The establishment of infrastructure for the Grootegeluk Coal Mine*

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SYNOPSIS

This paper, which is meant to be read in conjunction with the other papers on the Grootegeluk Coal Project in this issue (*J. S. Afr. Inst. Min. Metall.*, vol. 82, no. 12. Dec. 1982) deals with the extent to which civil-engineering infrastructure had to be provided for that project, near Ellisras in the Transvaal.

SAMEVATTING

Hierdie referaat wat bedoel is om saam met die ander referate oor die Grootegeluk-steenkoolprojek in hierdie uitgawe (*J. S. Afr. Inst. Min. Metall.*, deel 82, nr. 12. Des. 1982) gelees te word, handel oor die mate waarin die siviele-ingenieursinfrastruktuur vir die projek naby Ellisras in Transvaal voorsien moes word.

Scope

Infrastructure in the sense that it was provided for the Grootegeluk Project of the South African Iron and Steel Industrial Corporation Limited (Iscor) near Ellisras, Transvaal, encompassed the following, which together make up a relatively wide range of services:

- Roads and an airfield
- Townships including all services
- A major water-supply scheme
- A railway line from Thabazimbi and marshalling yards at Grootegeluk
- An extensive housing and accommodation scheme
- Internal infrastructure for the mining and beneficiation operations.

The involvement of civil-engineering and related disciplines in the provision of items such as the above is governed by the extent of any existing infrastructure, but at Grootegeluk the existing infrastructure was inadequate and not economically viable for extensions. Therefore, as far as the mining project was concerned, infrastructure had to be established as if no other existed.

The Viability Spiral

The establishment of any kind of infrastructure is regulated by the State in some form or another. Government and provincial departments are involved in the approval of new roads and airfields, townships, and water-supply and sewage-disposal schemes, while the South African Railways is an authoritative body on all matters of rail transportation. Many departments of the provincial administrations play crucial roles in the final establishment of such infrastructural elements, while all the controlling bodies have powers to enable them to determine when the construction of such elements is to be undertaken.

Most, if not all, of the government and provincial regulating bodies require extensive lead times in order to go through the motions of preplanning, estimating, budgeting, obtaining approvals, final planning, and construction. If the infrastructure to be provided is to meet the requirements of the project, fairly exact information has to be furnished to the government and provincial authorities. However, during the early stages of many projects, such accurate information is not available, and depends upon further feasibility studies and economic, social, or ecological restraints.

During the initial stages of the establishment of infrastructure, a viability spiral develops as shown in Fig. 1. This spiral needs to be dealt with rapidly if infrastructural elements are to be available in time for the operations, in this case the operation of the Grootegeluk Coal Mine. The time span required between viability cycles depends on the complexity of the overall economics, the production or beneficiation processes, and the policy restraints. While it may be quite acceptable within a certain corporate framework to extend the spiralling process to cover a wide range of viable possibilities, this is normally unacceptable and counter-productive for new infrastructure owing to the influence and needs of the government and provincial authorities.

The Grootegeluk Project went through a number of cycles, varying between 1×10^6 t and 5×10^6 t of coking coal as the annual design yield and ending with a yield of $1{,}8 \times 10^6$ t per annum, which is its present design capacity. Table I illustrates the influence of a spiral of this magnitude on the water requirement.

A final aspect complicating the determination of infrastructural elements is the fairly common policy of developing mines of this nature in phases. The present yield

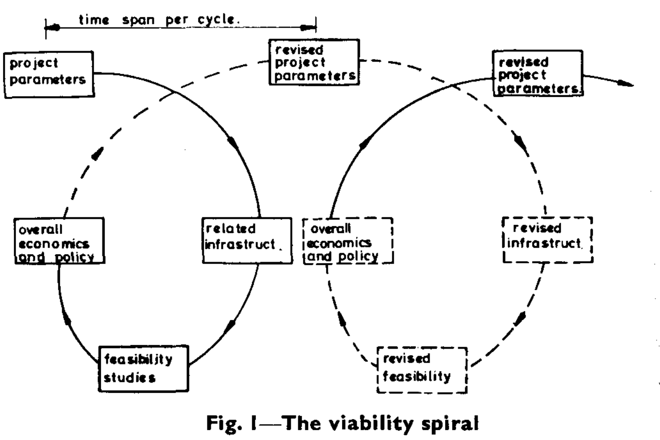

Fig. 1—The viability spiral

* Paper presented at the Colloquium on Project Management in the Metallurgical Industry, held in Johannesburg by the South African Institute of Mining and Metallurgy on 16th September, 1980.

