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An Example of a University-Industry Collaboration to Undertake Focused Research

The School of Mining Engineering (Wits Mining) at the University of the Witwatersrand (Wits), Johannesburg/South Africa, has a long history of Mining Engineering education, being the oldest and largest on the African continent. Wits Mining has signed a Memorandum of Agreement with one of the largest gold mining companies in the world with a common commitment to education, research and innovation in South Africa. Both parties agreed to further research and develop the field of mechanised mining and rock engineering. This paper reflects on the process that was undertaken for this and the procedure in place for the success of this collaboration. It has undergone a peer review process. The paper was held at the 30th SOMP Annual Meeting and Conference which took place from 29th June to 5th July 2019 at the TH Georg Agricola University in Bochum/Germany.

Introduction

According to Perkmann, et al. (2013), universities are organisations that perform a key role within contemporary societies by educating large proportions of the population and generating knowledge. The School of Mining Engineering (Wits Mining) at the University of the Witwatersrand (Wits), Johannesburg/South Africa, has a long history of Mining Engineering education, being the oldest and largest on the African continent. In 2016, the School celebrated 120 years of existence and according to the recent QS World University Rankings (2019) by subject area, it is recognized as one of the world's top mining engineering schools, ranked 13th and hosting an expansive mining engineering program. It also has one of the highest growth rates of any of the engineering schools or departments with a consistent increase in student numbers.

With mines in South Africa going deeper as shallow mineral resources are depleted, the challenges facing the industry today are substantial. However, best-practice innovations and technology offer the opportunity for the design and management of high-tech mines that are not only safer, but also more productive and environmentally and socially responsible, while still being economically successful.

As part of this, the School signed a Memorandum of Agreement (MoA) with Gold Fields Ltd (GF), one of the largest gold mining companies in the world, with a common commitment to education, research and innovation in the field of mechanised mining in South Africa. With the signed MoA, both parties entered into a collaboration agreement to advance academic knowledge in the area of mechanised mining and rock engineering in South Africa.

This paper discusses the process that was undertaken for the collaboration between Wits Mining and GF along with the procedure that has been in place for the success of this joint venture.

Need for Industry – University Collaboration

Historically, most mining and metallurgical companies had their own research and development units in-house. However, financial implications due to the economic downturn have led to them being closed or their capacity being significantly reduced (Ndlovu, 2018). Furthermore, according to Ndlovu (2018), innovation is a multidisciplinary venture which is driven by research and is impossible without the relevant researchers trained in the appropriate fields to contribute significantly across the different sectors of the minerals industry. These skills can be found at universities, and thus there are opportunities for the academic world to contribute to these ideas in order to assist when the industry is facing these challenges. Ndlovu (2018) further stated that there are several advantages of this collaboration, including the merging of fundamental and applied research. Universities are more focused on the creation of fundamental knowledge whereas industry on the other hand is focused on innovation. Universities can thus be seen to act as stimulating and enhancing the power of research and development in the industry (Rosenberg and Nelson, 1994 as cited in Ndlovu, 2018).

This collaboration between universities and industry have provided discoveries over the years and many ideas from university research have been put to use through collaboration between universities and firms (Eisenberg, et al., 2018). According to Ankrah & AL-Tabbaa (2015) cited in Rybnicek & Königsgruber (2019), industry–university collaborations (IUCs) have a long tradition in several countries worldwide. Furthermore, Pinheiro et al. (2015) cited in Rybnicek & Königsgruber (2019) state that universities play a crucial role in achieving economic growth in today's knowledge-based societies.

These IUCs are increasingly important and it is in the interest of governments, policymakers, researchers and practitioners that such collaborations are successfully implemented. While the advantages and potential of these collaborations are well recognized, there are at the same time numerous hindrances and challenges to be met, which can lead to failure (Rybnicek & Königsgruber, 2019).

Wits Mining Engineering

As previously mentioned, Wits Mining has a long history of Mining Engineering education, being the oldest and largest on the African continent.

It currently offers both undergraduate and postgraduate degrees. The undergraduate program is a 4-year degree which does not offer any elective courses (fixed curriculum programme), designed to provide graduates with the engineering expertise they require as mining engineers (Genc & Mitra, 2018). Since the beginning of this year, Wits Mining has started teaching their new redesigned curriculum in line with Mining 4.0 and is one of the first Schools in the world to undertake this process (Mitra, et al., 2018). Wits Mining has, in conjunction with the South African mining industry, developed a range/suite of postgraduate courses designed to cater for the needs of graduates, which include technical subjects for specialist skills in mining, mineral resource management and evaluation, and rock engineering, as well as management skills in evaluation techniques and fundamental principles in mineral economics. On an average, Wits Mining has approximately 600 students across the four years in the undergraduate program and another 250 in the postgraduate program.

Wits Mining graduates are ready for the industry's challenges and it is known and respected internationally for the quality of its programs and graduates. The School's new Strategic Plan and new technology driven curriculum will ensure that the Wits Mining Team can deliver excellence in Teaching, Research and Service – in line with the Wits Vision 2022 of being "a leading research-intensive university firmly embedded in the Top 100 world universities by 2022".

Wits Mining Institute

The Wits Mining Institute (WMI) is one of the six 21st century Institutes at Wits University and is a collaborative initiative aligning the University's multidisciplinary research capacity within mining problems and opportunities. Delivery on its mandate is through the Sibanye-Stillwater Digital Mining Laboratory (DigiMine); the Centres for Mechanised Mining Systems (CMMS) and Sustainability in Mining and Industry (CSMI); and a skills unit responding to the training needs arising from the WMI research agenda. DigiMine is an exciting project where the Chamber of Mines Building on West Campus was converted into a mine laboratory, consisting of a surface (using the flat roof of the building), vertical shaft (using a stairwell) and mock mine with a control room in the basement. The laboratory is equipped with digital systems that enables research into the mine of the future, that is: a mine capable of sensing, observing and acting with automated systems. DigiMine has several research themes and this article falls into the theme of technology monitoring systems for underground health, safety and mine security.

