The University of Zimbabwe Mining Engineering Programme - Responding to the Requirements of National Development

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ABSTRACT

This paper discusses important aspects of the growth of the Department of Mining Engineering of the University of Zimbabwe, and the ways in which the curricula has been tailor-made to address the national requirements. It sketches the programme from the start in 1985 to the present. It highlights the consultation processes employed, the academic merit, lessons learnt over the years, and the strategic thrusts being promoted in the revised programme beginning in 2002. The new programme emphasises producing mining engineering graduates who are highly computer competent. It also offers an option of specialisation in 'small scale mining'. On the whole, the programme has been built on the basis of very strong international collaboration directed at producing mining engineers of an international standard.

INTRODUCTION

The mining sector in Zimbabwe, with a variety of over forty different minerals under production, is clearly an important branch of the economy. It has strong forward and backward linkages into all the other sectors of the economy, particularly agriculture and manufacturing. Hence, its successful development (or lack of it) has significant ripple effect in these sectors.

Mining contributions to GDP rose steadily from around 4.4% in 1972 to over 8% in 1980, but has dropped to under 2% by 2002. Total employment in the formal mining sector stood at around 70,000 in 1980. The corresponding number for the informal small-scale mining sector would have stood at no more than 2,000. Formal mining employment has dropped to under 50,000 by 2002. At the same time the number of small-scale miners has risen dramatically to anything between 100,000 and 150,000. The difficulties being faced by the small-scale mining sector has been well documented in the past years (Wright, 1996; Svotwa, 2001; Hollaway, 2000, Murangari, 2002;Hoadley, Limpitlaw, and Weaver, 2002). These include shortage of resources, inadequate mining skills, and complicated marketing arrangements.

At independence in 1980, it was envisaged that the mining sector would continue being an important contributor to the economic development of the country, and in fact, was actually expected to expand. With only a small number of graduate mining engineers in the country at that time, the demand for graduate mining engineers to spearhead the envisaged growth in the sector was very well established. The same was true for metallurgical engineers.

Within the above background, negotiations between the governments of Germany and Zimbabwe resulted in a programme for the development of the two departments: Mining Engineering, and Metallurgical Engineering at the University of Zimbabwe. Both departments were established in 1985 within the Faculty of Engineering on the basis of a joint Zimbabwe-German Technical Cooperation 'project'. Zimbabwe provided the infrastructure, some staff, and material costs, while Germany provided laboratory and teaching equipment, some staff, and facilities for the further training of local staff through a Staff Development Scheme. Both parties were responsible for the development of the curricula in response to the requirements of the local minerals industry and the university.

The German contribution to the project was administered by the GTZ (German Agency for Technical Cooperation), while the University managed the Zimbabwean contribution. The number of academic staff in any one year hovers around five or six full time staff, with up to ten part time and visiting staff from the local industry, the University of Zambia, the University of Science and Technology in Ghana, Technical University Aachen, and the Technical University Berlin. Quality assurance has been guaranteed in part by the use of 'external examiners' from the University of Witwatersrand, and the Technical University, Berlin. The programme has been built on the basis of very strong international collaboration.

The discussion here is limited to the mining engineering programme. The presentation is in two broad sections. The first section sketches the first two distinct periods in the development of the programme, up to the end of 2001, and the second section highlights the characteristics of the current programme (starting in 2002).

SECTION 1: GROWTH OF THE DEPARTMENT OF MINING ENGINEERING

At the start, the degree programme in mining engineering was relatively standard - a four-year Bachelor of Science honours engineering degree, B.Sc. (Hons.) Mining Engineering. Students enrolled in the programme after successfully completing the Cambridge General Certificate of Education, Advanced Level (GCE A-Level) in Mathematics, Physics and Chemistry. The programme has now gone through two distinct periods: 1985 to 1992, and 1993 to 2001.

Period-1, 1985 to 1992

As noted above, the original programme was relatively standard, with part 1 (year 1) being common to all the other engineering disciplines in the Faculty, namely civil, electrical, mechanical, and metallurgical engineering. The mining students get a thorough grounding in the fundamental engineering subjects in addition to mathematics, computing science and communications skills. The subjects covered in the programme are shown in Table 1. Students were required to pass all the courses in parts 1, 2, and 3, plus any four courses (including Mine design and planning) in part 4, in addition to the final year project.

A particular character of the programme during this period was that of the requirement to complete two projects, one in part 3 and the second one in the final year. The first project was more of a 'warming up' in research project work, in preparation for the final year project. The projects were invariably based on issues recommended by the mining companies. The industrial practical exposure in the programme was limited to the mandatory 18 weeks of work in a mining environment during the vacations between the respective academic years.

