

INFANT INDUSTRIES AND INDUSTRIAL POLICY: A LESSON FROM SOUTH AFRICA¹

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Introduction

The debate on industrial policy is often counterposed between two truisms. On the one hand, market-based resource allocation is clearly important - 'it is not nations which compete, but individual firms'. On the other hand, firms operate in the context of 'created endowments' such as physical infrastructure and the education and training of their labour forces, so it is not so much that enterprises compete, but rather that they do so in the context of national endowments which are open to augmentation by government action (Reich, 1991).

These two positions are often used to reflect an ideological divide between those who believe, on the one hand, that government should get off the back of industry and allow it to pursue the path that it alone knows best, and on the other hand those who believe in a comprehensive role for pervasive government intervention in industrial resource allocation. However, a reasoned assessment of international experience points to two central features. Firstly, there are very few cases where sustained industrial growth has not involved a key role played by government, albeit a role which allows for a substantial degree of entrepreneurial independence. And, secondly, the effective role played by governments has to be moderated by the individual historical and strategic circumstances of each country. Lessons can be learnt from comparative experience, but each country (as well as each sector, region and firm) will have to pursue an individual path which reflects the particular circumstances in which it operates.

The South African economy has been built on rich natural resources, and its industrial sector pursued a predominantly inward-oriented path from the 1920s, particularly in the latter years of the Apartheid era. The post-Apartheid legacy includes a sustained period of falling per capita incomes, stagnation of manufacturing output, high levels of unemployment, a highly segmented profile of consumers, a particularly unevenly stratified skill distribution amongst its

labour force and a pattern of industrial relations which reflects the tensions of the Apartheid era (Joffe et al, 1995; Kaplinsky, 1995b). Like the economy at large, its corporations have failed to specialise effectively and have tended to encompass a wide range of products and activities, most notably reflected in the dominant position of five very large conglomerates whose activities span a large range of sectors. But like other previously inward-oriented economies, South Africa is being forced into a competitive global economy, one which requires very different patterns of industrial activity. Sustainable economic growth can only be achieved in this new environment if the corporate sector responds appropriately, and international experience suggests that this will require an appropriate form of governmental support.

For the corporate sector, competing in this global economy requires the ability to:

- produce flexibly and to respond rapidly to changing customer requirements
- introduce new products rapidly and to tailor these to the needs of particular market segments
- produce to ever-growing demands of quality
- meet customer requirements for ongoing product support in the consumer durables and capital goods sectors and
- reduce production costs

International experience has shown that these inter-linked objectives can be met through four sets of innovations (Kaplinsky, 1994). The first involves the introduction of a range of Japanese-inspired *organisational techniques* such as just-in-time production (JIT) and total quality control. The second requires the linked introduction of *electronics-based systemic automation techniques*. (However, primacy must be given to the prior adoption of these new forms of organisation if successful use is to be made of the new electronics technologies). Thirdly, *new forms of inter-firm organisation* are required. JIT production involves frequent and reliable deliveries of small batches, and the ability to respond rapidly to changing market requirements. Total Quality Control (TQC) requires that suppliers are able to produce to exacting and predictable levels of quality. And growing technological complexity often involves each part of the production chain focusing on its core competence so that suppliers are increasingly capable of mastering the ability to innovate sub-assemblies. Growing technological complexity also often requires firms to engage in cross-border technological agreements. And, finally, particular challenges are also faced in the process of *design and innovation* itself. Not only do the more competitive global conditions invariably require an increase in the level of effort, but also in the nature of the design process itself. Here success is enhanced

through the shrinking of design cycles and the reduction of production costs arising from the use of 'concurrent engineering', in which design is no longer the prerogative of the R&D function alone, but emerges from close interaction with other functional divisions such as marketing, purchasing and production. (It is also another area in which new forms of inter-firm cooperation are important). Design also needs to incorporate the principles of design-for-manufacture ('value engineering'), and gains particularly from the utilisation of electronics technologies such as computer-aided-design (CAD).

As the South African economy opens up, and the import regime becomes less restrictive, it will be necessary to meet the new competitive challenges sketched out in the preceding paragraphs. Moreover, penetrating external markets poses additional barriers as firms learn to overcome the barriers to external marketing and product support. With a few striking exceptions South African firms have not shown the capacity to meet these challenges. But some have, and the question arises as to what explains this exceptional performance. What is there about these particular firms which explains why they have managed to confront and overcome those obstacles which have led the mass of industry to remain focused on the relatively undemanding domestic market? Does the success of these firms arise solely from their internal structure and the drive of their owners and management, or does it also reflect the particular sector in which they operate or the beneficial hand of government, or a combination of these? And what lessons can be learnt -both for other firms and for government policy - which might assist South African industry as it restructures to meet the challenges of the new, open trading environment?

Bell Equipment Ltd (hereafter Bell), which is located in Richards Bay in KwaZulu Natal, manufactures a range of earthmoving, forestry and cane cutting and moving equipment. It competes with some success in an extremely competitive global sector against some of the world's largest and most well-known firms and has a record of consistent innovation, both in relation to new product development and in the variety of the products which it manufactures. In 1995, its overseas sales exceeded \$45m (representing nearly 40 per cent of the total in 1994) making it one of the most significant South African exporters of manufactured capital goods,² and in 1995 Bell was rewarded with South Africa's premium export award. But more significantly, these goods are constructed to Bell's own designs and without recourse to foreign design technology and ownership. For these and other reasons the experience of Bell makes compelling reading and opens insights into a series of policy issues of relevance to government, the corporate sector and to workers' organisations in South Africa. But since in many respects the South African economy is similar

in character to other middle income LDCs, especially those in Latin America (Joffe et al, 1995), its experience of the respective roles played by governments and enterprises in technological development and industrial restructuring is of wider relevance. It is with this purpose in mind that we can gain wider insights by exploring the evolution of the factors underlying Bell's past growth from infancy to adolescence and its potential future growth to adulthood.

From Infancy to Adolescence³

In 1995 Bell made the transition from a private to a public company. Its sales had almost doubled in the three years since 1992, exceeding \$185m in 1995. It produces equipment for two sets of markets. The first are the related markets of cane and forestry cutting and handling, where a range of three wheeled cutting and loading machines and haulers have a proven track record. The second set of industries are those in mining and construction, where Bell has developed a series of machines which are utilised in the loading and transport of various forms of dry materials.