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TABLE I

EFFECT OF DESIGN YIELD OF COKING COAL ON WATER REQUIREMENT

Coking coal, t/a	$1,0 \times 10^6$	$1,8 \times 10^6$	$5,0 \times 10^6$
Run-of-mine coal produced, t/a	$8,0 \times 10^6$	$14,4 \times 10^6$	$40,0 \times 10^6$
Specific water consumption			
Mining per t of run-of-mine coal, m^3	0,07	0,07	0,07
Beneficiation per t of run-of-mine coal, m^3	0,25	0,25	0,25
Total mining processes, m^3	0,32	0,32	0,32
Annual demand for mining processes, m^3	$2,5 \times 10^6$	$4,5 \times 10^6$	$12,5 \times 10^6$

of $1,8 \times 10^6$ t per annum of coking coal is only the first module of a likely number of modules, two at least and a possible three or four, that could be developed in terms of the capacity of the coal deposit. As the developer retains the privilege to decide when such additional modules are to be brought into production, it becomes a fairly complicated guess for any governing body to determine the parameters of the infrastructure required. The parameters should therefore be dictated by the developer in most cases.

Lead Times for New Infrastructure

The government and provincial authorities have to go through annual budgeting and approval processes before any serious planning and construction activities can take place. Restricted to an annual cycle and based on a scheduling time of six months, the following minimum lead times should be allowed for infrastructural elements:

Preplanning estimates	6 months
Scheduling into next year's budget	6 months
Approval process	3 months
Final planning tenders, award	12 months
Sub-total	27 months
Construction and commissioning (depending on the size of the element)	18 to 36 months.

Table II illustrates some typical lead times for specific infrastructural elements from the time the requirement becomes known until it is commissioned. For larger or smaller elements than those given, only the longer or shorter construction times should be considered respectively.

Many projects are initiated by their developers without allowance for the necessary governmental and provincial budgeting and approval processes. Often the infrastructure requested is required for the construction of the development, and therefore needs to be commissioned prior to the construction of the development (water, roads, housing, etc.).

An acceptable way in which the lead times can be reduced is by negotiation between the developer and the relevant authority, the former planning, financing, and constructing the elements to government and provincial standards, and the latter taking over the element from the developer after completion and reimbursing the total cost. In this manner, the relevant authorities have sufficient time to go through their administrative and financial procedures.

In the Grootegeluk Project, some 20 km of tarred provincial road was provided in the above manner, while a bulk potable-water storage and supply system, including a full treatment plant, that was constructed may eventually be taken over by a future municipal authority.

By guaranteeing the interest and capital redemption of an element such as a railway line, the developer can gain priority for the construction of the facility. In this way, the 110 km railway-line extension to the national system between Thabazimbi and Ellisras was guaranteed to the South African Railways.

A third way in which lead times can be reduced is for the developer to assume the responsibility for infrastructural elements. Elements such as a major water supply system from a Department of Water Affairs dam, including pumping, chemical treatment, storage, and distribution, need not necessarily be constructed by, or belong to, the Department of Water Affairs. At Grootegeluk, a 47 km steel pipeline of 800 mm/700 mm in diameter, together with a pumping station and storage reservoir, was constructed for the use of the Mine and its housing development, as well as for the provision of water to an existing local township under the jurisdiction of the peri-urban authority.

Some Statistics

The following are some statistics on the infrastructure of the Grootegeluk Project.

Accommodation

A new township providing some 2100 domestic sites and all appurtenant facilities such as school and business sites is in the process of proclamation. Initially, some 350 houses, single quarters, an apprentice training centre, and full recreational facilities (e.g. club, golf course, etc.) will be provided.

