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Demand and supply for geoscientists in Southeast Asia for the 21st Century

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Abstract: The demand and supply of geoscientists in Southeast Asia has increased due to the unprecedented rapid economic and mineral development since 1970. Mineral and energy resources contribute significantly to the economies of Indonesia, Malaysia, Philippines and Burma and are predicted to expand in Thailand and Indochina. This mining development has also been stimulated due to the establishment of favourable for investment mining laws. Despite recent financial weaknesses, the past up to 8–10% growth of these economies has led to overall expansion of industries and infrastructure that also require increasing geotechnical and environmental inputs. Geoscientists with the appropriate training are now in great demand in exploration, mine geology, mine environment and in the geotechnical and overall environmental areas. These trends indicate increasing future demands also in research and development. On the supply side there are problems with the available training facilities and of attracting the numbers and quality of students, especially on the post-graduate level. The greatest demand is for technologically capable graduates that can meet the needs of an increasingly sophisticated and changing workplace even though this demand is often cyclical and characterised by alternating periods of shortage and oversupply of geoscientists. In periods of shortage the slack is still taken up with considerable numbers of expatriate geoscientists.

A guide that can be utilised to estimate the demand and supply for geoscientists for the mining and energy industries, which are the largest employer of geoscientists in the Southeast Asian region, is based on a simple Australian model which correlates the mining in GDP (MGDP) with the professional geoscientific stock (GEO) and the manpower projected increase with the MGDP predicted growth rate (Katz, 1994). Applying this model correlation to a number of Southeast Asian countries results in some reasonable preliminary estimates. Although the numbers of geoscientists necessary to meet the needs of the region in the 21st century are speculative projections the increasingly technological quality required is without question. The current globalisation and economic competitiveness of the rapidly changing mining industry also places pressure on the quantity and especially the quality of professional geoscientist demand and supply. A case study from Indonesia illustrates some of the supply problems that are common to the region.

INTRODUCTION

For geoscientists the growth and development of the mineral sector in Southeast Asia has created many employment opportunities. The growth in the mineral sector, however cyclical, has been further advanced by the introduction of favourable for investment exploration and mining policies in many Southeast Asian countries. The successful COW system in Indonesia established in 1967 has led the way for other countries in the region to follow with similar attractive to investment mining acts. In the last few years the emphasis has been to set up mining laws and policies that would attract more foreign investment in line with the liberalization and increasingly competitive nature of the global economy and mining industry. Past mineral and energy development of countries like Malaysia in tin and oil and gas has opened up to foreign investment in gold and base metal exploration. The introduction of the Philippines mining law in 1995 has led to an increased foreign involvement in mineral exploration and similar laws are boosting exploration and mining investment in Thailand, Vietnam, Laos and Burma.

EDUCATION AND TRAINING INSTITUTES

McDivitt's (1993) survey of the geoscience education and training institutes in Southeast Asia has provided much useful information on the current state of development. Although there has been progress in the strengthening of universities and technical institutes in the geosciences, many problems still exist in training for middle and high level posts in universities, research institutes and in the mineral industry. In most cases, the basic programs in these countries are adequate. Facilities for university level geoscientific training are relatively new, modern, and have good equipment and facilities. However, the development has not been long enough to permit the necessary balance of facilities, training programs, research programs and staff training. The facilities and programs for geoscientific training are limited in countries like Brunei and Singapore. Mineral and energy rich countries like Indonesia, Philippines and Malaysia have full structures for training of nationals to participate in this development. Newly emergent countries like Vietnam are actively developing their programs although they are not so advanced. In most cases the rapidly changing industry requirements for practical graduates trained in new technological applications and management methods are not being addressed.

SUPPLY AND DEMAND FACTORS

In the ideal situation, supply and demand of geoscientists should be in balance, given that the mining industry is characterised by cyclical and fluctuating demand periods. Indicators are that in various Southeast Asian countries supply exceeds demand, demand exceeds supply and/or there is some local equilibrium perhaps disguising oversupply or shortfalls. In all cases there is a lack of appropriate R and D experts for the development of national technical self reliance. Most, if not all, exploration, and geotechnical products, goods and services are from overseas which results in the avoidance of employment or underemployment of significant numbers on R and D functions. In general, there exists persistent short falls in the supply of geoscientists covered by a propensity to rely on R and D work done off shore. This is not in the national short or long term interest and unless the supply of geoscientific expertise increases, the nationally-essential demand may never arise.