Market Specialisation and the Focus of Future Growth

By the far the greatest share of sales is accounted for by a *family of three-wheeled machines* which are utilised for cutting cane and wood, and for loading these cut pieces onto purpose-designed, low-level trailers, which are then pulled by a range of haulers. Although Bell has a significant share of the market for these three-wheeled cane and timber cutting and loading machines in most of the countries where it competes, these three-wheelers comprise only a small proportion of haulage equipment in these sectors. By value, the dominant items transporters in these sectors are rigid haulers (in the sense that their carrying bays are attached directly to the cab of the vehicle and are thus inflexible) and trailers.

Bell also manufactures a range of *articulated dump-trucks* (ADTs) which are predominantly used in the construction sector. In these products, the carrying bay is flexibly attached to the cab and drive-train so that the trucks can be used for hauling materials on wet and clay soils - this is less efficiently done with rigid haulers. Over the past decade these ADTs, operated in tandem with front-end loaders (FELs) (hydraulic excavators), have begun to supplant the traditional rigid trucks and scrapers, particularly in Western Europe and the North Eastern seaboard of the USA where wet clay underfoot conditions are widespread. However, in recent years ADTs have also begun to filter backwards into cane and forestry since the spreading of the load onto six wheels has a less adverse environmental impact than the rigid four wheel haulers which have traditionally

been utilised in these sectors. The ADT market is growing rapidly, and being in its early stage, provides not only potential for future growth, but space for new entrants.

Of total sales, approximately 40 per cent are in external markets, and around one-third are exported from the South African factory; the balance of external sales are accounted for by two plants which Bell operates in Mauritius (traditionally serving much of Sub-Saharan Africa) and in New Zealand (which targets the timber markets in Australasia, Chile and South East Asia). The two major markets outside of South Africa are North America and the Rest of Africa. However, this structure of output and geographical distribution of sales is likely to change significantly, since Bell already commands much of the relevant timber and cane markets - it is virtually the sole supplier in the timber markets of Australasia and S.E. Asia, accounts for 28 per cent of Chilean demand and around 18 per cent of the US timber market. Partly for this reason, and partly because the ADT market (which originated in Western Europe) shows the potential for long-term growth, Bell has targeted this sector for its future expansion, particularly in North America, where there is no indigenous production, and which is served by European-based producers.

Bell is not alone in foreseeing the growth-potential of the ADT market. The major producers in the earthmoving and construction equipment industry have similar designs. But Bell alone has shown a significant growth in market share in the period 1990-1995, from virtually nothing in the late-1980s, to 13 per cent in 1994 (Table 1). Bell is also the only major producer not manufacturing in Europe, since Volvo produces in Sweden, Caterpillar in the UK (where it has just taken over its long-time OEM supplier, David Brown), Komatsu in Norway (through Moxo, formerly independently owned), and Terex (an American firm) manufactures in the UK. So, if a single indicator of Bell's ability to hold its own position in testing global markets is required, then its performance in the rapidly expanding and highly-competitive ADT sector represents a suitable benchmark. But it is also reflected in the more rapid rate of sales-growth of Bell as a whole (that is, for all products, not just ADTs) when compared to its rivals (Figure 1 below).

Entrepreneurship and Innovation

How did Bell get to be in this position where it commands a dominant share in the cane and timber cutting and hauling sectors in South Africa, Australasia, Chile and North America, and where it has made rapid inroads into the expanding and highly competitive ADT industry which is dominated by global giants such as Caterpillar (with global turnover of \$11.1bn) and Volvo (turnover of \$1.6bn)?

Table 1: Global Shares In Production of Articulated Dumptrucks (ADTs), 1990-1994.

	Location	1990	1991	1992	1993	1994
Volvo VME	Sweden	37	61	54	57	58
Caterpillar	UK	24	18	17	21	21
Moxy	Norway	18	3	12	12	14
Tenax	UK	11	9	9	8	9
O&K	Germany	7	6	6	2	0
JCB	UK	3	2	1	0	0
Avelling Bedford	UK	1	1	1	1	2
Others	NA	0	1	1	0	0
Bell	South Africa	NA	7	7	5	13
Total		100	100	100	100	100

Source: Non-South Africa data from Off-Highway Research, London.

In the post-war period Irvine Bell had been employed in the coal-mines and subsequently in the farming sector. Technically untrained, his hobby was to rifle the neighbouring coal scrap yard for interesting bits and pieces. He was forced to confront the back-breaking task of cane-cutting and loading so he designed and began manufacturing a rugged, self-loading trailer in 1954 (when Bell Equipment was formed). Bell and his brother-in-law (who had become his partner) were primarily occupied with farming and their general engineering operations which had been given a boost as the Richards Bay mining and port complex was being constructed. They thus licensed the manufacture of this cane equipment to a Johannesburg-based firm. But by 1976 the major structural works on the Richards Bay harbour had been completed and the demand for general engineering services declined. Hence Bell decided to take back the manufacturing rights to the three-wheeled machines. Sales took off rapidly as the cane-cutting machines were rapidly picked up by the local sugar industry. It also raised the prospect of export sales, but given South Africa's political isolation, it became necessary to produce off-shore. So in 1977 an assembly plant was established in Mauritius, working on completely knocked-down kits (CKDs) from South Africa and supplying Mauritius, Reunion, Egypt, Zimbabwe, Kenya and the Caribbean. A similar plant, but this time aimed at the timber industry, was then established in New Zealand in 1981.

At about this time, Bell's three sons began to play an active part in the business. They began by applying the principles of the three-wheeled cane cutter and loader to the timber industry, which proved to be very successful. But easily bored, they decided to move to new challenges, and a process of diversification was set in

train. The route to this lay in their bidding for a coal-hauling contract for a Vryheid mine. For this, they built a rugged two-wheel drive (2WD) rigid hauler, with an automatic gearbox, engine and transmission (all purchased off-the-shelf) and operated this contract successfully for a number of years. When the mine closed they saw the possibility of manufacturing and selling 2WD haulers for other parties. Moreover, there was an obvious progression from these 2WD haulers - since they were already hauling, why not also not undertake the loading? This turned into a basic, cheap and rugged front-end loader in 1982.

