WASTE GEO Technics

Human Resources and Education in Mining and Mine Waste Engineering

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Human Resource Needs

The June 3 Apache Energy explosion in Western Australia that occurred earlier this year slashed WA's gas supply by 1/3. The City of Perth has since been pushed into a serious shortage of electrical power supply, even to the extent of giving consideration to rescheduling football matches from evening to afternoon events. The June 19, 2008 edition of "The West Australian" reported on the front page that the explosion was the result of a pipeline rupture. While the cause of the explosion was still under investigation, the Department of Industry and Resources, which is responsible for the inspections conducted on vital pipelines has experienced an exodus of staff from the department and no longer has the resources to "cover the integrity issue". Even while funding has been set aside to recruit a pipeline engineer, the department has found it increasingly difficult to fill the post, "due to the spiraling demands of the resources boom". Fortunately there was no loss of life in the accident, but clearly there could have been a severe number of fatalities caused by this catastrophic event. The incident in WA paints a clear picture of the problems we can and will face in runaway times of economic growth when we do not have adequate human resource to service accelerated development.

Our world of mining has changed radically in less than a decade. Unprecedented global expansion due to economic development in China and India has driven record commodity prices and increased stability in some resource-rich countries (e.g. Peru) while increasing instability in others (e.g. Africa). The demand for talent in mining engineering together with all the other essential engineering disciplines such as mine waste geotechnique is well beyond extreme. We are exploring, investigating, designing, building and operating mines at a racing pace never witnessed before. In addition, we are planning to create new mine waste repositories with physical scales that most members of the general public have difficulty visualizing. Just imagine, for example, a conversation in the backyard with your neighbor where you are attempting to explain that you are currently engaged in a prefeasibility study for the excavation of Grouse Mountain; and that you are planning to deposit it in Stanley Park or on the UBC campus. What's more, we must also explain, that we have the skills with which to build these gigantic mined earth structures such that their geotechnical stability and environment integrity will be maintained over the centuries and millennium ahead. So where will we acquire the skills, knowledge, talent, experience, expertise and human resource to meet this global demand?

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The current human resource crisis has created a dire shortage of experienced specialists but this will be compounded further by the need for a new breed of specialists as new technologies become implemented. This crisis extends well beyond the end practice of mine waste geotechnique. The implementation of automation and control in both underground and surface mining systems is a particularly significant example, following on from the well established advances in process control in mineral processing plants. Underground automated drill-blast-transport systems in hard rock mines, particularly in block caving systems, are on the verge of widespread operational implementation (albeit after more than 20 years of sporadic research). The underground coal industry faces renewed advances in automated excavation, anti collision and process control technologies. Autonomous truck haulage is imminent in surface mines. Having the professional expertise to deal with these forms of excavation and transport automation, in addition to further mineral processing and environmental impact mitigation technologies, will test the ability to take competitive advantage of the new technological advances. Above all, the considerations of systems safety and human factors will be paramount, particularly with respect to the potential interaction between automated systems and the workforce.

The current issues in recruitment and retention of human resources, compounded by the ongoing global mining boom and demographics-based HR crisis, have prompted significant recent initiatives, although these have yet to look too far in the future. In Canada this has resulted in the formation of the Mining Industry Human Resources Council, funded by the Canadian government (http://www.mihr.ca). The Council collaborates with all communities of interest (employers, educators, organized labour, Aboriginal groups, and others) to address human resources challenges facing the Canadian minerals and metals sector. A related initiative in Australia is the Mining Industry Skills Centre (http://www.miskills centre.com.au). This has a vision to create a "One Stop Shop" for both industry and government on all matters relating to the training and development of a sustainable workforce to meet the mining industry's current and future needs. The HR crisis also underlines the priority need to address mining education, not only from the point of view of product quantity but also quality, relevance and alignment. Re-engineering the mining education process is getting underway in some schools and recognized to be a challenge that needs to be shared together by industry and academia.

Education, Training and Professional Life Cycles

Mining engineering education is professional training, similar to medicine, dentistry, law, pharmacy, and nursing. In general, employers expect the young mining engineer to make a contribution from the first day of employment (i.e. short term planning, data analysis, feasibility studies, etc.) While many opportunities for continuing education in focused areas are considered essential, a Bachelor of Science Engineering is usually considered a terminal degree by most mining companies. At the same time mining engineers do not typically have the geotechnical background to be mine waste engineers and thus we rely on civil and geotechnical engineers to provide this essential service. Consultants who provide expertise in advanced mine waste geotechnique require a Masters degree as a minimum, while a PhD is becoming more and more common. The training of mine waste engineers generally occurs independently of mining engineering followed by graduate school. In summary, it generally requires 4 years at university to become a mining engineer and 6 years to enter and become established in the field of mine waste geotechnique. However, it is important to understand that a new graduate does not have the capacity to function at the level of a Professional Engineer. An additional 4 years of mentoring and training under the direct supervision of a professional, senior level engineer must follow graduation. We must to keep these points in mind when we consider human resources within the context of professional life cycles.