TABLE II

TYPICAL LEAD TIMES

Infrastructural element	Lead time, year
Dam by Water Affairs yielding some 40×10^6 m^3 per annum	4 to 6
Major pipeline, 800mm/700mm dia., some 50 km long, pumping station, etc.	$3\frac{1}{2}$
Tarred road to provincial standards some 40 km long	4
Railway line by S.A.R., 113 km long	4
Marshalling yards, 26 km, to S.A.R approval but cost and execution by developer	2
Airfield — cost and execution by developer	$1\frac{1}{2}$
Township — approval by Department of Planning, Survey, Services and Proclamation	$3\frac{1}{2}$

In addition, there is another township for married employees, with single quarters for 1200 employees, and full supporting facilities (kitchen–dining, store, shop, post office, and medical and sports facilities).

Roads

Some 20 km of tarred provincial road and some 40 km of secondary gravel roads were provided. The latter are deviations of an existing system to permit mining operations.

Airfield

A tarred airfield 1200 m long was built.

Raw Water

A dam yielding some 40×10^6 m^3 per annum was constructed by the Department of Water Affairs. Iscor has constructed some 47 km of steel pipeline, 800 mm/700 mm in diameter capable of delivering 1000 l/s ultimately, including a pumping station, storage, and distribution pipelines.

Potable Water

A water-purification plant delivering 40 l/s with a possible extension to 200 l/s has been provided, delivering into 6000 m^3 of reservoir capacity and township feeder mains some 33 km long.

Sewage Disposal

A water-borne system has been provided for the townships and the mine. One township is served by an effluent-purification works, while the other township and the mine are served by oxidation ponds for the time being.

Railway Lines

An extension to the national network of 113 km was constructed by the South African Railways, while Iscor constructed 26 km of rail marshalling and loading yards.

Conclusion

The requirements for the infrastructure of a new mine in undeveloped territory are considerable, and early decisions with regard to the capacity of the services to be provided is seen as essential to timeous commissioning of the facilities.

PGM Seminar

The International Precious Metals Institute is continuing its educational programme to the world-wide precious-metals industry by sponsoring a seminar entitled 'The Platinum Group Metals — An In-Depth View of The Industry', which will be held in Williamsburg, Virginia, U.S.A., from 10th to 13th April, 1983.

The platinum-group metals, consisting of platinum, palladium, rhodium, ruthenium, osmium, and iridium, will be reviewed in depth at the seminar, which is being co-chaired by Mr David E. Lundy, Johnson Matthey, Inc., and Mr Edward Zysk, Engelhard Industries.

A field of international experts is being assembled for the seminar, which will consist of five half-day theme sessions, each having a keynote speaker and supporting talks followed by a question-and-answer period.

The tentative programme is as follows:

Session 1 The Geopolitics of Platinum
- (a) The platinum-group metals — a global appraisal (keynote address)
- (b) The Stillwater Complex and its strategic importance
- (c) South Africa as a source
- (d) Canadian and Russian sources
- (e) Government stock piles

Session II Extraction Sources
- (a) Extraction — primary and secondary (keynote address)
- (b) Newer processes
- (c) Automotive
- (d) Petroleum
- (e) Chemical and pharmaceutical
- (f) Electrical and electronic

Session III Unique Properties/Unique Uses (Non-Catalytic)
- (a) Unique properties lead to unique uses (keynote address)
- (b) Jewelry/decorative
- (c) Photonics/micro-electronics
- (d) Palladium in dentistry
- (e) Medical
- (f) Glass/fibreglass

Session IV Unique Properties/Unique Uses (Catalytic)
- (a) PGM catalysis (keynote address)
- (b) Fuel cells
- (c) Automotive
- (d) Air-pollution devices
- (e) Fibres and polymeric materials
- (f) Pharmaceuticals
- (g) Petroleum

Session VI Economics of PGM
- (a) Investment trends in PGM (keynote address)
- (b) Hedging—basics for the layman
- (c) How to manage scrap
- (d) Short-term/long-term strategies
- (e) A professional outlook

Additional information and details of the Seminar can be requested from IPMI, 2254 Barrington Road, Bethlehem, PA 18018, U.S.A. (Telephone: 215 866-1211)