Period-2, 1993 to 2001

By the second year of the new programme (1986), the industry had already expressed the desire to see the university producing mining graduates with industrial training of at least one year, as opposed to the 18 weeks called for in the standard engineering degree regulations. The first sets of regulations for the one-year attachment were drafted by the end of 1987. By and large, the regulations covered details on:

- The aims and objectives of the practical training;
- Entry requirements and application procedures;
- The lengths of the various phases in the training;
- The number of shifts to be spent in the different mines - metalliferous, coal, industrial minerals - for both surface and underground mines;
- Supervision of the practical training;
- Responsibilities of the trainees;
- The keeping of a training diary and report book, and
- The mine (examination) tour and certification/grading of the practical training.

Some aspects of consultations

On the whole, the practical training covered some 225 shifts. The one-year industrial attachment was introduced into the programme in 1993. Before then extensive discussions were held with the relevant stakeholders, namely the mining industry, the university authorities, the Ministry of Higher Education, the Ministry of Mines, students, and staff of the department and the Faculty of Engineering. The issue of where to position the one-year practical training presented some interesting challenges. One set of stakeholders favoured positioning the practical year immediately prior to the students entering the university. This would have been implemented in a manner similar to the then 'Practicum' year for students in Germany, (call this option-1). A second set of stakeholders opted for positioning the one-year practicals after the first year at university, prior to the student delving into the study of mining courses, (call this option-2). The arguments for this option were that the students would already 'have a feel' for mining before studying the mining courses in the later part of the programme. Yet a third set of stakeholders proposed that the one-year industrial attachment should be positioned just before the final year. In this way, it was argued, the student will be going to the mines when he or she has already studied several mining courses, and would then be more productive for the mining companies, (call this option-3). In any case the decision was taken to position the industrial attachment in the second year of the programme, namely option-2. The subjects in the programme and the positioning of the industrial attachment are shown in column-3 of Table 1 above.

The duration of the programme was therefore extended to five years. The regulations were approved in time for the five-year degree programme to be introduced in January 1993. This five-year degree programme is being phased out, with the year 2002 intake joining the new four-year degree programme.

Advantages and disadvantages of the five-year programme

The advantages experienced with the five-year programme included:

- Students found it easier to cope with the pure mining courses after completing the one-year industrial attachment;
- Students who have completed their industrial attachments also found it easier to obtain real mining employment during the vacations after the second and third years of studies, and also upon graduation.

There were also some disadvantages associated with the five-year programme:

- To obtain an honours degree in five years after completing A-Levels was considered too long by both students and their sponsors;
- Some mines found students on industrial attachment to be more of hindrances than of help. This was basically because the students went on the industrial attachment immediately after completing the first year of the degree programme. By that time they would not have studied any mining subjects. Consequently, they ended up being just 'trainees' rather than productive mine employees. This was particularly

a problem for the smaller mines, especially during the years of depressed mineral prices.

SECTION-2: RESPONDING TO THE SITUATION IN THE MINING SECTOR

By the end of period-2, developments in the Zimbabwe mining sector were once again indicating the need for changes in the mining degree programme (Svotwa, 2001). These developments included:

- Increasingly difficult macroeconomic situation marked by weak mineral prices, and the consequent shortages of foreign currency for imported equipment and supplies;
- Marked contractions in the large scale mining sector, including mine closures;
- Phenomenal increases in the number of 'small scale miners'.

Period-3, 2002 and beyond

The year 2002 marks the start of the third distinct period in the development of the programme. Taking the above into account, extensive consultations were once again held with stakeholders in the mining sector, with the view of seeking out ways to ensure that the degree programme continues to address the needs of the industry and remaining relevant to the economy as a whole. A four-year degree programme was then defined (see column 4 of Table 1). Highlights of the programme include:

- The shifting of the one-year industrial attachment from the second year to the period extending over the vacation after the first semester in the third year, the second semester of the third year, and the vacation after the second semester in year-3, a total of some 230 shifts. This corresponds to option-3 noted above;
- The introduction of the course 'Engineering and the National Economy' in the first year. This course covers minerals and engineering materials and their role in development;
- The introduction of the course Small and Medium Scale Mining Enterprises, building on extensive experience that has been accumulated in the department, covering the small scale mining sector (Murangari, 2002);
- The dropping of the third year project. In a way, the one-year industrial attachment would include relevant project work.
- Consolidating the original three geology courses into two: Fundamentals of Geology, and Mining Geology, and
- Replacing the Computer Application Course (which had an emphasis on mining computing) with a more broad-based course in Information and Communication Technology (ICT).

Further Highlights of the mining degree programme

Three further highlights can be noted. The first covers the issue of ICT. In 1999 the university launched a campus-wide computer network programme, with the assistance of the Flemish Universities, Belgium. This programme provided widespread access to computers for both students and staffs. As such the new mining degree programme is capitalizing on opportunities for increased self-study via Computer Aided Learning (CAL), a process already started in the late 1980s (Wright, 1989). The second highlight covers that of the revamping of the Industry Advisory Board (IAB). This board ensures that inputs from the mining industry into the activities of the mining department are fully taken into account. At the same time, the IAB will continue to facilitate university-industry linkages covering such areas as: places for the industrial attachments, students' final year projects, contract research, consultancies, and continuing education short courses. The third highlight is that of the introduction of modular teaching in the final year. This was introduced as a result of its success in the masters' programmes, such as that in water resources in the Faculty (Wright et al, 2001). The modules, normally of three-week durations are concurrently offered as continuing education short courses for participants from industry.