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We are barely 5 years into the current boom cycle and no one can really predict where we will be in another 5 years. All of us are accustomed with the cycles and we have all heard that this one is a super cycle, what ever that means, so let us assume the cycle will last another 10 years. Why 10 years? Well in the same way it typically requires 10 years to take a mine from discovery to production, it requires about the same period of time to take a bright young student from high school to a P.Eng, or PE level of practice. It is interesting to note that an engineer who has just reached this level and graduated from the department of mining, geological or civil engineering would have entered first year engineering in the year 2000 (think back carefully to the year 2000 and imagine a first year student asking what the job prospects in mining will be in a few years!) Even after graduation in 2004, this same young professional would have required considerable supervision, mentoring and professional development over the next 4 years.

Supervision of Engineers in Training is essential and mentoring should be provided by existing senior level Professional Engineers who can remain engaged in the continuing professional training of the young engineer over the next several years. We must understand that from a human resource point of view, the training of an intermediate level mining or geotechnical engineer requires both university education and professional training over a period of almost 10 years following high school graduation. Senior level, highly qualified personnel require perhaps another decade of professional practice. Such a level of professional capacity would therefore be found in people who entered first year university during the later 1980's. Frankly, it is these people who are now carrying the lion share of the existing demand within the current super cycle, and they are also carrying the load of training our new graduates.

One of the must ironic facts is that this sudden demand for human capital in the mining industry is occuring within just a few short years following years of under enrollment, under funding and in many cases, the near collapse of many mining schools. Mining schools globally have traditionally seen recruitment and survival at risk during industry down cycles, for example at the turn of 2000 many North American, as well as Australian schools were close to extinction (Scoble, 2003). In fact our own Department of Mining Engineering at UBC had only 6 students enter the program in 2000, and if it wasn't for the vision and good will of our then Dean, Micheal Isaaacson, could have come under threat of closure. The threat was even more pronounced in Australia. 10 years ago the Minerals Council of Australia published "Back from the Brink – Reshaping Minerals Tertiary Education" (Minerals Council of Australia, 1998). Without changes, it was suggested that Australia's minerals education could be *"pushed over the brink of viability as a long term supplier of the graduates that Australian industry will need in years ahead."* The paper also pointed out the need to improve existing programs in that *"graduates often have a poor understanding of how their theoretical knowledge can be applied in practice. They also tend to be unaware of the importance of communication and "people skills", how business decisions are made, OHS, the demands of life in (often remote) operational settings and other significant issues facing industry"* and *"undergraduate education should deliver technical excellence in the fundamental principles of science and engineering, an understanding of broader issues facing the industry and the ability to continue to learn."* This discussion paper was the catalyst for change in mining engineering education in Australia and one of its tangible outcomes is Mining Education Australia, the joint venture between the top three Australian mining schools. This and other initiatives have eased the supply shortages in terms of quantity and quality but challenges will still need to be met in the future.

Many mining programs are now in a state of renaissance, after decades of being the *Cinderella on Campus*. At UBC a concerted development effort has raised mining student recruitment significantly as well as industry and B.C. government financial support to form the N. B. Keevil Institute for Mining Engineering (http://www.mining.ubc.ca). Its staff are currently working with both the students and its Industry Advisory Committee to reappraise its curriculum to meet a new definition for the future mine and its mining engineer.

Many engineering academics are also looking to the Master's degree as becoming the professional engineering degree of the future because of difficulties of cramming enough of the diverse courses into the bachelor degree curriculum over four years (Galloway, 2007). (The Mining Engineering undergraduate degree at UBC like many others was reduced from five to four years in length in the nineties.) Other strategies include appending blocks of courses in relevant disciplines onto a mining engineering degree, for example as a Minor in Management, or a specialist area such as Environmental Management, or Community Relations. Another strategy may be to recruit engineers or scientists from advanced technology areas who themselves have completed Minors in Mining Engineering. UBC offers a Certificate in Mining Studies, aimed to enable cross-training, later in the career to acquire new skill sets for upward or lateral mobility in a professional career (Scoble, 2007). The Certificate is based on a blend of internet-based courses and conventional short courses (http://www.edumine.com/xedumine/ubcminingcertificate.htm). This enables the integration of learning into employment patterns. The recognition of the value of lifelong learning in developing the mine's human capital is beginning to be appreciated, as companies begin to promote professional development opportunities with employees. This process will likely gain momentum as the *future mine* transforms into a Learning Organization (Scoble, 2007).

Another aspect that we have not discussed here is how can we increase our vigilance to ensure greater due diligence in monitoring and ensuring the integrity of design, planning, operation and closure for the next generation of waste structures? Also, what does this mean in terms of our investment into research that will help us fully understand the behaviour of such large scale structures? In closure, it might be said that we in the mining business live in interesting times. It is not clear how long the current super cycle will last or how successful we will be in meetings the demands for human resources. However, in order to truly understand human resource issues in mining, we must also consider mining cycles, mine life cycles and professional life cycles within a holistic context. It is important to note that the decision to enter a mining engineering program is typically made at 19 or 20 years of age. In a subtle but powerful way the current supply of human resource available over the next few years has already been determined with previous decisions made by young people. Increasing this supply will have a lag of at least 5 years and the question still must be asked, what will be the demand for the young people who have yet to make the investment into the world of mining? Only time will tell.

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