URBAN GEOLOGY IN WALES: Managing Geotechnical Risk: Contemporary Challenges

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1. Introduction

In January 2011 the authors convened a seminar in Cardiff entitled ‘Geotechnical Risk Management: adding value to construction projects’. The event was timed to mark the 10th anniversary of publication ICE/DETR book on 'Managing Geotechnical Risk – improving productivity in UK building and construction' (Clayton, 2001) with the author attending to provide the keynote speech. This is a core reference for Standards such as HD22/08 ‘Managing Geotechnical Risk’ contained within the Design Manual for Roads and Bridges which sets out the procedures for certification for all Geotechnical Works on highways in England, Wales and Northern Ireland.

In its supporting statement for the seminar the Welsh Government (WG) noted that:

‘….it is well recognised nowadays that ground-related problems can adversely affect project cost, completion times, profitability, health and safety, quality and fitness for purpose. These can also lead to environmental damage not forgetting the corporate damage that can ensue when things go wrong…….[the WG wish] to move away from a process driven methodology to geotechnical risk management, whereby geotechnical certification was the principal aim, towards a value driven approach. The purpose of driving value into its projects is of primary importance with the certification being a natural by-product and audit trail for standards compliance……. [the WG are convinced that] effective management of the certification process can add significant value to projects whilst also enhancing the quality of risk management within the industry and also increasing the confidence of clients, contractors and their multidisciplinary teams in the effective and efficient delivery of their projects i.e. fewer surprises…..[The seminar will provide] a refreshed focus on value led geotechnical risk management whilst ensuring that geotechnical professionals, clients and contractors alike consider geotechnical risks as part of a wider set of project risks rather than isolated technical issues.’

This paper summarises the key issues of the day based on presentations and discussions about attitudes to risk between stakeholders across various industry sectors and generates ideas for value enhancement, progress and greater integration for further consideration by the ground engineering sector.

2. Contemporary challenges

‘No construction project is [geotechnical] risk free.
Risk can be managed, minimised, shared, transferred or accepted:
It cannot be ignored’
(After ‘Constructing the Team’, Latham 1994).

Historical and contemporary challenges largely revolve around this statement and most problems occur where risks have been ignored, mismanaged or indeed have remained unrecognised and unmitigated until they manifest themselves during the construction as ‘unforeseen’ but rarely ‘unforeseeable’ ground conditions.

A statistical review of historical projects revealed that 50% of commercial buildings and 37% of industrial buildings experienced delay due to unforeseen [sic] ground conditions and all developments on previously developed land meet unexpected [sic] ground during construction (Alhalaby and Whyte, 1993). Furthermore, research by the British Geological Survey identified that corrected for inflation ‘subsidence’ losses by the UK insurance industry have averaged c£400M per annum over the last 20 years. The effect on the whole life financial performance of a project can be significant, especially if commissioning for geotechnical risk management is delayed.

Recent focus on public finances has brought the management of project risk to the fore through discussion in the press. Some correspondents suggest a culture of optimism has been present for public projects which permits acceptance of hopeful estimates to stimulate project approval. It is likely
that challenges within ground engineering and geotechnics contribute significantly to escalating outturn financial impacts as compared to budgets.

‘The weight of evidence confirms that the UK is more expensive than its European peer group and demonstrates that there are significant opportunities to reduce costs in the delivery of infrastructure. There is a clear opportunity to realise savings of at least 15%, which can deliver sustainable benefits of £2bn to £3bn per annum.’

(HM Treasury and Infrastructure UK Infrastructure Cost Review, December 2010).

Key factors driving higher costs identified in the 2010 Infrastructure Cost Review and where more effective management of geotechnical risks could enhance cost efficiency include:

• ‘… lack of clarity and direction, particularly in the public sector, over key decisions at inception and during design. Projects are started before the design is sufficiently complete.’
• ‘over-specification and the tendency, more prevalent in some sectors than others, to apply unnecessary standards, and use bespoke solutions when off-the-shelf designs would suffice.’
• ‘… lack of targeted investment by industry in key skills and capability limiting the drive to improve productivity performance.’

