Journal Comment

Life skills needed for the 4th industrial revolution

The annual SAIMM Student Colloquium that was scheduled for October 2016 unfortunately had to be cancelled due to the *Fees must Fall* disruptions that took place on just about all the university campuses in South Africa. From these student colloquia in the past, the best project presentations were selected by the judges and published in the Student Edition of the SAIMM *Journal*. When the Colloquium was cancelled the *Journal* Editorial Committee decided that each of the participating academic institutions would identify their best student and make those papers available for publication in the April 2017 *Journal*.

This *Journal* therefore now showcases the best students of all the academic institutions that normally take part in the SAIMM Student Colloquium, and includes contributions from mining and metallurgy. Once again the topics covered were very relevant and the papers of high quality. I want to echo Vaugh Duke's statement in a previous Journal Comment, that we are on the right track in terms of developing our next generation of mining practitioners.

The World Economic Forum (2016) published an article written by Alex Gray (formative content January 2016), with the title; '*The 10 skills you need to thrive in the fourth industrial revolution*', the fourth industry revolution being based on the use of cyber-physical systems. The first, second, and third industrial revolutions were based on mechanical production equipment driven by water and steam power, on mass production enabled by the division of labour and the use of electrical energy, and on the use of electronics and IT to further automate production, respectively.

My immediate reaction on reading this article was to consider how we, as academic institutions, can adapt our approach to teaching and learning so as to prepare our students for coping in this new environment (with specific reference to the developing of related skills). The ten skills highlighted in the article were as follows:

- Complex problem-solving
- Critical thinking
- Creativity
- People management
- Coordinating with others (group work activities)
- Emotional intelligence
- Judgement and decision-making
- Service orientation
- Negotiating
- Cognitive flexibility.

In another article that was published in a local newspaper in January 2017, the following were proposed as activities that machines will not be able to do in future (obviously there can be more). The number in brackets indicating the importance of the skill mentioned (source: PwC):

- Creativity and innovation (4)
- Leadership (3)
- Emotional intelligence (5)
- Adaptability (2)
- Problem-solving (1).

In the article by Gray it is mentioned that by 2020 the fourth industrial revolution will have brought us advanced robotics and autonomous transport, artificial intelligence and machine learning, advanced materials, biotechnology, and genomics. So it comes to mind, how will we deal with this in the future?

When considering all the skills mentioned as thriving in the fourth industrial revolution it was no surprise that complex problem-solving was the first item mentioned, and incidentally also the one activity identified that would not be replaced by machines. In the context of a student's vacation work project, several of the abovementioned activities feature in terms of completing a successful project.

As academic institutions we now have to think differently about the way we educate and teach the next generation of mining practitioners (and in this context how to solve complex problems). It is a recognized fact that whatever students are being taught now will be obsolete in the next 5–10 years. Specific skills such as complex problem-solving, critical thinking, and creativity in terms of how we deal with problems/challenges in our work environment will become non-negotiable. Independent learning will be a skill that must be acquired so as to be able to deal with the complexities associated with the mining industry. In simple terms, students need to be challenged to act beyond their comfort zones sooner rather than later, and through this to become equipped to challenge the norm.

In terms of the projects that students do on mines, inquiry-based learning (IBL) becomes a crucial component in completing a project successfully. IBL implies student involvement that leads to understanding. This helps the student to learn the content and key concepts and to gain a deeper understanding of the problem to be solved. IBL emphasizes constructivist ideas of learning, as well as the ability to successfully apply that knowledge, and through this engages the students in their own learning process. Through this, students take more responsibility for:

- Determining what they need to learn
- Identifying resources and how best to learn from them, and how to use the knowledge
- Using resources and reporting on their learning
- Learning to value and build on their prior knowledge.

It is my humble opinion that in the context of project work, the abovementioned will not only enhance the quality of learning and the implementation of solutions, but also ensure a high quality and successful project. Creativity and innovation are internal values and can be developed through a properly structured awareness process.

If one considers the other skills mentioned earlier, more than 50% of those relate to 'people skills'. People management, cooperating with others, service orientation, and negotiation become key skills that one needs to successfully engage in any problem or research project. There are always other people that know more than you do, and your ability to successfully engage with them is a key success factor to continuously build on.

Journal Comment *(continued)*

To my mind the projects that are published in this edition of the *Journal* must have included many of the attributes mentioned above. It is therefore a very important requirement that academic institutions include related skills-development activities in the design of their curricula. Solving problems is an acquired skill and obviously the more it is practised the better you will become.

It has been stated that machines will not be able to solve problems creatively and innovatively, will not have the ability to be emotionally intelligent, be adaptable, and be leaders – how comforting is that! There will, therefore, always be some sort of human interface required. In an article by Kris Hammond (Advisor Computerworld, October 2015), three arguments are listed as to how machines and humans will coexist in future. The arguments are quite fascinating and are summarized as follow:

- Machines take our jobs, new jobs are created
- Machines take only some of our jobs
- Machines take our jobs, we design new machines

In the article the differences are explained in detail, but the great conclusion is that there will always be a place for people, but with a very important difference. People will have to change and adapt to a new set of skills required to be successful in the fourth industrial revolution. We as academic institutions and related industries need to ensure that we are also equipped to further help develop the skills required.

In conclusion, the mining industry is in dire need of the next generation of innovative complex problem-solvers and practitioners with the other skills mentioned. Here, academic institutions and industry alike play a significant role in ensuring that in future we will be able to deal with the envisaged complexities in the mining industry. I hereby commend and acknowledge the contributions made and that are still going to be made by all the academic staff and other industry role-players in achieving this goal.

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