At about this stage the horizons of the Bell family were widening and they then turned back to the industries they knew - forestry and cane - and sold haulers and grabbers to these sectors as well. Also at this time - the early-1980s - Volvo withdrew from the South African market as the sanctions campaign mounted, and other foreign suppliers began to tread carefully in the politically charged environment. Not only did this tend to lessen the intensity of competition, but it also provided an immediate gap in the market for handling equipment for sawmills which provided a further platform off which production could grow.

A new factory site was built in 1983, in Richards Bay. This was not ideally-located for Bell's expanding markets, but it was close to the family farm and home, an important feature for a family-owned private firm. Sales expanded and were further boosted by the introduction of the first rigid dumper truck in the mid-1980s, and then in 1989 (after the eldest brother had gone to Europe and witnessed the new Volvo ADTs in operation) the first ADT was produced.

In 1986 Bell decided to export to the US market. The opportunity for this bold geographical diversification was opened by the intra-family division of labour. The eldest son was clearly adept at technical innovation, and the middle son was an adroit marketer. This left a role to be found for the youngest brother who was dispatched to the USA to develop this market. The geographical dispersion of sales continued (both to Latin America and S.E. Asia) and Bell's expansion took off. But it required significantly increased levels of working capital and it was for this reason that, in 1991, Bell borrowed R45m (\$16.3m) from a group of banks. The understanding provided to the lending banks was that at some stage Bell would go public, to allow them to realise capital gains. This was accomplished in 1995, but under terms which has left the Bell family with effective equity control - 12 per cent each with the three brothers and with the brother-in-law's family. Thus, although Bell is now formerly a public company, it remains a tightly held family operation and this, as we shall see below, is an important feature of Bell's emerging global strategy.

In hindsight it might appear as if Irvine Bell has constructed a long-term strategy for Bell's eventual entry into world markets. Caterpillar's major

challenger, Komatsu of Japan, did this in 1964 when it decided to mould its growth with the objective of 'encircling and overwhelming' Caterpillar (Bartlett and Ghoshal, 1994). However, this does not seem to have been the case, and instead Bell progressed in an unplanned and stumbling manner through a pattern of linked and complementary product innovations.⁴ Significantly, as in the case of many entrepreneurial family firms, none of the core family members had advanced education. Instead, between them they covered the range of skills required for basic innovation, product development and, crucially, marketing.

Here it is important to bear in mind the niche in which Bell operates, particularly in the haulage and FEL markets. Individual items of equipment will often sell for more than \$200 000 and will work in extremely tough terrain and operating conditions. Crucially, therefore, the equipment must not only be robust, but be available for continuous operation. Hence servicing and spares availability is a major incentive to users. Globally, it is in its extensive global network - manufacturing in 12 countries, with 187 dealers in 128 countries - that Caterpillar's competitive advantage is to be found. But in South Africa, where Caterpillar, Volvo and other manufacturers have found it difficult to operate, this is a role which has been commanded by Bell. Not only does it have 19 service sites capable of providing near-instantaneous servicing of equipment, but Bell has invested in a high-profile set of helicopters which it uses to reinforce this image of rapid response to operating problems. Although not a profitable operation in its own right, the availability of these helicopters, often piloted by one of the brothers, has proven to be a major marketing strength, providing not only high-quality support services, but also reinforcing the 'localness' (an important attribute, especially during the siege years of Apartheid) and family nature of Bell's South African operations.

But this mix of skills, although suitable for a nationally-based, sub-\$100m manufacturing enterprise, faced limitations when it was forced to compete on the international stage. So, as the 1990s progressed, so did the professionalisation of Bell senior management. It remains an unusually informal and 'intimate' firms, with managerial and support staff on first-name terms and informal dress the rule. But this is increasingly complemented by the growing professionalisation of each of the major functional divisions, with the partial exclusion of manufacturing itself (see below).

Difficulties in Measuring up to International Competitors

Compared to the major producers in the haulage and construction sector, during the 1990s Bell has grown very rapidly (Figure 1), particularly in relation to Komatsu of Japan. Yet, both its labour productivity and working capital

productivity (measured via inventory turns)⁵ are relatively poor (Figures 2 and 3). Some special factors explain this poor relative performance. For example, at almost 25 per cent, internal value added is much higher than at Komatsu (12 per cent). But this tends to underestimate Bell's labour productivity (measured, here, for want of better data as sales/employee rather than value added/employee); cane and forestry equipment (which none of its rivals make) are relatively low value added products; and Bell does more of its own distribution and hence has a longer tail of spares and finished goods inventories. Nevertheless, despite these caveats, Bell's relative productivity is clearly lower than that of its global rivals.

Figure 1: Index of Sales (1991=100)

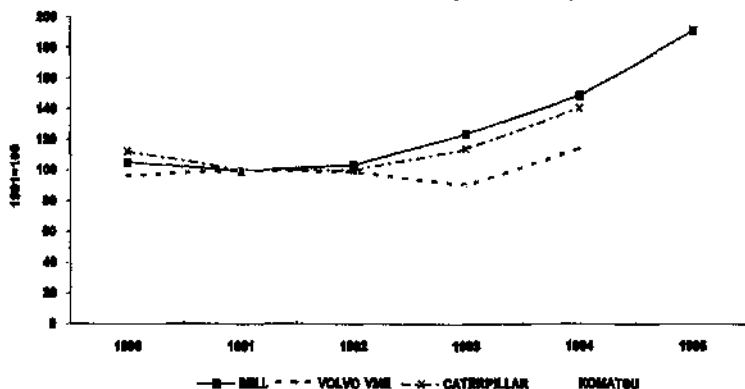


Figure 2. Labour Productivity, Sales per worker (\$'000)

