

# Science as Applied to Technical Rescue Research

Technical rescue places human lives on rope systems expecting they will hold. Consequently the science behind technical rescue techniques has profound consequences for preserving human life. Most science is not subject to this standard, as such the science supporting technical rescue should be performed with greater rigor and be an example of quality philosophy, methods, and analysis to other sciences. Presented here is a description of the philosophy of science, the methods that should be used to facilitate the philosophy, a discussion of analysis, and recommendations for improvement. This presentation is not an indictment of the quality of technical rescue science, but an honest appraisal of the state of our science, a description of the logic that should be used, and a set of concrete suggestions for improvement.

Science is defined by falsification. If an explanation can be falsified, it is science, if not, the explanation is not science. To facilitate this demarcation of science, the 'scientific method' is used. The 'scientific method' is not a set number of steps, but an approach to dealing with problems, one that will be presented here as a set of steps for ease of communication, but which are, in reality, performed simultaneously during problem solving.

A phenomenon is observed and an investigator becomes interested in the phenomenon. Multiple hypotheses are developed to explain the observations, which all have three parts; based on data (observations), explain the data, and the explanation is falsifiable (makes testable predictions). The hypotheses are exposed to critical tests, either through prediction and experimentation, or retrodiction and the collection of additional historical data. Those hypotheses that are falsified are rejected, and those that were validated are kept. Results are then communicated to others via publications (permanent accessible records). The entire process of hypothesis generation and testing is repeated until a single hypothesis is left and has been tested sufficiently to warrant the elevation to the status of theory.

How does technical rescue science compare to the ideal? Technical rescue science is in its infancy, performing small, statistically weak tests, usually in small groups, often without hypotheses. Most research qualifies as pilot studies whose results are rarely published, and when they are, they are difficult to access. Most importantly, all the research qualifies as science.

How can we improve? Work in collaborative teams, and subject your work to peer review from project inception to dissemination of results. Generate multiple hypotheses, and test them with thoughtfully designed experiments with multiple treatment groups and large sample sizes in each group. Quantification is optional, depending on the hypotheses. All samples should have a common known history, and all experiments, old and new, should be replicated. Quantified results should be analyzed with statistics. Calculate statistics correctly, or not at all.

Collaborative groups should submit grant applications for larger sums of money. Funding is available, and obtaining the funding for large high impact projects would be comparatively easy and would facilitate the type of science suggested here. If you or your collaborative team does not have the required expertise to complete a project, ask for it. Ask local universities for physical and mental resources. Solving problems is academia's job, so keep asking until they help. Lastly, information dissemination in

technical rescue research is poor. Results must be published in a freely and easily accessible form and location. I propose we create, as a community, a free peer reviewed technical rescue journal to publish results of the better science we complete.

Technical rescue science is in its infancy, like the state of Newton or Darwin's respective sciences when they lived. This is an exciting time in technical rescue science since we have the opportunity to set the research standard for later generations, so let us act quickly, collaboratively, and thoughtfully to improve the standards to which we perform our science.