The future of Geotechnical Engineer

As part of the Virtual Time Capsule Project promoted by ISSMGE, the Young Members Committee of the Italian Geotechnical Association (Associazione Geotecnica Italiana, AGI) encouraged a discussion about the future of Geotechnical Engineering, by asking to answer a survey about the new developments the participants would foresee in the field and the skills required to engineers in the coming years. The results of the survey are summarised in this document, together with some comments that arose during the debate that was scheduled for the Annual Meeting of Young Geotechnical Engineers (Incontro Annuale dei Giovani Ingegneri Geotecnici, IAGIG), held in Pisa on the 3-4th September.

Survey participants

93 participants completed the survey; most of them are young (under 40, 61.9 %) (Fig. 1), whereas the over-60s (8.7 %) represent the smallest part of the participants. The majority of them is represented by public employees involved in Research (48.4 %).

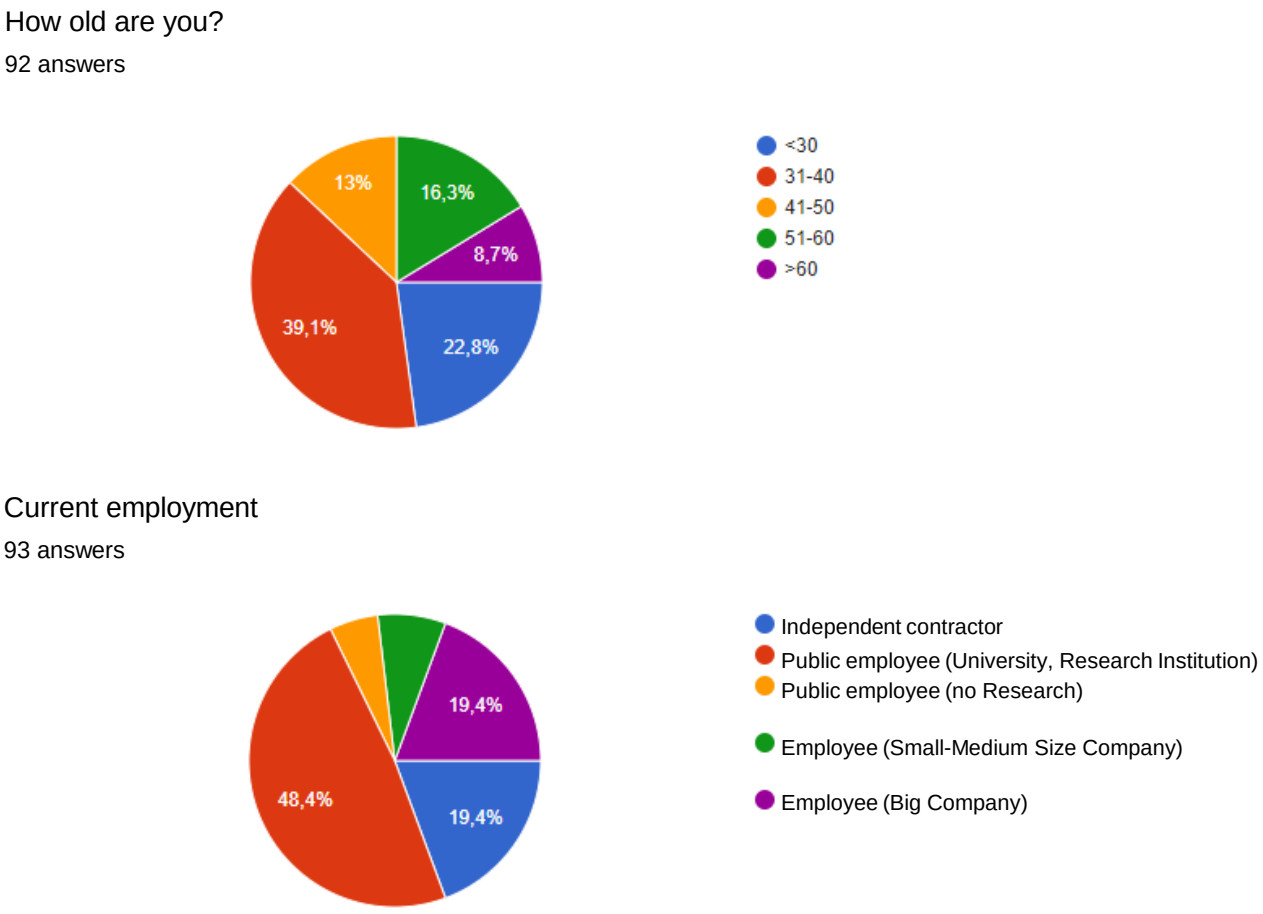


Figure 1. People involved in the survey

How much do you think the following sectors will be growing in the next 15 years?

Survey participants were asked to assign the sectors given in Fig. 2 a rate between 0 and 5 about their growth expectation in the coming years, with 0 meaning “no development” and 5 “very strong development”. They identified “Innovative materials for Geotechnics” and “Energy Geotechnics” as the most promising categories, whereas “Foundations” and “Simplified design procedures” as the least attractive for the coming years.

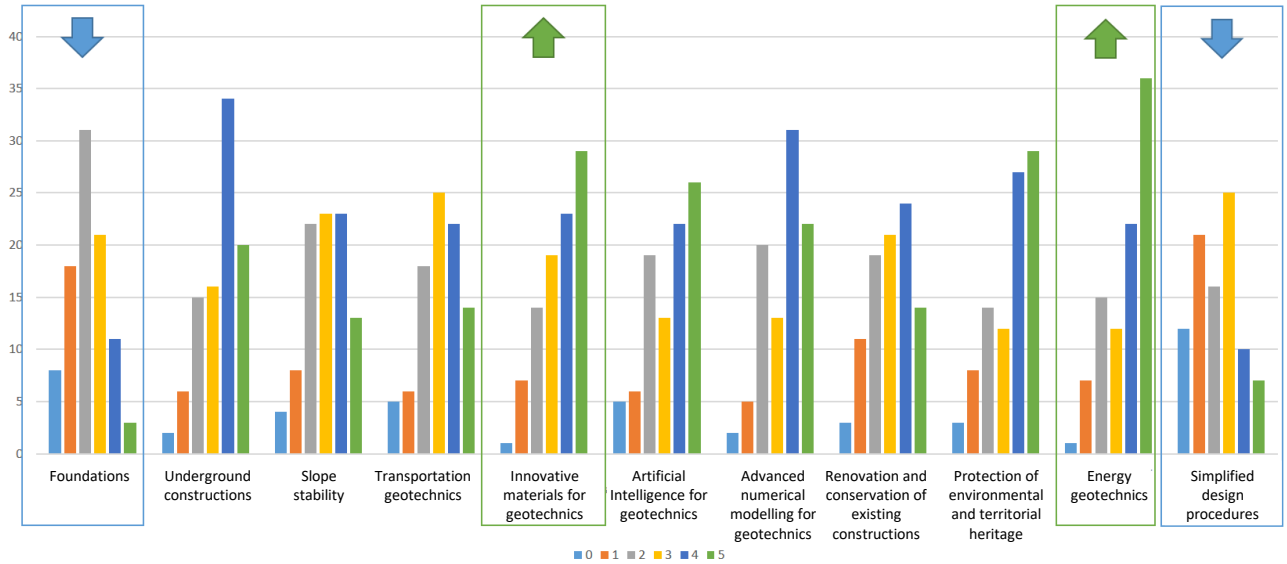


Figure 2. Future developments in Geotechnical Engineering

What technical advancement do you expect by 2036?