The January 2011 seminar invited speakers from a range of industry groups; attitude to risk between stakeholders across industry sectors vary and include (but are certainly not limited to) those below:

• From a contractor’s perspective, risk management is often driven by the desire to limit commercial exposure.
• From a client’s perspective, risk management can be driven by the desire to divest themselves of risk responsibility whilst not always recognising that they will pay for this luxury.
• From a consultant’s perspective, risk management can be used to minimise liability without necessarily providing maximum value to clients.
• From a legal perspective, the main causes of legal disputes arise from inadequate risk identification and allocation as well as an inconsistent approach to standard forms of contract.
• From the Health and Safety Executive perspective, risks can be better understood through early involvement of a ground engineering practitioner.
• The NHBC offers a commercial warranty for residential properties with approximately 50% of claims are related to ground conditions.
• The mining industry approach to slope risk assessment of opencast mines differs in that the main driver is safety, but focused towards the economic potential of the mineable resource.

The seminar also demonstrated how large scale impacts can result from ineffective risk management resulting in high profile events whilst also recognising that small, frequent events through inappropriate management of geotechnical risk can also have profound effects, particularly on minor schemes.

No consideration of contemporary challenges for ground engineering in the current era would be complete without consideration of the carbon challenge and the value of collaborative working encapsulated by Constructing Excellence in their aptly named publication ‘Never Waste a good Crisis: A review of progress since Rethinking Construction and Thoughts for our Future’ (2009) as:

‘perhaps the greatest challenge is how we can deliver a built environment that supports the creation of a low carbon economy for the UK. ……. We believe that the era of client-led change is over, at least for the moment, and that it is now time for the supply side to demonstrate how it can create additional economic social and environmental value through innovation, collaboration and integrated working – in short, the principles outlined in Rethinking Construction. Clients should focus instead on professionalising their procurement practices to reward suppliers who deliver value-based solutions.’

Constructing Excellence also noted the following in the same publication:

‘For the last decade, the industry has been sheltered by a healthy economy. This has enabled construction to prosper without having to strive for innovation. The current economic crisis is a perfect opportunity for us to think again. We can not afford to waste it.’

The authors hope that their January 2011 seminar will be seen in future as a key marker of change within the construction industry to readdress the focus on effective geotechnical risk management as a value adding activity that will provide a significant contribution to meeting the contemporary carbon
and cost challenges faced by modern society whilst also supporting improvements in other metrics including health and safety, completion times, quality and fitness for purpose.

3. Value adding approaches

The seminar highlighted potential changes to our approaches to managing geotechnical risk extending beyond the old mantra’s of spend more money on ground investigation and get a ground engineer into the project team earlier than is often the case now. Briefly outlined below are the authors’ thoughts on:

- Registration
- Regulation
- Ground models and risk registers
- Enhance collaboration
- Understanding European practices
- Financial leverage

The UK Register of Ground Engineering Professional (UKRoGEP) was presented at the seminar and opened for registration on 8th June 2011. The register will have CGeol, CSci or CEng as compulsory core qualifications, and will build upon them. It will: allow engineers and geologists alike to demonstrate that their expertise lies within ground engineering (rather than another area of geology, civil or mining engineering) and (by passing through UKRoGEP grades of Professional, Specialist and Adviser) help practitioners to demonstrate progressively increasing competence, predicated on recognition by their sponsors and formal assessment by their peers. UKRoGEP will enable clients and other professionals to identify those ground engineering practitioners who are likely to bring the greatest value to a project. Registration will demonstrate an individual’s technical competence, professional attitude and experience.

UKRoGEP will be refined and improved by usage over time or fall into disuse dependent on the value that Registration earns for the profession. It will be recognised by clients and others as they see fit to improve the value obtained from ground engineering be that measured in terms of cost, carbon impacts, completion times, health and safety or other metric as considered appropriate. However, Registration does create an opportunity, should it be seen to add value, for regulation beyond that currently undertaken by certification through compliance with standards such as HD22/08 Managing Geotechnical Risk on UK Highways schemes.

Geo-environmental risk management is effectively regulated by the Environment Agency and includes a requirement to fully articulate and visualise the issues within the ground that lead to contamination risks in the form of a Conceptual Site Model (CSM). The development of Conceptual Ground Models in ground engineering is often not sufficiently explicit with a resultant potential loss in value from poor focus on the challenge and refinement of Conceptual Ground Models.