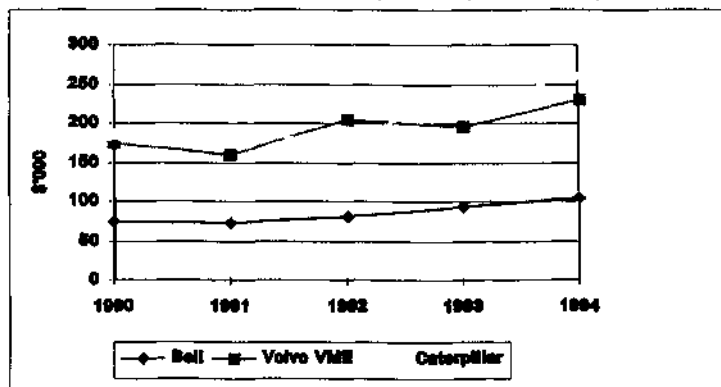
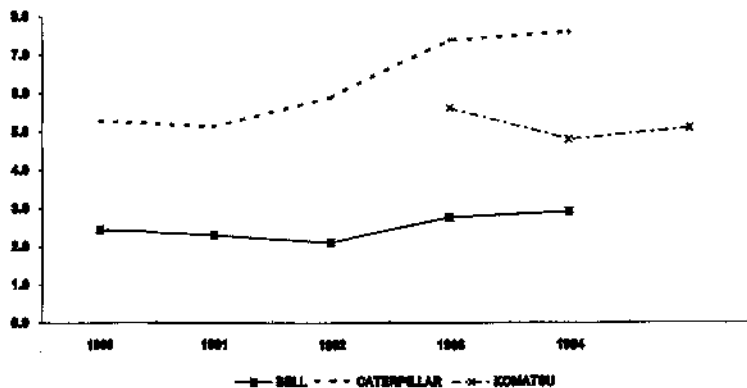


Figure 3. Inventory performance: Stockturns



However, it is clear that Bell suffers from four internal weaknesses which undermine its present profitability. Firstly, its internal manufacturing operations are organised in a classically functionally laid-out plant which builds in sub-optimal quality and large inventories and means that actual production (1 400 units in 1995) is significantly below potential production (2 000 units).⁶ Secondly, its strength in product differentiation and meeting customer requirements is also reflected in a proliferation of product types in Bell, as well as in an overwhelming variety of components arising from its historic commitment to customised production and to testing in the field.⁷ Parts proliferation has exploded, with serious implications both for manufacturing and for future servicing of customer needs. Currently Bell has 46 000 different 'live' parts, but since some of these are sub-assemblies, the real number is more like 100 000. In a recent case, the manufacturing division examined the specification of a complex product which it was assembling and compared the parts actually utilised against the original Bill of Materials. Only 40 per cent of these corresponded, even though they were only on the 14th item manufactured since the product was first introduced. At the same time, the pressures of competition are forcing Bell into continually launching new products and updates of existing products. For example, during 1995 they worked on 11 products scheduled for 1996-early-1997 launch (two of which were major designs), and completed the designs for three new haulers.

Thirdly, Bell operates with a very weak supplier base, which is often characteristic of LDC operating environments. Consider two examples drawn

from Bell's network of major suppliers. The first manufactures a core product, in which the import content is 70 per cent. Since the lead times for its imports are long, it offers Bell a five month delay in satisfying orders, which locks Bell into considerable inflexibility in its own inventory management and in its ability to met variable customer orders. (This supplier's long lead-time is not only due to the delay in obtaining inputs, since its internal manufacturing organisation leaves much to be desired⁸). This lead-time could be reduced if more of this suppliers parts were sourced locally, such as many castings and machined shafts. But here it suffers from inflexible production from its own functionally laid-out suppliers who are unable to manufacture and deliver in small batches. Hence Bell's inability to respond flexibly to external customers is constrained not only by its own inflexibility, but also by that of its suppliers and its suppliers' suppliers. It is ironical that this core supplier achieved the award as Bell's Best Vendor for 1995, largely on the basis of its 'just-in-time' (JIT) deliveries. Yet these JIT deliveries are nothing of the sort, since they are based upon stocks of final products which are 'stored' in the open under cellophane covers for approximately six weeks. The MD of this firm remarked wryly that he thought that this award from Bell was 'unfair' since 'we have just become Bell's warehouse'.

The experience of a second major supplier is also indicative of the problems of achieving systemic efficiency in Bell's production chain. This is a firm which not only exports 30 per cent of its output, but also supplies to Toyota, Mercedes Benz, Volkswagen and Nissan in South Africa; Bell only accounts for approximately 12 per cent of its sales. The basis for its export sales are its abilities to produce in relatively low volumes - that is, by comparison with German manufacturers - and its stringent quality procedures. In the domestic market it delivers on a 'JIT basis' daily to Toyota (using kanbans), fortnightly to Mercedes Benz/Honda and monthly to other customers, including to Bell. But these 'JIT deliveries' are a charade, since it keeps three months final stock in its warehouse, and works to a ten weeks lead time (which has in fact deteriorated from earlier performance of four weeks). The factory requires this long lead time since, like Bell, it operates with a classical functional layout and produces in large batches. The outcome is unnecessarily costly production, since the need to keep three months final stock (arising from its inflexible production methods) has led it to construct a new final goods warehouse 48 kilometres from the factory and to use two pantechnicians to ship output to this warehouse on a daily basis. Its quality procedures reflect similar inefficiencies, since these are largely based on end-of-line inspection and rework, rather than on in-process quality-at-source.

And, fourthly, as with most South African firms, Bell suffers from poor human resource endowments and a legacy of confrontational industrial relations. This undermines its capacity to upgrade its production operations, produce flexibly and to improve its products. For example, Bell has instituted a QSP (Quality, Safety, Productivity) programme modelled on the Green Areas at Nissan's Pretoria plant. This involves group meetings in 'home-zones' twice a week for 15 minutes, and a suggestion scheme. There has been some moderate success with the suggestion scheme - with 364 successful suggestions since 1990 - but most of these arise from the non-black labour force. When the HR manager (the first black manager appointed by Bell) attended one of these home-zone meetings, the conversation was in Afrikaans, and the black workers observed to him privately that they had not understood any of the proceedings! Black workers also observe that the previous racism of white junior management has been made even more complex by the insecurity which these relatively untrained white South Africans feel in the New South Africa.

