

Keynote lecture
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The law of large numbers in underground construction – Risk Management for Mega-Projects – Lessons learned from the Gotthard Base Tunnel

Pravidlo vyšších počtů v podzemním stavitelství – Zvládání rizik pro megaprojekty – Zkušenosti z Gotthardského bazového tunelu

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In probability theory, the law of large numbers is a theorem that describes the result of performing the same experiment a large number of times. According to the law, the average of the results obtained from a large number of trials should be close to the expected value, and will tend to become closer as more trials are performed (Definition of Wikipedia). Underground construction is not a random experiment, and the law of large numbers is not directly applicable. Modern design and construction procedures, latest technology and a state of the art risk management help to guarantee each day the fulfilment of all the different project requirements. The lessons learned from the Gotthard Base Tunnel show the high importance of a professional risk management for Mega-Projects from the earliest beginning of a project with such long project duration. An adequate risk management has to guarantee the required quality and functionality, the lowest possible costs within a short construction time, a low level of accidents and no environmental offences on site. Mega-Projects need a special approach due to the high level of remaining risks. State of the art procedures were used for the civil works for the Gotthard Base Tunnel in Switzerland. The lessons learned from the longest railway tunnel of the world show room for further improvement for future Mega-Projects. Time and cost requirements can only be achieved if the owner's organisation has clear procedures for the approval of design changes. A high quality standard for mega-projects needs additional checks from the owner's side compared to the standard procedures of the technical codes, as they often were not developed for Mega-Projects. Additional means and methods have to be found for a further reduction of the number of site accidents in underground construction. The contractor and the owner should still more act as partners in an integrated, continuous and all-embracing risk management. Future civil engineers should be trained in risk management already during their studies.