Wits – Gold Fields Collaboration

Wits and GF have developed a common commitment to education, research and innovation in the field of mechanised mining in South Africa. Both the parties have signed a MoA between them as previously mentioned. The idea for this collaboration is to expand the scope of tertiary mining education as it relates to technical, operational and organisational aspects of mechanised mining and rock engineering to the benefit of mechanised mining as a whole in South Africa. This collaboration will contribute to develop skills and expertise required to bring South Deep, one of the deepest GF mines to full production and to assist in developing young professionals with the required knowledge and skills to support mechanised deep level gold mining in South Africa. Digital mining is also becoming a reality at many modern mining operations around the world, including at South Deep. The University's DigiMine Lab, which is part of WMI is also a critical component of this collaboration. Figure 1 shows the broad overview of this arrangement.

According to Eisenberg, et al. (2018), University-industry collaboration requires careful management and can bring many benefits. As can be seen in Figure 1, a Steering Committee has been developed to look into this arrangement. This Steering Committee is chaired by a member of the GF Executive team and consists of three members from GF, two members from Wits Mining and

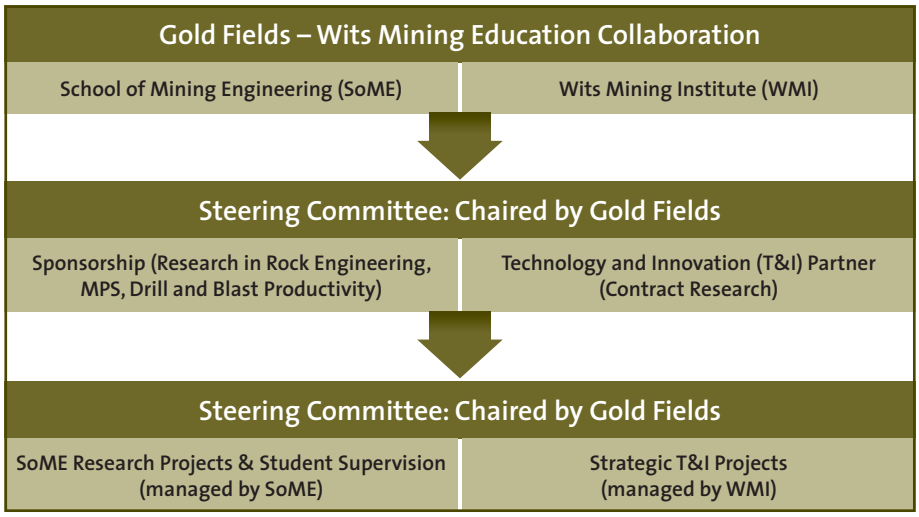

Fig. 1. Broad overview of the Wits-GFI collaborative arrangement.

one member from WMI. The role of the Steering Committee are as follows:

- Receive written progress reports from students and researchers conducting research on projects.
- Assist, evaluate and develop the feasibility of proposed projects and make recommendations.
- Make recommendations on the merits of requests for equipment and supplies.
- Report on spending against the approved budget.
- Facilitate formal feedback from students on their dissertation projects.

As part of this collaboration, GF has agreed to contribute two million South African Rand per calendar year for each year of this Agreement starting from 2018. The Steering Committee has been regularly meeting since the signing off of the MoA and has now agreed to meet on a quarterly year basis.

Current Status

The Steering Committee has met five times to date, since the signing of the MoA. In the first meeting, the members agreed upon the purpose of the Committee and the regular agenda items that they would like to be included in all the meetings. Furthermore, the expectations from the University was made clear at this meeting, especially the fact that the research that will be undertaken within this agreement will be done within the timeframe for a Masters degree and the outcome of the research will be a Masters research project report.

In each of these meetings, one of the agenda items that the Committee looks into is the progress of the current projects. The idea behind this is to make sure that the projects are progressing in the correct future direction and they also have all the necessary required infrastructure for their successful completion. As an example to this, one of the rock engineering projects requires some tests to be conducted as part of the project. However, unfortunately, these tests could not be completed in house and hence there was a need for involving an external consultant. The research team at Wits had to include an explanation of the above along with the costs for the consultant. This was approved after discussion within the Committee.

Currently, Wits Mining is undertaking four projects in the area of rock engineering, fragmentation and multi-point statistics. There are five students who are currently involved in these four projects. There was a request from the Committee for the students to present their progress to the Committee in their meeting in June 2019. Mining personnel who are involved in the current projects were invited along with the key role-players in the company.

The students did a good presentation to the Committee and they were all happy with the progress to date. There were some very good comments from one of the top executives in the company about the betterment of the projects. These were all implemented in the outcome of the final research.

The other regular agenda item in the Committee meetings is to look for future research topics that will be beneficial to the company/mine site. As an example, in the last meeting of the Steering Committee, it was agreed upon that a proposal will be put forward for two other projects - one looking into the entire logistics and operating system/value chain and the other into the communication side of things.

Conclusions

As has been highlighted by many researchers in the past, industry-university collaboration is important mutually. There have been previous instances of support from GF such as funding for the Engineering Library at Wits and the Rock Engineering Laboratory at Wits Mining. These along with the current agreement between the two parties are great examples of industry university alliance. Wits and GF continue to have a good relationship and the School continues to conduct other research apart from the ones through this collaboration.

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