The Key to Successful Maturation

Despite these weaknesses, Bell has managed to grow successfully from infancy to adolescence. This maturation can be encapsulated in the recent change in its design philosophy - instead of designing for the South African market and then adding on features for more demanding external markets, Bell now designs for external markets and subtracts features for the domestic market. It is also reflected, as we saw above, in its large global share of particular sets of equipment for the cane and forestry industries, and a growth in global market share for its chosen vehicle for expansion, ADTs, from seven to 13 per cent over the period 1991 to 1994. Its ability to compete effectively in these demanding markets is, in turn, explained by four factors.

The first is Bell's sustained ability to innovate. As can be seen from Table 2, the four decades between 1954 and 1995 reflect both the inventive genius of the Bell family and the growing commercialisation of these efforts to meet particular market needs. In recent years, the design function has moved from the individual ideas and tinkering of the father and one of the sons to a team of personnel in the Design Department which employed 70 people in 1995, accounting for 1.3 per cent of total sales.⁹

Table 2. The Evolution of Invention and Innovation in Bell, 1954-1995.

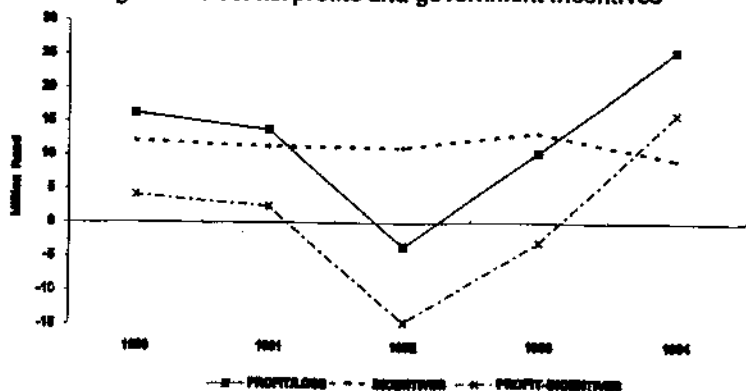
Date	Innovation	Significance
1954	Self-loading sugar cane trailer	Eased task of cane cutting and loading
1962-3	Three-wheeled hydrostatically operated loader	Raised productivity in cane cutting and loading
Late-1970s	Loading equipment for timber industry	Application of principles from cane industry equipment
1978	Two-wheel drive rigid hauler	Significant step in expanding the technological content and value added in products
Early-1980s	Rigid haulers for coal mining industry	Diversification of user-base from agriculture to mining and haulage
1982	Front end loader; feller buncher for forestry	Extension of technological horizons and product complexity; extension of principles from cane cutting
1985	First ADT launched (25 tons), subsequently extended with low profile model for trackless mining	Based on observation of Volvo equipment in Europe, and recognition of growing niche market. Move to high unit value product (above \$200K)
1986	Application of logging equipment to US timber industry	Joint venture with Morbark Industries
1987	Extension of ADT capacity (18 and 30 tons) and high speed versions for open-cast mining	Extending the range of customers, and building volumes to underwrite future R&D.
1989	40 ton ADT	Extending the range of customers, and building volumes to underwrite future R&D.
Early-1990s	6 wheel driven and steered logging equipment	Based upon ADTs and innovating 'backwards' into mature timber market; tapping market for environmentally friendly equipment in USA
1993	Extension of product variety in most product families	Filling-out of product portfolio, to provide both for scale and capacity to meet customer's full needs
1995	Larger FEL	To match growing size of ADTs and thus provide the capacity to meet customer's full needs

Secondly, Bell has been aided by the fortuitous timing of its expansion, particularly in external markets. The dying years of Apartheid were characterised by a severe slowdown in investment in South Africa, one of the reasons

underlying Bell's decision to move into exporting. Here, from the early-1990s it benefited from a sharp growth in global commodity markets in which its final customers operate, especially in the timber industry (where pulp and paper prices skyrocketed until the end of 1995). It is on the back of this demand that Bell based its production expansion in the first half of the 1990s, at a time when most of its major competitors were struggling to meet the growth in global demand. For example, in the ADT sector (which benefited less than the timber industry), sales grew in volume terms by 22 per cent between 1992 and 1994. This growth in sales has been an important factor in providing the scale economies to support new product development and external marketing support.

Thirdly, Bell's growth from infancy, has been significantly aided by government financial support. In the late-1980s, the South African government became anxious to promote manufactured exports, and thus instituted a financial incentive programme, the General Export Incentive Scheme (GEIS) from which Bell benefited considerably. In addition, there have been various financial packages designed to promote industrial decentralisation from which Bell benefited, given its location in Richards Bay. The net impact of these two types of financial incentives was very beneficial to Bell and enabled it to expand and diversify during periods of low underlying profitability. As can be seen from Figure 4, these incentives significantly supplemented Bell's earnings during the 1990-1994 period for which data are available. The total (undiscounted) value of these incentives was R57.14m, compared to post-tax profits of R62.06m and pre-tax profits of R67.87.

Figure 4: Post tax profits and government incentives



And, finally, Bell's relatively low labour productivity (Figure 2) is to some extent counter-balanced by lower wages. Here Bell has an undoubted advantage compared to the UK producers with whom it competes. Whilst the average industrial weekly wage for unskilled labour in Caterpillar's UK ADT factory 1995 was R1,750 (\$450), that in Bell's South African plants was only approximately R400-450.

From Adolescence to Adulthood?

Successful growth from infancy to adolescence does not necessarily mature into adulthood. Adolescents can remain stunted or may even die. Here Bell faces a series of critical challenges in addition to the need to tackle the internal manufacturing problems identified in the previous section. Most critically, it operates in a global sector which has benefited from rapid market growth in the first half of the 1990s. But, once these market conditions tighten, then it is likely that the competitive pressures will strengthen. Moreover if this should coincide

Table 3. Some Recent Examples of Globalisation of Ownership and Joint Ventures in ADT and Construction Equipment Industries.

