

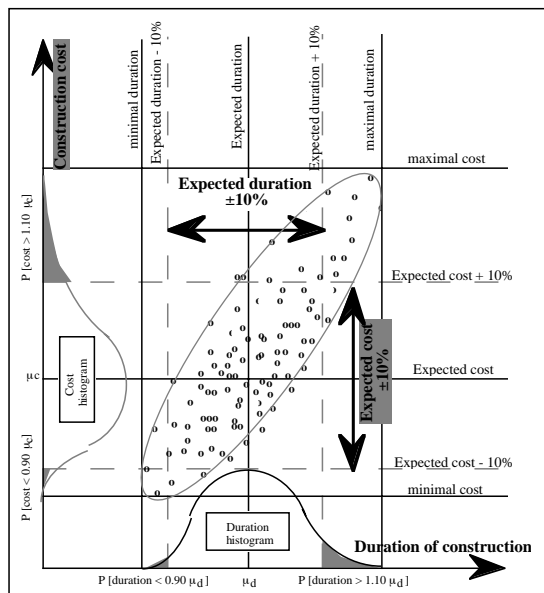
## Decision Aids in Tunneling

The prevision of construction cost and time of large tunnels - based on geological, geotechnical and constructive uncertainties - is studied in collaboration with the team of Professor H.H. Einstein at MIT. The simulation codes, based on theoretical work carried out by H.H. Einstein, have been developed and applied to construction sites, such as the base tunnels under the Saint Gothard and Lötschberg of the project AlpTransit in Switzerland.

The programs permit the simulation of:

- possible geological profiles based on a set of probabilistic geological parameters;
- the construction of a network of tunnels, galleries, shafts, etc. through these profiles while taking into account random construction parameters.

A large number of coupled geological and construction simulations give the distribution of the expected construction cost and time.



*Simulation results to predict the construction cost and time of a tunnel and risk to overcome the range "expected cost  $\pm$  10%" and "expected duration  $\pm$  10%".*

The figure shows such a result, where each point is the result of a construction of a complete tunnel network through a possible geological profile. Those results may then be used as input for economical studies, risk analyses, comparisons of options, etc.

The methodology also allows the evaluation of the value of complementary geologic exploration through a comparison of exploration cost and possible gain. During construction, it also permits a continual reactualisation of the parameters as a function of the encountered conditions in the already excavated part, and therefore a refinement of the previsions.

### Publications

- Descoedres, F., J.-P. Dutt 1993. Instruments d'aide à la décision pour la construction des tunnels (ADCT), *Publication de la Soc.Suisse de Méca.des sols et des roches, No.128, Kandersteg*, pp.79-87
- Descoedres, F., J.-P.Dutt, H.H.Einstein, V.Halabe 1992. Entscheidungshilfen für den Tunnelbau, *Kurzbericht*.
- Dutt J.-P., F. Descoedres 1994. Applications d'instruments d'aide à la décision pour la construction des tunnels (ADCT), *7ème Congrès Int. de l'AIGI, Lisbonne*, pp.4611-4620.
- Einstein, H.H., F. Descoedres, J.-P. Dutt, V. Halabe 1991. 'Entscheidungshilfen für den Tunnelbau', *Schlussbericht über die im Auftrag des Bundesamtes für Verkehr ausgeführten Arbeiten*.
- Einstein, H.H., F.Descoedres, J.P.Dutt, V.Halabe 1991. *Decision Aids in Tunneling. Monograph*