The open-ended question “What technical advancement do you expect by 2036” received several interesting answers, as summarised in the word cloud represented in Fig. 3. As it is well known, the bigger the font size, the more important the word: this is particularly the case for “Modeling”, “Monitoring”, new materials”, “Artificial Intelligence” and “Climate Change”. “Modeling” was mostly related to 3D numerical analyses, even referring to methods which go beyond the Finite Element drawbacks (e.g. Smoothed Particle Hydrodynamics, Material Point Method, etc…). As for “Climate Change”, the answers of the participants focused on environmental protection and low demographic impact, thanks to the adoption of “Innovative Materials”. “New materials” are seen mostly devoted to slope stability and Environmental Geotechnical Engineering.

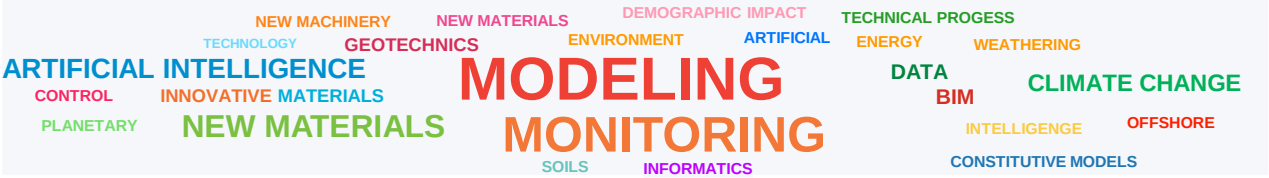


Figure 3. Technical Advancements in Geotechnical Engineering

It is also worth reporting that some different views about future technical advancements were recorded in the survey: indeed, some participants showed a few expectations about future development, as they stated that Geotechnical Engineering will be developing little and that the only remarkable change will be concerning the use of new techniques, updating already-existing design procedures. Conversely, some others anticipate certain, huge changes, mostly related to Building Information Modeling (BIM). Regarding the last point, it is interesting to note that some conflicting opinions were given, as the BIM is deemed as not applicable to Geotechnical Engineering by some participants.

What are the keywords that best describe the future of Geotechnical Engineering?

Participants to the survey were also asked to describe the future of Geotechnical Engineering through keywords. From the word cloud shown in Fig. 4, it is apparent that words such as “Innovation”, “Sustainability”, “Multidisciplinary”, were most adopted, together with “Modernisation”, “Modeling”, “Resilience”, and “Hydrogeological Hazard”. All these keywords refer to the need of heading towards a greener and renewable planet, despite now being subjected to stronger stresses mainly due to climate change and increasing world population, for which Resilience is deemed as necessary.

Figure 4. Keywords about the future of Geotechnical Engineering

Which skills do you expect being more required to the geotechnical engineer in the coming 30 years?

The survey participants were asked to assign the skills given in Fig. 5 a rate in between 0 and 5 about their expected appeal in the coming years, with 0 meaning “no needed” and 5 “fundamental”. The results of the poll showed that the specific geotechnical skills are deemed as the most appealing for the future, while the opposite can be said for general engineering skills (excluding Civil Engineering). This is somewhat surprising as this goes in the direction of “Specialisation”, as an opposite of “Multidisciplinary” which was one of the mostly chosen keywords in Fig. 4.

