanc), this requires a certain level of capacity among the participants, and particular environmental conditions to guarantee that the situation is manageable.

3.2 Modelling the search space of manageable situations

One way of interpreting these results is to consider preparation as an activity that continuously aims to satisfy constraints arising from these five types of variables: e.g. *“What makes you take the lowest risk is that you've adapted the difficulty of the route to the conditions and the clients. Then you've solved 50% of the problem, because you'll be in the right place, at the right time, with the right person”* (Guide 7).

These findings enabled us to design a model of the preparation (see Fig.1).

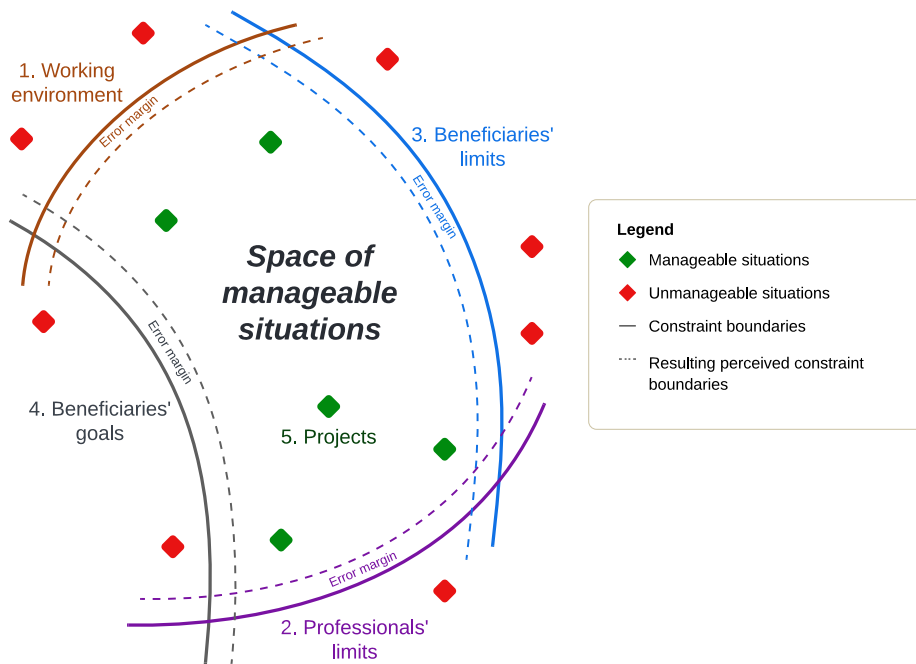


Fig. 1. Model of preparation as a process of constraint satisfaction.

The constraint boundaries, which illustrate the four types of dynamic variable, delimit a *space of manageable situations*. Because of the uncertainty of the situations, they are

associated with perceived boundaries, showing the professional's perception of them. The differences between the two types of boundaries constitute margins of error. As static variables, projects are represented by dots. The distance between dots and boundaries represents margins of quality and safety.

The intersections between the *space of manageable situations* and the dots represent the formulation of constraints based on the five types of variables. The projects within the boundaries constitute solutions (manageable situations) to the problem to be solved.

A way to construct safety is then to choose between possible solutions to regulate risk-taking and ensure sufficient safety margins. However, certain issues may arise.

3.3 Safety issues and strategies

We highlighted four main safety issues and corresponding strategies to overcome them.

The first is the risk-taking due to a misperception of the constraints by the professional, for instance by underestimating the difficulty of a route or the danger of environmental conditions, or overestimating clients' capabilities or goals: *"We can put pressure on ourselves according to what we think people expect"* (Guide 5). Corresponding strategies would encompass all the ways to improve perception of the boundaries (e.g. developing experience, meta-knowledge, social skills, forecasting tools, among others).

The second issue is the risk-taking involved in resolving possible contradictions between the different dimensions of the activity. For example, to guarantee a sufficient margin in terms of the clients' limits, professionals may have to choose a project that brings them closer to their own limits or to environmental limits. On the other hand, to guarantee a sufficient margin to meet clients' expectations, it may be necessary to get closer to the clients' limits: *"When you have groups of eight clients, and still have to climb a summit, you have to be really accurate in your route choice, while trying to keep enough [safety] margin"* (Guide 3). There are often many good and bad choices, but one strategy to avoid bad choices is to develop one's own trade-off skills.

The third safety concern is the variable level of risk that each professional is willing to take. Because of their self-knowledge, expertise and autonomy, professionals are the only ones who can define the manageability of a situation: *"The decision belongs to each guide, and each guide puts his risk-taking cursor at a different level"* (Guide 15). Nevertheless, the acceptability of risk may not be shared by clients, the profession or even by society. Formal or informal discussions about acceptability judgements with others (clients, other professionals, etc.) appear to be a relevant strategy for adjusting the level of risk-taking.

The fourth is risk-taking due to a feeling of obligation. The greater the constraints, the smaller the search space, and there are fewer solutions to meet quality and safety objectives. In critical conditions, there may be no solution to the design problem (no project in the *space of manageable situations*). To provide service, the professional may be tempted to accept unmanageable situations and take risks. If they do not, they can decline the request: *"If there's nothing to be done, I suggest cancelling"* (Guide 2), with the ensuing commercial and financial consequences. We also observed that a natural way to improve safety is to act on constraints to widen the space of manageable situations through four main strategies which must be negotiated with beneficiaries:

1. **Searching for better conditions**, e.g. by widening the acceptable space-time scope: “*I try to tell the client that the conditions are not right and that for the moment they need to do something else, and if they don't want to, we postpone it*” (Guide 17);
2. **Reducing the workload**, e.g. by asking for help from other professionals: “*It's much better to work in pairs to manage the risks on certain routes*” (Guide 10);
3. **Developing beneficiaries' resources**, e.g. by providing technical training: “*Rope handling is quite important, when you're going on a difficult route, it's good if the client knows a bit about it*” (Guide 4);
4. **Transforming the beneficiaries' goals**, e.g. by directing them towards other practices: “*I try to educate them and point them in other directions*” (Guide 3).

4 Discussion and conclusion

By addressing safety issues involved in guided mountaineering, we have provided a safety model, along with related issues and strategies for outdoor activities that also reflect the concerns of small businesses [3] and service activities [1].

We believe that our results could be applied to other activities, for instance healthcare. Every medical protocol is a form of *project* which inherently has its own difficulties and dangers. To create a manageable situation, the practitioner must consider their *working environment* (equipment, team, etc.), their *own limitations* (capabilities, objectives, etc.) and the *patient's acceptance and tolerance* [2]. Moreover, to regulate risk-taking, practitioners must choose between different protocols [6] in their *space of manageable situations*. To consolidate these potential applications, the scope of our model and strategies should be tested in further research.

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