	Residence of Parent Company and 1994 Turnover (\$)	Nature of Links in ADT Sector	Links in other Sectors of Construction Equipment
Volvo VME	Sweden \$1.6bn	1985 50:50 joint venture with Clark Equipment of the USA. In 1995 purchased Clark's equity for \$573m	Joint venture with Hitachi for rigid dumptrucks
Caterpillar	USA \$13.9bn	In 1996, Caterpillar purchased equity of David Brown which had previously manufactured its ADTs on an OEM basis	Acquired Dana Spicer (UK) which previously manufactured transmission units for backhoe loaders
Komatsu	Japan \$918m	Equity share of Moxey (Norway) which manufactures its ADTs on an OEM basis	Joint venture between John Deere and Hitachi for excavators. Purchased Hanomag (Germany) from Varity (US)
Terex	USA \$786m	Manufactures ADTs in the UK through UK subsidiary, Terex	Took over Clark fork-lift trucks. Makes ADTs on OEM basis for O&K of Germany
Dresser	USA \$@		50:50 Joint venture in US with Komatsu; now wholly owned (dissolved 1995)

with a downturn in global commodity prices (for sugar and timber) and squeeze Bell returns in its 'cash-cow' and/or if the planned infrastructural investments in the domestic economy are either significantly delayed or put-off, then Bell might find itself operating in an extremely hostile environment. The consolidation of the global construction equipment industry in recent years (Table 3) suggests that future growth from adolescence to adulthood may be very difficult. Hence the need to identify a role which government might play in helping to consolidate this past growth trajectory.

The Wider Implications of the Bell Experience

In the Introduction we flagged the wider context in which South African industrial restructuring is occurring, and in particular the debate over the appropriate role which government might play in aiding this process. Two polar views were identified - one prescribing that government should withdraw entirely from trying to affect resource allocation and technological development and leave this entirely to market forces; the other, that government should play a highly active and interventionist role, directing resources in the pursuit of dynamic comparative advantage. Not surprisingly, Bell's experience shows that neither extreme is appropriate. On the one hand, the firm's success is unambiguously a reflection of the particular nature of the Bell family. Over a period of four decades and in a succession of generations, it sustained a combination of invention, innovation and marketing. These pure 'animal spirits' (as Keynes dubbed successful entrepreneurship) are largely unpredictable and cannot be created by government fiat. Few entrepreneurs possess them in abundance, for if they did, there would be no winners to market competition.

But entrepreneurship alone is not an adequate explanation of the firm's success, for there were a number of factors external to Bell's operations which facilitated this growth. These naturally lead our attention from a crude market oriented approach ('it is not nations which compete, but individual firms') to a more complex model in which the efforts of entrepreneurs are rooted in historical circumstances and national factor endowments and are complemented by effective government support. So what are these extraneous factors in which Bell's entrepreneurship has flourished, and to what extent do they reflect government interventions? And, if these government actions have been significant, what implications does this hold for the wider development of South African industry as well as for industry in other LDCs? Before addressing the policy implications which are raised, it is first necessary to briefly locate Bell's evolution in the context of two exogenous factors over which government has

no control -South Africa's natural resource base, and the fortuitous timing of Bell's recent expansion.

Although it was never a conscious strategic objective in Bell's development, the company clearly gained from the links it had to South Africa's abundant mineral sector, particularly in the first two decades of its existence (1954-1975). Its early products were initially targeted at the agricultural sector (cane, and then forestry). Subsequently, diversification into rigid haulers was spurred by links to the coal-mining sector, as well as by the general engineering business contracting for Richards Bay harbour (which, itself, was built to accommodate the needs of the mineral sector). And even in the 1990s, much of the demand for FELs and ADTs arises from the need to shift materials in the mining and resource sectors. In this sense Bell can be seen as a partial expression of what has been termed the 'mineral energy complex', that is, that cluster of industries which has arisen from South Africa's comparative advantage of cheap energy and abundant natural resources (Fine and Rustomjee, 1996).

Bell also gained in recent years from the fortuitous juxtaposition of domestic and global market conditions. The early-1990s were years of significant global demand growth in Bell's core markets (timber and construction). This gave it the volumes and the margins to fund diversification into the ADT market which is the focus for its drive to 'adulthood'. It also provided the experience in international markets on which the expansion of ADT production (for which there is only a limited domestic market) could be built. This provided Bell with the crucial lesson in the US that it could not expect to be a serious supplier unless it marketed its products through an established brand-name, and it was for this reason that it closed its independent distributor network and is marketing its products through the John Deere network. Furthermore, had Bell attempted to penetrate the global ADT market during a period of global recession, it would almost certainly have been forced out by the price-cutting of competitors with significantly greater corporate muscle than Bell possesses.

However, in itself the combination of Bell's endogenous entrepreneurial excellence and these two exogenous factors (the bounty of nature and fortuitous timing) do not fully explain its successful growth. Other factors - largely in the domain of government policy - have played an important role in the past and will be necessary in the future if Bell, and other firms in its position, are to sustain their growth.

The Role of Industrial Policy

Infant Industry Policy: The theory of infant industries is based on the view that firms (and industries) need the space to grow into adulthood (Bell, et al, 1984).

This is for three reasons. Firstly, in many sectors there are significant economies of scale so that late-comers to an industry need the opportunity to build-up production in a protected market so that they can travel down the cost curve. Secondly, firms learn-by-doing, that is, the greater the experience of production, the more efficient they become. This is often referred to as the 'Boston Experience Curve', based upon the evolution of efficiency growth in the electronics industry recorded by the Boston Consulting Group in the 1970s. And, thirdly, firms do not only learn-by-doing, but they also learn-by-trying, that is, the growth of technological capabilities requires conscious effort, and this takes time.

For all these reasons, it is argued that nascent industries need protection from the icy winds of international competition in their domestic markets. They also require government support as they enter export markets, since this, too, is a learning experience and is also subject to scale economies. However, the major argument against infant industry policies is that by protecting firms against competition, it promotes inefficient production. Moreover, it is argued, despite the best intentions of those promoting infant industry policies, protection and subsidies breed a coalition of interests which makes it politically very difficult to wean infants into adulthood and so-called 'temporary' protection becomes solidified over time (Kreuger, 1974).