Both in terms of numbers and quality, the mining engineering degree programme has, in fact, made clear contributions to the mining engineering human resources needs of Zimbabwe and, to some extent, of the southern Africa sub-region. The number of graduates produced has risen from the 4 in 1988 to a high of 25 in 2001 - a total of some 185 graduates in 14 years. The graduates are engaged not only in Zimbabwe, but also in Botswana, Malawi, Mozambique, South Africa, and Zambia. Some have ventured as far away as Australia. Several of them have been mine managers for sometime, while a few have also completed graduate studies at universities abroad.

CONCLUSIONS

The development of the mining engineering degree programme at the University of Zimbabwe has gone through two distinct periods - the first being the period 1985 to 1992, and the second being 1992 to 2001. The durations of the programmes during these periods were 4 years and 5 years respectively. The 5-year programme included a one-year industrial attachment. The introduction of the one-year industrial attachment was brought about by the requirements of the industry for new graduates to have a certain amount of hands-on experience at graduation. Five years has however proved to be too long for the bachelor's degree programme. Consequently the programme has now been reduced back to four years, but this time still including the one-year attachment without loss of theoretical content. The consistency of the theoretical aspects of the programme is being guaranteed through increased computer aided learning made possible by the widespread availability of computers through the a

university wide computer network programme. The new programme is also designed to enable graduates to service the expanding small-scale mining sector. With a total of some 185 graduates produced in 14 years, the Bachelor of Science (Honours) Mining Engineering programme at the university of Zimbabwe has clearly been servicing the needs of the national economy for graduate mining engineers.

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TABLE 1
Spread of subjects in the Mining Engineering Programme over different time periods

Part / Year	1985 to 1992	1993 to 2001	2002 to …
1	▪ Engineering Mathematics I ▪ Computing Science I ▪ Communication Skills for Engineers ▪ Engineering Drawing and Design ▪ Engineering Materials ▪ Engineering Mechanics ▪ Workshop Practice ▪ Electrical Principles	▪ Engineering Mathematics I ▪ Computing Science I ▪ Communication Skills for Engineers ▪ Engineering Drawing and Design ▪ Engineering Materials ▪ Engineering Mechanics ▪ Workshop Practice ▪ Electrical Principles	▪ Engineering Mathematics I ▪ Computing Science I ▪ Communication Skills for Engineers ▪ Engineering Drawing and Design ▪ Engineering and the National Economy ▪ Engineering Mechanics ▪ Workshop Practice ▪ Electrical Principles
2	▪ Engineering Mathematics II ▪ Electrical Machines ▪ Fundamentals of Geology ▪ Advanced Geology ▪ Introduction to Mining and metallurgy ▪ Strength of materials ▪ Geomechanics ▪ Thermofluids	One year industrial attachment	▪ Engineering Mathematics II ▪ Electrical Machines ▪ Fundamentals of Geology ▪ Surface Mining ▪ Underground Mining ▪ Rock Mechanics ▪ Mine Ventilation ▪ Thermofluids
3	▪ Mining Machinery ▪ Applied Geology ▪ Surface Mining ▪ Underground Mining ▪ Mine Surveying ▪ Mine Ventilation ▪ Rock Mechanics ▪ Operations Research ▪ Professional and Industrial Studies ▪ Third Year Project	▪ Engineering Mathematics II ▪ Electrical Machines ▪ Fundamentals of Geology ▪ Advanced Geology ▪ Introduction to Mining and metallurgy ▪ Strength of materials ▪ Geomechanics ▪ Thermofluids	▪ Mining Machinery ▪ Operations Research ▪ Mine Surveying ▪ Mining Geology ▪ Mine Environmental Management, Health and Safety ▪ Industrial Attachment, covering: 1st semester vacation, plus 2nd semester, plus 2nd semester vacation (total 2+ semesters)
4	▪ Materials Handling and Services ▪ Mine design and Planning ▪ Mine Economics and Management ▪ Mining Law, Environment and Safety ▪ Mineral processing ▪ Computer Applications in Mining ▪ Final Year Project	▪ Mining Machinery ▪ Applied Geology ▪ Surface Mining ▪ Underground Mining ▪ Mine Surveying ▪ Mine Ventilation ▪ Rock Mechanics ▪ Operations Research ▪ Professional and Industrial Studies ▪ Third Year Project	▪ Mine Economics and management ▪ Mine design and Planning ▪ Mining Law ▪ Information and Communication Technology ▪ Small and medium Scale Mining Enterprises ▪ Mineral Processing ▪ Final Year Project
5	N/A	▪ Materials Handling and Services ▪ Mine design and Planning ▪ Mine Economics and Management ▪ Mining Law, Environment and Safety ▪ Mineral processing ▪ Computer Applications in Mining ▪ Final Year Project	N/A