

strative personnel. A healthy stream of research publications in scientific journals was maintained despite the ever-growing amount of externally sponsored contract work. Then in 1983 came a final split: the divisions forming the Materials Sciences Group became the National Institute for Materials Research. This removed from the NPRL electron microscopy, spectroscopy, high-pressure physics and crystallography, as well as the sections specifically under the designation of materials sciences.

The remainder was an unbalanced NPRL, far less representative of physics than before. Two groups were left. The one was General Physics, made up of National Measuring Standards and Metrology (covering many branches of physics but in a restricted manner), Optical Sciences and Acoustics. The other group, Earth and Atmospheric Sciences, was composed of Geophysics, Geochronology, Natural Isotopes and Atmospheric Sciences. The final fragmentation came when these divisions were absorbed in the new order under the titles of Production Technology and Earth, Marine and Atmospheric Sciences and Technology.

#### The end and a new beginning

The NPRL assisted government bodies, industry, universities and other sections of the CSIR. It participated in many international projects. Its annual reports describe a fascinating variety of projects and many outstanding achievements. There was a steady stream of original research, which can be seen from the annual reports by the lists of publications in scientific journals. The titles of the many listed contract and other reports also show the wide range of activities of the Laboratory.

The numerous projects done under contract emphasize the amount of contact with the outside world. This work ultimately generated one-third of the total income of the NPRL. Some sections brought in up to half of their income in this manner. The strong feeling had developed that too much directed work was being undertaken. Staff of a calibre able to meet new challenges could be maintained only by ensuring that they were not overwhelmed by 'measuring' rather than by 'thinking' tasks. Certainly not all contracts fell into the former group, and much of the sponsored work was highly stimulating. What was frustrating was when new ideas were generated but could not be followed up.

The present drive of the CSIR towards even greater financial self-sufficiency has the danger (no doubt well-recognised) of leading to a still higher proportion of financially but not scientifically rewarding projects. Premature advertising may be another consequence. An example from the CSIR, but not from the NPRL, was the recent publicity in the press given to achievements

in the field of superconductors. While not decrying the ultimate goals of these researchers, articles elsewhere have described how superconductors with similar characteristics can be made in a high-school science laboratory using readily obtained materials.

The NPRL was a kind of breeder reactor, giving rise to a remarkable list of groups which became viable on their own. On a lesser scale, many individuals moved on to senior positions elsewhere. Despite such losses the Laboratory thrived. It always covered a broader range of physics than any university could manage and it maintained a number of long-term projects of a type unlikely to be found in a university. Will the re-distribution of its resources lead to greater productivity or otherwise make them of greater value to the country?

An optimistic view sees the changes ultimately creating better opportunities for research in physics at the CSIR. However, there will surely be a period when students considering a career might reject physics on the basis of the only laboratory in the CSIR devoted to the subject having been dissolved. The dilution within the CSIR of the work of the NPRL, and knowing that physicists in most other organisations have to 'fit in', might make another discipline seem preferable. There is, for example, a tendency amongst the medical fraternity to

regard graduates from other disciplines who work with them simply as useful technicians. Physicists, chemists and mathematicians within the CSIR will have to ensure that such an attitude does not develop towards them now that they have become displaced. Another important goal will be to create an environment which attracts top persons from elsewhere. One enduring memory of the NPRL is the colourful array of personalities from all over the world who worked there.

Physics is aimed at understanding the universe. Knowledge gained is directed towards improving our lives—from the treatment of cancer and exploration for oil and minerals to nuclear fusion for the energy of the future. Keeping up with modern developments requires involvement. The days of direct access to high technology without some exchange are past. Ability to exchange implies keeping at the top. There should always be a nucleus of those extending frontiers of science without necessarily being concerned about immediate applications. Also, an environment of innovation stimulates all to do better. These are widely appreciated ideas. It will be no surprise to find that before we enter the 21st century they will best be achieved by setting up another national facility covering a broad spectrum of basic and applied physics.

## Identifying entrepreneurs by means of a simulation game

Jan Boeyens

*It might be simple to put up a hotel and watch the money pour in if you're on the board—the Monopoly board, that is. (It would be one way of passing the time in the debtors' prison.) A new game has been devised with a more serious purpose, however: to predict the likely degree of success of would-be small entrepreneurs, and thus avoid costly mistakes on the part of financial backers.*

It is a growing realisation that the development of entrepreneurial potential is of cardinal importance for the economic development of South Africa. Entrepreneurs in the labour-intensive small business sector of the economy collectively have the potential to create a large number of employment opportunities, but the development of this potential has been limited by restrictive legislation and lack of capital.

In 1986 the Urban Foundation approached the National Institute for Personnel Research (NIPR) and indicated that it intended to mobilise a large amount of capital for lending to viable businesses in the informal sector. The assignment given to the NIPR was to develop a method, complementary to the Foundation's financially orientated one, of identifying entrepreneurial potential.

Because the Urban Foundation is in daily contact with a large number of business people, and has access to their financial records, it was requested to arrange interviews between six successful and six unsuccessful businessmen and NIPR researchers. The interviews were directed towards the uncovering of characteristics that were shared by members of each group, and that differentiated the successful from the unsuccessful.

The successful businessmen were all running large, expanding enterprises. Some of the unsuccessful ones were beyond the level of strictly informal sector operations, but were experiencing severe financial problems. All the successful businessmen had work histories that were relevant to their subsequent business ventures. This characteristic was not exclusive to the successful

group but exceptions were observed only among the unsuccessful businessmen.