Bell's experience throws light on this policy debate, not so much because it reflects conscious government policies to promote infant industries, but because of the unconscious evolution of the required policy environment. In Bell's case, protection was provided in part through heavy tariffs, which kept imports out of the market. But, as in many import-substituting economies, this may well have led to foreign investment which would, too, have made it difficult for Bell to thrive. But, here Bell was aided inadvertently by international sanctions against Apartheid South Africa in the 1970s and especially in the 1980s. This led major competitors such as Volvo and Caterpillar to hold back from the South African market, including through the restriction of exports. This enabled Bell to grow and develop its product range. Then, in the late-1980s the government introduced a generous export scheme - the General Export Incentive Scheme (GEIS) - which subsidised its drive into external markets. Further subsidies were provided through a decentralisation fund which 'compensated' Bell for producing in Richards Bay, even though it was located there because of its proximity to the family base.

These various factors - tariffs, international sanctions, GEIS incentives and the decentralisation scheme - provided the shield for Bell's growth. But what protected it from inefficiency? Here Bell has benefited from the temporary

nature of these various benefits. Tariffs have been scaled down since South Africa has rejoined the international community; sanctions have been removed since Apartheid was overthrown; the GEIS scheme is being removed since it is WTO-illegal, and the decentralisation fund is being re-thought by the new administration. All of these factors have confronted Bell with a moving policy frontier which promoted its growth to adulthood.

But, even though Bell has benefited from this largely unconscious exercise of infant industry policy, its sustained growth in the future will require other types of government support which are promoting of sustained growth in output and efficiency. This is an important policy debate in South Africa, since the new government has committed itself to using the funds previously earmarked for the WTO-illegal GEIS export incentive scheme for a series of supply-sided measures (Department of Trade and Industry, 1995). Yet these supply-sided measures have not yet been implemented and are the subject of considerable imprecision. It is partly in this context that the following elements of industrial policy relevant to Bell's past and future expansion may also be relevant to future expansion in other sectors.

Support in External Markets: As observed, penetrating external markets can be very costly, particularly when this involves entering new markets. Here, Bell has begun to benefit from appropriate government support. The new post-Apartheid administration in the Department of Trade and Industry (DTI) has observed that South Africa's trade with western countries largely involves the export of commodities, whereas much of its eastward oriented exports are more technology-based. For this reason, and because it wanted to diversify South Africa's trade base, the DTI organised a large trade mission to visit India in late-1995. One of the Bell brothers participated in this mission and recognised that India presented a growing market opportunity, not just for ADTs but also for Bell's three-wheeled cane and forestry equipment. A decision has therefore been made to make a big push into Asia, based initially on the growth of sales in South Asia. However, it was clear that selling in India might require a productive presence there, so Bell has begun to explore the establishment of a third overseas production facility (in addition to those in Mauritius and New Zealand).

This reflects an example of the type of government support which is able to assist Bell in the growth and diversification of its export market. In this case, the appropriate action by government was to initiate new trade contacts and to open trading doors. But it may be that in other environments, additional forms of export support may be required such as providing support with respect to

obtaining market intelligence and ensuring that South African exporters achieve adequate quality levels to maintain the country's reputation as a reliable exporter.

Anti-dumping legislation: New disruptive entrants into the South African market from Korea are clearly dumping their products, particularly excavators (which are currently only of peripheral concern to Bell) where selling prices barely exceed material costs, let alone labour, overheads and profits. The same actions by these firms in Europe led to punitive tariffs, and (because of the large size of the European market) this forced the Korean firms to establish manufacturing subsidiaries in Belgium and the UK. Similar protective action is probably warranted in South Africa if Bell's home base (as well as that of Barlow Rand - see below) is not to be eroded. It is unlikely that this will lead many large firms to produce in South Africa, since the market for this type of equipment is small. But anti-dumping actions, by protecting the margins of domestic producers from unfair competition, will allow firms such as Bell to continue to grow, with the pressures for efficiency being provided by low-tariff imports and by Bell's domestic competitor, Barlow Rand.

The Functioning of South Africa's Capital Markets: On the basis of Bell's past experience, there are reasons to doubt whether the South African domestic capital market operates in a manner best designed to foster industrial success. This undermines the prospects of medium-sized firms such as Bell in three different ways. Firstly, South African real interest rates have been at historically high levels (eight-ten per cent), hindering the capacity to invest in new equipment and to fund the working capital requirements of high growth, including in export markets.¹⁰ It is for this reason, therefore, that high-growth economies such as Korea combine high real-interest rates (to promote savings) with subsidised credit to export-oriented and growth-oriented firms (Wade, 1990).

Secondly, the highly concentrated pattern of industrial ownership in South Africa (see earlier discussion) has meant unequal access to funds and differential interest charges to different parties. By its nature this type of imperfection is difficult to document but our own discussions with the senior strategist of one of the major conglomerates confirms its existence (see also Joffe, et al, 1995). Bell, being a medium-sized firm with no links to any of the major banks or conglomerates was therefore forced to pay high market rates of interest. But it is not only large South African firms which benefit from favourable access to capital. In 1992, Volvo VME, the largest producer of ADTs, had a debt-equity gearing ratio of 300 per cent, supported by the financial resources of its parent

and by favourable capital market conditions. At a similar stage of Bell's development, in 1996, its gearing was limited to only 65 per cent.

Thirdly, like the British and American stock markets, equity-linked finance in South Africa orients enterprises towards short-term profitability. As we have seen, Bell's requirement for funds to promote expansion in the early-1990s, forced it into the hands of banks which demanded that it float on the stock exchange to provide the banks with capital gains on their equity-linked funds. And, as many British firms have found, going public often constrains firms from long-term growth, since pension fund shareholders who own the bulk of equity require high annual dividends. Moreover, pension fund and other public stockholders are happy to see takeovers since this provides them with windfall capital gains.¹¹ Most damagingly from the national perspective (and also from Bell's point of view of course), this feature of this South African capital market led Bell to hold back from future growth in 1996-1997 in order to avoid losing its independent status. Bear in mind, also, that Bell faces a real danger of being too small to protect itself from cyclical market conditions, and unless it grows significantly rapidly, it may be in danger of losing its independent status and become an appendage of transnational firms, as has happened to both Moxy (formerly Norwegian, now owned by Komatsu of Japan) and David Brown (formerly British, now owned by Caterpillar of the US) in the ADT sector (Table 3 above).