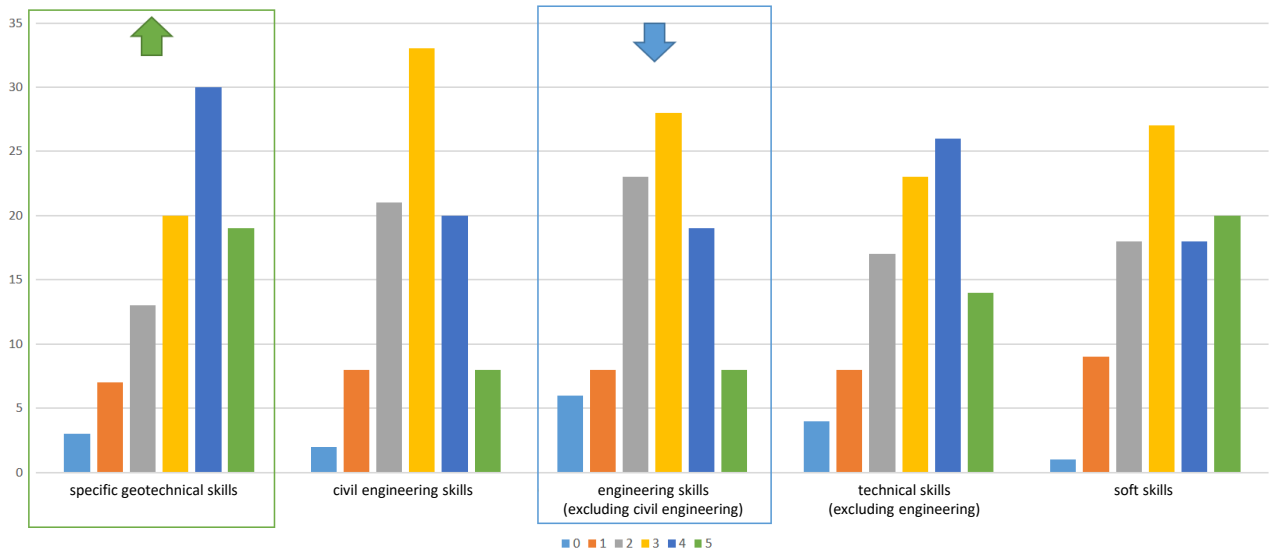


Figure 5. Skills required in the future of Geotechnical Engineering

What engineering technical expertise do you do you believe will be required the most in the coming 30 years?

Participants to the survey were allowed to give multiple answers to the question reported above, regarding the technical expertise that is expected to be required the most in the coming years. As shown in Fig. 6, Environmental and “It & Telecommunications” were anticipated as the most required, together with Management, Geology, Hydraulics and Structures. Mechanical Engineering received a bit of attention as well, while the remaining fields received one vote only. At first glance, this result is somewhat surprising, as “Energetic” was voted just twice, in contrast with the need of a greener world arising from Fig. 4: however, here it is worth mentioning that this topic was perhaps covered by “Environmental”.