Members of the successful group stressed the importance of obtaining knowledge from experts and indicated that they were active gatherers of information and expertise. The seeking of others' opinions often serves the additional purpose of building business relationships. It did not occur to members of the unsuccessful group that their problems stemmed from a lack of knowledge and they consequently did not seek know-how.

The unsuccessful businessmen were rigid in the way they ran their businesses. Even when their strategies were not working, they failed to see the need for change. The successful businessmen repeatedly indicated that they would take advice from anybody, evaluate any suggestions, and experiment with new methods. This observation reflects the popular notion of entrepreneurs as flexible innovators.

The successful businessmen all indicated that they did not take chances. They all agreed, however, that it is sometimes necessary to take calculated risks. Members of the unsuccessful group either took no risks or made costly, impulsive and ill-considered decisions. 'Delayed gratification' was another feature observed in the successful group, whose members postponed the buying of luxuries and reinvested profit in their businesses. It was impossible to compare the unsuccessful group on this count; they simply had no money.

### The game

A business simulation game was designed to permit most of the above-mentioned characteristics to be monitored in an appropriate setting. The player is told that the aim of the game is to set himself up as a successful businessman. His personal interpretation of 'success' therefore influences his choices. At the beginning of the game the player receives money and two shops. He is also given a photograph representing his current house. The game is divided into 24 'months' representing two 'years' of business. During each month the testee must buy stock for his shops. At the end of each month money is paid out to the value of his sales. The monthly maximum possible demand for each type of product is predetermined, and follows certain trends which reflect changing market conditions. Some aspects of the game are discussed below.

Shops are cheap and expansion profitable. A new shop will pay for itself in a matter of months. It was expected that the typical 'survivor' would be content to expand only to a very limited extent, whereas the entrepreneur was expected to take full advantage of the favourable conditions in the game.

The player is allowed to buy up to ten

shops of a given type. This enables the player who wants to expand into similar fields the opportunity to get a strong business under way before additional expansion necessitates moving into new areas. The game was structured to benefit a player expanding in the domains in which he started rather than in other areas.

Changes in the demand for products are designed to assess the flexibility of the player. An inability to adjust to changes in demand will adversely affect the amount of capital accumulated.

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At the beginning of most months several 'information cards', bearing short statements indicating the sort of information contained on the other (concealed) side of the cards, are placed in front of the player, who must decide which cards he wants to turn over and read. It was thought that the true entrepreneur would examine all information, while the 'survivor' would see the cost involved in obtaining information as outweighing its potential benefit. None of the cards contains information essential for understanding the game, but some have information essential for playing well.

The player is given opportunities to 'gamble'. A die is used, and the odds for winning or losing are 50/50. Those who are willing to take gratuitous risks can be identified in this way. The ability of the player to separate his personal and business life and his willingness to plough money back into the business was assessed by offering him opportunities to spend money on an entire range of motorcars, a few light delivery vehicles, a range of houses that span the entire economic spectrum, and even a soccer team. These items can drain away the player's available capital.

### Validation

Business people were tested on the game. Because of poor administration the scores of 26 cases were unusable. The remainder of this discussion concerns itself with the remaining 54 cases. A questionnaire was constructed to assess business success in terms of: finances (asset control, credit, debt collection, tax handling, turnover,

cash flow), marketing (location, promotions, product, price, targeting), personnel (recruitment, treatment, salaries, training), operations (production method, inventory control, quality control, maintenance), and expansion. The questionnaire was administered by an independent consultant, who was asked to rank the business people he evaluated. This ranking was used as the criterion. The sample was divided in half, with the top 50% constituting the 'successful group' and the bottom 50% the 'failures'.

The scoring of the game was kept simple by calculating a single score, called 'End Asset', which is the sum of the player's assets at the end of the game. The mean 'End Asset' score was R126 322 (s.d. 56 562, range R66 750 - 309 400). The effectiveness of 'End Asset' as a means of correctly classifying individuals into the successful and unsuccessful categories was investigated. At an optimal 'End Asset' cut-off point, 58% accuracy of classification was achieved. A closer examination of the data revealed the performance of the older players was unrelated to their business success. The 'track record' of an older person is probably a more appropriate index of future business performance than scores on the game. Subjects over 45 were consequently removed from the sample. The mean score in this reduced sample ( $n = 37$ ) was R134 511 (s.d. 58 190, range R72 350 - 309 400). The cut-off point of R125 000 in this sample yielded 65% accurate classifications. It appeared, however, that six subjects reacted impulsively at a critical point in the game, when allowed to sell shops and blindly buy new ones. All these testees were rated as failures by the business counsellor, but the game did not adequately penalise them for their impulsivity. When these cases were taken as failures at the optimal cut-off point, 71% were correctly classified. The correlation between 'End Asset' and the consultant's rating was 0,44 ( $n = 31$ , significant at the 0,01 level of confidence).

It is more important from a money-lender's point of view that only accurate selections are made than it is that only accurate rejections are made. At an 'End Asset' cut-off point of R125 000, with impulsive players taken as failures, 90% of the cases selected were successes.

The investigation reported here suggests that the instrument can enhance the identification of people likely to succeed in business, and it seems to be useful in differentiating between individuals with potential and those in need of counselling, assistance, and guidance in the running of their enterprises. □

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