DEMAND FOR GEOSCIENTISTS

As in most Southeast Asian countries the demand for geoscientists is divided between the public and private sectors. The government tends to employ many of the graduates as administrators, educators, and engineers in the civil service, and in statutory boards. Geoscientists who enter the private sector are not exclusively employed in the exploration, mining or geotechnical organisations. Some are employed as managerial or sales personnel. Few professionals are self-employed; most are salaried employees in private as well as public sector organisations.

Demand for geoscientists in the Southeast Asia has increased since 1975 where these economies have in the past experienced high growth rates averaging 5–10% a year. The exact rate of growth will depend on economic factors such as cyclical mineral and energy commodities world market conditions. In addition to continued but slower quantitative growth, there will be a substantial qualitative change in the composition of employment in the late 1990's and beyond. Industrial upgrading means a higher ratio of indirect to direct labour, of skilled to unskilled workers, and of engineers and technicians to production operators. The current financial crisis in Southeast Asia may lead to short-long term investment problems that may result in a slowdown in the mineral industry as well as the geotechnical/construction industry's demand for geoscientists

The demand for geoscientists may also accelerate if major technological or functional shifts occur. Moving into R and D activities, which have considerable economies of scale, will also multiply demand. The composition of demand will also shift towards more management and planning and fewer technical jobs, though the numbers of both may grow.

Development of a new comparative advantage in a more skilled, physical, and human capital-intensive exploration, mining and geotechnical sectors, that will create a strong demand for geoscientists also depends on the availability, cost, and quality of the professionals themselves.

SUPPLY OF GEOSCIENTISTS

Manpower forecasts project, that if the countries in Southeast Asia are to achieve a reasonably high annual GDP growth in the late 1990's and beyond, despite the current economic slowdown, its tertiary and post-secondary institutions must together take in substantial numbers of new students each year. The problem of finding enough suitable applicants for geoscience courses will be particularly severe. Southeast Asian institutes are expected to raise their intakes by the year 2000; and at present only a small percentage of students are enrolled in geology. As science and engineering enrolments are expected to grow faster than those of non-engineering courses the proportion of students studying geology may also rise.

Currently, about ten per cent of secondary school-leavers proceed to the university and a similar per cent to technical and vocational colleges. Only a fraction of these students have the ability and inclination to enrol in geology programs which are variable in the region and often restricted to a few university departments (McDivitt, 1993). Female students, for example, have traditionally preferred other fields of study.

Even if the quantitative targets are reached, they may be inadequate in terms of the quality and type of geoscientist required for industrial upgrading and intensive activities like R and D. The geoscientists required for these activities must be highly intelligent, well trained, imaginative, and versatile and an improvement in quality over the ones now being produced.

RESEARCH AND DEVELOPMENT DEMAND AND SUPPLY

The quality of Southeast Asian geoscientists is crucial in the development of research and development capabilities. The exploration, mining and geotechnical industries are now becoming more sophisticated and in order to make these industries internationally competitive there is a need for greater investment in R and D and a greater demand for professionals with postgraduate degrees and research training and experience. In all cases, research trends are away from the fundamental to the applied, especially in regard to possible local, unique exploration, mining and geotechnical problems which cannot be solved by using outside R and D results. R and D expertise is absolutely necessary for national technical self-reliance.

The expectation is that the R and D demand will increase during the next decade which will require more quality student recruitment and higher retention rates as follows:

Recruitment

- more women
- quality of teaching in schools
- encouraging young students
- encouraging post graduate studies and continuing education
- equal opportunity and greater access
- awareness of challenging career
- availability of scholarships

Retention

- ensuring degree completion-grants
- preventing the loss of qualified persons-fellowships
- short term to long term appointments
- retraining and conversion

There will also be pressure on strengthening existing research facilities and developing new ones in academia, government and industry organisations.

PRELIMINARY MINING PROFESSIONAL MANPOWER PLANNING — AUSTRALIAN MODEL

Manpower planning and demand projection methods have utilised:

1. Industry opinion surveys
2. Extrapolation of existing data
3. Functional relationships

The provisional supply-demand geoscientific manpower prediction method used here considers a simple economic model based on 1988–1989 Australian data (Katz, 1994).

This model guide assumes an approximate balanced labour market and that the mining (and energy) component of the GDP (MGDP) and its growth rate directly correlates with the number and stock of geoscientists (GEO). In Australia in 1988–1989 there were estimated to be 5,000 geoscientists out of a total industry workforce of about 100,000. Figures for that year indicate that the Australian MGDP accounted for about $16,000 million, so it can be shown that for every $100 million MGDP, the workforce requires about 30 geoscientists (GEO). Given an estimated MGDP growth rate of about five per cent, 250 geoscientists graduates (GG) would be required each year to meet this demand.