Appreciation of the Conceptual Ground Model (CGM) at the earliest stage will significantly reduce ‘unforeseen’ problems associated with ground engineering tasks. Development, refinement and challenge of the geotechnical risks identified within a CGM will facilitate risk and hazard identification and early mitigation within a hierarchical risk management approach of avoid, eliminate, accommodate or minimise. Furthermore, interrogation of the ground model to support the development of geotechnical risk registers will aid effective communication of risk between professionals working on a scheme whilst also acting as an effective management tool for targeted risk mitigation actions. An effective risk management approach can generally be considered as:

- Adequate and comprehensive investigation: The adoption of a total engineering geology approach to understand geology and engineering characteristics of the ground, and define baseline conditions as early in the project cycle as possible.
- Peer review at critical hold points during geotechnical design development combined with total project risk management.
- Contract flexibility that allows contractors to be paid for work that needs to be done and that fair allocation of geotechnical risk between owner and contractor is possible.
- Adoption of the observational method during construction.
- Using residual risk registers to manage risks during the operation and maintenance phase.

To be effective in terms of reducing risk and identifying opportunities, geotechnical risk management needs to be commenced as soon as possible. The process is one of continuous review and refinement during the development and execution of the project and the whole process must aim to have identified and either overcome, minimised or managed those risks.
Enhancing geotechnical risk knowledge of clients and members of other professions who are often in leadership roles on schemes, projects, policies and programmes (e.g. engineers, architects, quantity surveyors, cost and accountancy professionals) could result in earlier involvement of geotechnical specialists when they can provide greatest value. Enhanced collaboration and working with other professionals informed about the value that can be gained from more effective geotechnical risk management can therefore enhance the benefits that can be gleaned from a partnership approach to project delivery. The converse is also true, though, and ground engineers better informed of the skills and needs of colleague professionals will enhance the ability of the team to manage total project risks.

Finally, the 2010 Infrastructure Cost Review benchmarks UK construction costs with Europe and we do not fare well in comparison. We need to better understand their practices, how they implement European wide directives and regulations, what their approach to and tolerance of risk is and how they draft their standards such that construction and associated design is driven to add value rather than to follow due process. Could this affect our approach to improvements in our risk management processes such that financial value is enhanced? Furthermore, in these financially austere times when private financing of construction projects is a globally competitive business, the need to demonstrate that our projects provide the greatest opportunity for good returns on investment is of key importance. With ‘unforeseen’ ground conditions giving rise to significant project financial risk then more effective approaches to geotechnical risk management will enhance the confidence of potential investors in construction cost estimates to the benefit of the home economy.

4. Conclusions

The main recommendations and essential principles from the ICE/DETR report: ‘Managing Geotechnical Risk’ are:

- The ground is a common cause of significant delay and cost increase in construction.
- There is a need for systematic risk management, started early with desk study and walk-over survey, expert identification of geotechnical hazards and risks and communication.
- Implications of conditions of contract for risk sharing and methods of dealing with unforeseen ground conditions.
- The importance of design in minimising risk.

It is not surprising that these themes were repeatedly highlighted and discussed through the seminar and although great improvements have been made, much more can be done to fully realise the benefits of an integrated and value driven approach to geotechnical risk management.

Some areas to focus on in the future include the education of geotechnical practitioners, clients and other professionals within integrated design teams; enhanced understanding of geotechnical uncertainty and its communication; capturing the knowledge of experienced professionals and better use of the specialist skills of ground engineering practitioners from different professional backgrounds; recognising new issues/areas for improvement; and assessing all party tolerance to risk. Whilst geologically varied, if common problems in geotechnical risk management could be catalogued at a central point then industry-wide benefits could potentially be realised. This may not be achieved without a formal body responsible for, or regulating, geotechnical projects in the UK. Finally the cost, carbon and economic benefits that are there to be captured are as yet not fully recognised by the ground engineering sector nor, it is probably fair to say, even the authors of this paper.

The issues raised in this paper are naturally wide ranging, unlikely to be exhaustive and are likely to possess different levels of validity depending on the construction sector under consideration. However, the underlying message is that by more effective management of geotechnical risks greater value can be added to the contemporary challenges of reducing the cost and carbon impact of the UK construction industry in the future.