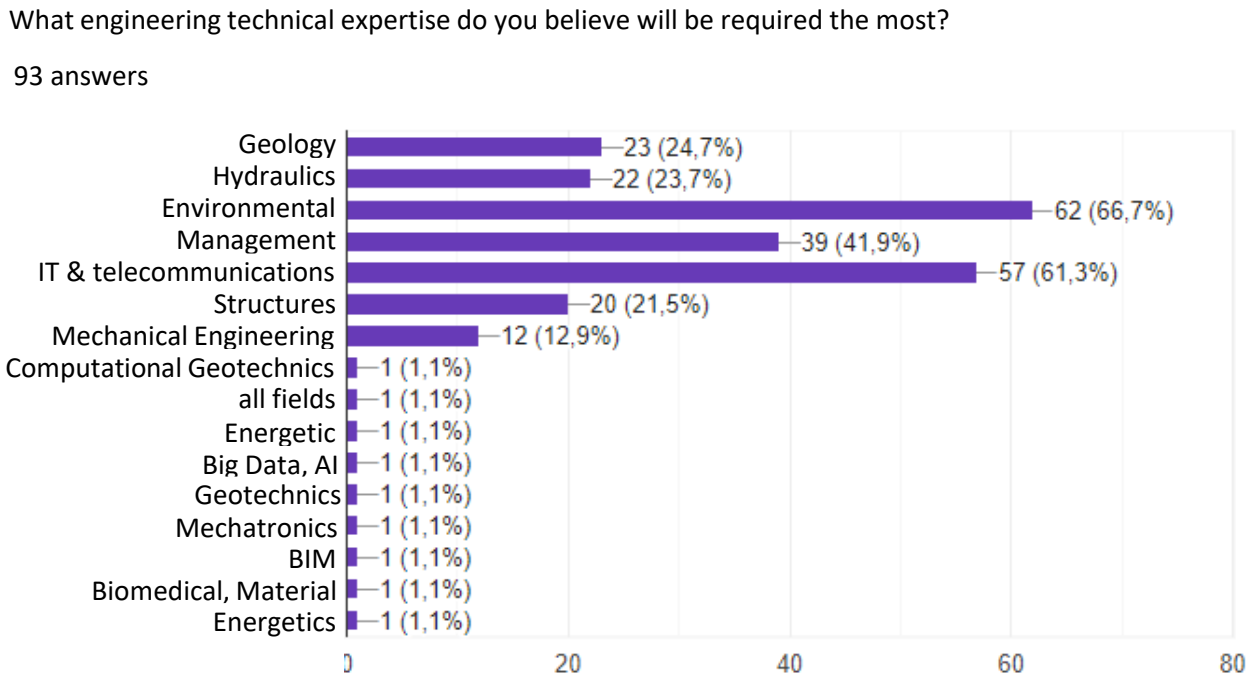


Figure 6. Technical expertise required in the future of Geotechnical Engineering

Geographical aspect

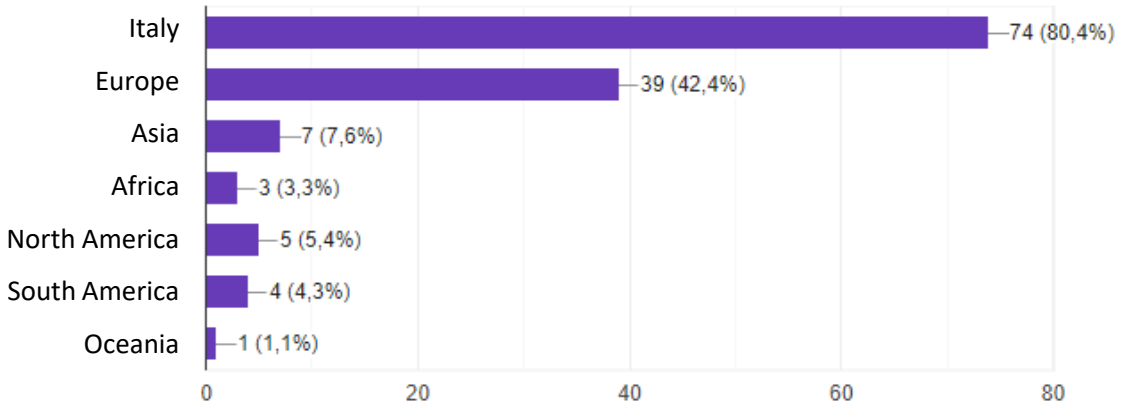
In the poll, participants were also supposed to indicate where they expect to be working in the coming years and where they think the major developments of Geotechnical Engineering will take place. The obtained answers are given in Fig. 7, where it is evident that the vast majority of the participants expect to work in Italy, followed by Europe, although the job market is shifting towards Asia, followed by Africa and South America due to the presence of emerging economies. Clearly, a bias in the first question can be detected as perhaps all participants are Italian.

Confidence in the future of Geotechnical Engineering

Regarding the confidence about the future of Geotechnical Engineering, the results plotted in Fig. 8 show that the respondents are still confident about the future, as demonstrated by the rate 4 (on a scale of 5) chosen by almost half of the participants (47.3 %), while some of them are very confident (rate 5, 17.2 %). Here it is worth noting that low rates (1-2) come from under-40s, while over-40s gave all rates higher than 2.

Where do you suppose you will work in the coming years?

92 answers



Where do you think major developments will take place?