As there is a necessary shift toward R and D, the supply of more highly qualified personnel will have to be increased to keep up with the progressive demand from academia, government and industry. Based on Australian earth science R and D data there were about 800 researchers (RS) in the 1991 estimated geoscientific stock of 5,000 (about 15 per cent of the total). Earth science research expenditure (RE) amounts to about $160 million which is eight per cent of the national R and D and about one per cent of the MGDP. Using these figures, as an estimate of the R and D supply/demand component, for every $1 million spent on R and D requires about four geoscientific researchers (RS) and about one per cent of MGDP should be expended on earth science R and D. Of the total 250 annual geoscientific graduates (GG) for the next few years, about 15% (40) should be postgraduate to PhD level (PG) (see Katz, 1994).

AUSTRALIAN-SOUTH EAST ASIAN MODEL

The Australian model based on a simple (MGDP)-(GEO) correlation estimate (every $100 million of MGDP requires about 30 geoscientists) will have to be modified in regard to various Southeast Asian conditions including education, technology and labour factors and the current economic slowdown. This model would not necessarily be considered appropriate for the countries like Vietnam, Lao PDR or Burma.

Table 1 shows some important mineral economic parameters that must be taken into consideration in the Southeast Asia. The gross domestic product (GDP) is an indication of the size of the economy and the mining in GDP (MGDP) and the mining in export (ME) reflects the importance of the mining sector.

The MGDP and ME varies from important (Indonesia — 14.5% and 49%), of lesser significance (Malaysia — 9% and 18%) to minor (Thailand — 3% and 3%). In general the Southeast Asian countries are low to lower-middle income nations and where the mining sector is significant the position of geoscientists in the mining industry of the future should be sustained and if required, expanded.

Indonesia is a case in point with an important mineral sector. Applying the Australian model MGDP-GEO correlation (Table 2) estimates of geoscientists (GEO) required by this level of activity by the year 2000 would be in the order of 10,000 with an ideal percentage (~ 15%) of R and D experts (RS of about 1,500). Research expenditure (RE) estimates should be in the order of one per cent of MGDP ($320 million). Assuming a conservative MGDP growth rate in the order of five per cent, some 500 geoscience graduates (GG) are required by the year 2,000 including 75 postgraduate students (PG). Geoscientific manpower estimates and research expenditures for Malaysia, Thailand and the Philippines (Table 2) indicate professional stocks of 2,700, 1,700 and 370 respectively, with the required graduates of about 135 per year for Malaysia and 85 for Thailand and about 20 for the Philippines and about 20, 13 and 3 postgraduates respectively. These figures are only first order approximations, based on Australian model data, and must be treated as very provisional and speculative.

How these results match actual stock and graduate figures can only be examined when detailed data becomes available. In conclusion, the MGDP-GEO guide correlation estimates may be used to predict theoretical numbers of geoscientific professionals required for a relatively efficient and expanding mining industry as found in Australia. The Southeast Asian countries may be considered to be the group in Asia that most closely approaches the Australian model ideal as presented here.

ENROLMENTS AND GRADUATES

A major problem of supply of geoscientists is the rates of enrolments and graduation. Enrolment rates are dependent on the numbers of secondary school students who opt for science and engineering and those that choose geosciences as their specialty. Enrolment rates in science and engineering are increasing with technology development and those that select geology courses may be streamed into that direction or show interest because of employment opportunities on graduation and/or take these courses as a 'soft' science option. In Australia about 13 per cent of all university students enrol in natural sciences. Of these, about five per cent of the science students are in the geosciences and the graduates amount to about 20 per cent of those enrolled. Of those graduates about three per cent are geoscience graduates.

It is interesting to compare these figures from Australia on enrolments and graduate numbers to the data and estimates for the countries in the region (UNESCO). The Southeast Asian nations indicate relatively low enrolments (2–7%) in the natural sciences, with graduation rates low in Indonesia and Thailand (4%) and the Philippines (2%) and high in Malaysia and Thailand (over 20%). Of these enrolees and graduates only a small proportion would be in the geosciences (< 5%).

INDONESIAN COMPANY MANPOWER SUPPLY CASE STUDY

A paper presented to the Indonesian Mining Association Conference in Jakarta, November 1997, by Didik I Kuntadi, Assistant Vice President Human Resources of PT Freeport Indonesia Company, one of the largest mines in the world, illustrates some mining professional supply problems and solutions in Indonesia that may be relevant to the region.

The small number of graduates in Indonesia has limited the number of local personnel able to fill key positions. The government policy of Indonesianisation has also increased the pressure

Table 1. Mining in GDP and Export Southeast Asia Region.

(US$ millions rounded off) (Mining Annual Review 1996, GDP Figures for 1996)				
Country	**Category**	**GDP $**	**Mining in GDP (MGDP)**	**Mining in Export (ME)**
South East Asia				
Indonesia	Lower Middle	220,000	14.5%	49%
Malaysia	Lower Middle	98,000	9%	18%
Thailand	Lower Middle	185,000	3%	3%
Philippines	Lower Middle	83,000	1.5%	12%
Lao PDR	Low Income	551?	1.5%	25%
Vietnam	Low Income	22,000	2%	
Burma	Low Income	9,950?	1%	

Table 2. Southeast Asia Geoscientific Professional Manpower and Research Expenditure Guess Estimates — 2000.

Assuming MGDP (in US$ million) Growth Rate of ~5%						
COUNTRY	**MGDP**	**RE**	**GEO**	**RS**	**GG**	**PG**
Indonesia	32,000	320	10,000	1500	500	75
Malaysia	8,820	88	2,700	400	135	20
Thailand	5,550	56	1,700	255	85	13
Philippines	1,245	12	370	56	19	3

MGDP — Mining in Gross Domestic Product (GDP X % Mining)
RE — Research Expenditure (1% of MGDP)
GEO — Geoscientific Professional Stock (30/$100 million MGDP)
RS — Research Stock (15% of GEO)
GG — Professional Geosciences Graduates (5% of GEO)
PG — Professional Geosciences Postgraduates (15% of GG)

to find solutions to this supply problem. Careers in the mining sector are often overlooked due to the recent growth of mining as a major industry and many potential students do not realise the growing availability of secure and attractive careers in this sector. Indonesian universities have been late to introduce programs to meet the need for skilled mining experts and of the 60 state universities and 1,200 private universities in Indonesia less than 10% produce mine professional graduates. In addition many students tend to concentrate less on their goals and necessary job skills than on the graduation certificate.

As is the case elsewhere there is a reluctance to work outside the cities in remote areas and this has been termed the 'City Boy Syndrome'. The traditional Indonesian graduate also lacks international experience and an assertiveness that can be important in the workplace.

In response to the Ministry of Education 'link and match' program, Freeport, Indonesia has initiated the Student Cooperative Training Program, similar to the Coop Program operating at the UNSW, Australia, where university students take part in a full range of positions available at Freeport, Indonesia. The six month program, which is fully supported by the Company and not binding, offers the students a chance to combine classroom theory with real hands on mine experience and also allows them to experience cultural (American) changes in a remote environment. Freeport Indonesia has formed close, mutually beneficial, bonds with ten Indonesian Universities where the Universities nominate the base pool of candidates and the Company selects the final Program participants. The participants receive a Certificate and complete accreditation of the Program should be approved by the Minister of Education. In any event statistics indicate that Coop graduates receive more job offers than those that did not participate.

Linked to this student coop program is a one year Management Training Program for graduates who have the desire and capabilities to work for Freeport Indonesia. Pre entry courses include English, management courses and safety awareness programs. Participants are treated as regular employees and are given varied work experience to prepare these potential employees to meet the needs and the standards of a productive team. In 1997, of the 84 participants in the program, 50% were hired as permanent staff.

CONCLUSIONS

In all cases, economic and structural changes must be taken into account in demand and supply of geoscientists in Southeast Asia in the 21st century. Given that prediction of supply is as reliable as weather forecasting, and demand projections even more difficult given the cyclical nature of the demand. Table 2 gives a guess estimate of numbers and research expenditure in the year 2000 based on an assumed and speculative demand/supply balance and some positive economic growth rates.

The changes indicate that there will be increasing and pressing emphasis on high-level, technical and management skills to meet these future needs. The speculative projected stock of the geoscientists of the 21st century, however quantitatively accurate, will be required to have a qualitative edge in order to deal with new technology; in mineral evaluation, exploration, geological data processing, geostatistics, mine geology and environmental geology as well as new and modern exploration, geotechnical, environmental and impact management methods and techniques. Increasing R and D expenditures will be necessary. The geoscientist with technical research, computer and management skills should be in high demand in the future developing mining-related industries in Southeast Asia. In response to these new changes all mineral education and training institutes in the region will have to develop new and innovative programs with the support of government and industry that will not only serve the modern needs of undergraduate and postgraduate students but also be able to set up continuing education, retraining and upgrading opportunities for geoscientists already in the workplace. Models such as the short course award programs developed by the Key Centre for Mines, University of New South Wales, Sydney, Australia could be considered appropriate.

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