92 answers

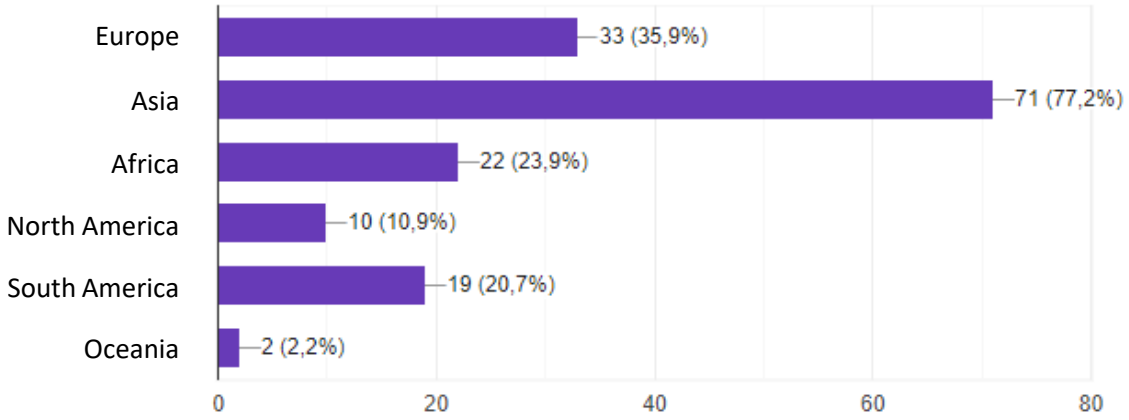


Figure 7. Geographical aspects

93 answers

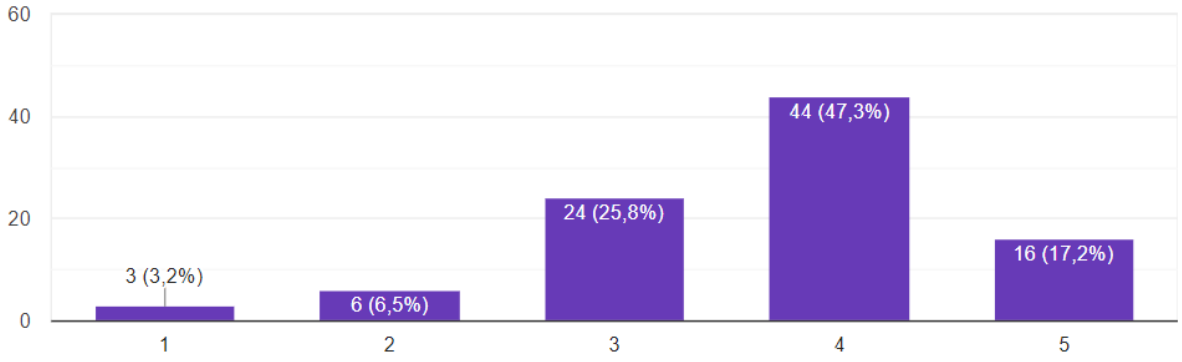


Figure 8. Confidence in the future of Geotechnical Engineering

What message do you want to send to the engineer of the future?

Several interesting (and sometime funny) answers were obtained in this regard. Amongst them:

- never stop studying and learning;
- strong attention to multidisciplinarity;
- getting the most of your experience at university and use your brain;
- do not forget direct and experimental observation of physical phenomena, although numerical modeling is now dominant;
- communication and marketing are becoming more and more important, at the expense of technical expertise;

and also

- “forget Winker!”;
- “hold on, do not give up!”;
- “good luck!”;
- “I hope you will get paid more than we do nowadays!”.

Summary and conclusions

Discussion of results of the survey showed that Geotechnical Engineering is perceived as a living field that is mainly moving towards the green design of resilient structures. To do this, the adoption of innovative materials is needed and project designs involving Energy Geotechnics are deemed as necessary, following a multidisciplinary approach and performing advanced numerical modeling. Specific geotechnical skills, together with Environmental awareness and IT and Telecommunication technical expertise, will allow geotechnical engineering to face even Climate Change-related issues, particularly of interest for areas where major developments will take place (such as Asia, Africa and South America). Confidence in the future is, however, mainly a prerogative of over-40s, indicating that there is still much to do in order to make Geotechnical Engineering more attractive for young people.