Supply Chain Development, particularly for SMEs: Supply chain development is critical for the sustained competitiveness of firms such as Bell, particularly if they wish to move to industry benchmarks of low value added which allows firms to concentrate on their core competence. There is much which Bell can do itself in upgrading its supplier base, as occurs in many other countries, including in developing countries with poor supplier capacities such as India (Kaplinsky, 1995b; Humphrey and Kaplinsky, 1998 forthcoming). But as even many industrialised countries have found, the upgrading of suppliers, especially SMEs, cannot be left to user-firms alone. The UK has had a series of schemes to promote the improvement of manufacturing organisation, despite its ideological hostility to industrial policy; so, too, have many other countries, involving both national and local government (Robbins, 1995). Such programmes designed to upgrade manufacturing performance will not only benefit Bell through the upgrading of its supply chain, but also in the improvement of its own, internal manufacturing operations. As we saw in earlier sections, this is a key weakness in Bell's current operations.

The Need for Sectoral Policies: The protection offered by sanctions did not only benefit Bell. We have so far ignored the operations of Bell's principal competitor, Barlow Rand. Barlows manufactures some Caterpillar equipment under licence in South Africa, and, in 1992 it acquired Finanzauto, Caterpillar's principal distributor in Spain, whose needs it partially meets from its South African manufacturing base.¹² Clearly, the two firms together constitute a potentially formidable national sectoral specialisation. Since they have common needs, in export promotion (particularly in new markets), in technological infrastructure, in links to the resource sector (where increasing use is being made of special steels, most of which have to be imported) and in human resources, there is clearly scope for the development of a strategic sectoral support initiative, but one which does not slip into the familiar cartelisation which has dogged much of South Africa's industrial performance so far (Joffe et al, 1995). The promotion of policies to support sectoral specialisation lies at the heart of the new administration's industrial policy, based upon identifying appropriate industrial clusters. The haulage sector in which both Bell and Barlow Rand operate must surely qualify as an appropriate cluster for policy support.

Strengthening the Human Resources Fabric: As we have observed, the key competitive resource for the future lies in human resources. This is one area in which South African producers are acutely disfavoured. In the past Bell has systematically disadvantaged itself even further, by its hostile approach to industrial relations and by its failure to invest adequately in the training of its labour force. If it is to make the transition to a more effective manufacturing organisation, this is certain to lead to the need for a more flexible and multi-skilled labour force. It is also certain that this will require greater participation by the direct labour force in continuous improvement programmes and in a new approach towards Total Quality Control.

Here, much of the necessary action lies in Bell's own control. But some also necessarily involves government, both at the national and local levels. For example, the new Labour Relations Act (LRA), modelled on the successful experience of countries such as Japan and Germany, is designed in part to foster a more cooperative pattern of industrial relations and participation. The LRA makes provision for Workplace Forums in workplaces of over 100 employees and can be activated by organisations which represent more than half of the plant's workforce. The intention of the act is both to separate productivity innovations from wage negotiations and to replace confrontational bargaining with 'joint problem solving and participation', especially on issues related to working conditions and productivity. This represents an important departure

form past patterns of industrial relations in South Africa and provides the potential for meeting some of the major problems confronted by firms such as Bell - for example, ensuring a more effective continuous improvement programme (see above), diminishing the fear of middle management over organisational changes and making sure that the workforce is kept adequately informed of the external pressures which risk undermining Bell's growth from adolescence to adulthood.

Yet, much of South African management (including in Bell) is hostile to this policy initiative, viewing it as a mere reflection of trade union power in the new government, rather than as a tool for improving efficiency. Thus, government will need to act sensitively, to help firms such as Bell restructure their historic approaches towards training and industrial relations. International experience shows, too, that support for human resource development also necessarily has implications for local government as well, particularly in developing closer links between education and training institutes and local industry.

Implications for Trade Unions: The changes which Bell is required to undertake, particularly in its work-organisation and human resource management, are substantial if it is to manufacture effectively and this, as we have seen above, poses major challenges to management in its industrial relations and training initiatives. But it is equally challenging for its workforce, including for the trade unions (of which the metalworkers union, NUMSA, is by far and away the largest). Some of the shop-stewards interviewed at Bell have clearly recognised that their long-term future lies in a successful company, and have begun to change their attitudes, for example toward quality procedures. But in general the union remains hostile to management, a position which is common throughout South African industry.

In Australia, the trade unions have played an important role in restructuring worker attitudes, as indeed this has also recently been the case in South Africa (Joffe, et al, 1995). But, the pace of this change is not adequate and, moreover, the trade union movement in South Africa has lost many key officials to government, so the struggle to manage this change successfully will not be easy.

The Role of Local Government: In many respects the appropriate level of government support for industry may not be at the centre, but in the region in which the enterprise is located. In Bell's case, this is particularly evident in relation to supply-chain and human resource development and in the availability of what is called 'real producer services' such as quality and inventory management skills and design and marketing capabilities. As we have seen,

Bell's ability to maintain its global competitive edge is undermined by its weak supplier base, particularly since it has made the decision to reduce its internal value added. But few of its suppliers are located in its region, so that supply-chain development will become that much more difficult to achieve unless local suppliers can be developed. This benefits of supply-chain proximity are especially evident in Japan (Sako, 1992), but are also apparent in India (Humphrey and Kaplinsky, 1998 forthcoming) and in the European auto industry. The Italian experience is also one in which local governments have assisted networks of firms (including interlinked networks of suppliers and customers) in gaining access to necessary services (Pyke and Sengenberger, 1992). Again, this is an important area of policy debate in South Africa, since the post-Apartheid constitutional agreement has not clearly specified the appropriate responsibilities of central and local government. Moreover, for local government to play a more constructive role would require a change from the sorts of administrative role which it played under the inherited constitutional dispensation.

Science and Technology Policy: Historically South Africa has never had a national technology policy. Policy support was largely confined to strategic and military sectors. But the need to reorient South African industrial capabilities to meet the challenges posed by trade policy reform, and especially the need to encourage manufactured exports, has led the new government to develop a comprehensive national science and technology policy. The DTI's focus on supply-sided measures thus explicitly commits itself to a national science and technology policy and this has led to the preparation of a Green and a White Paper on this policy agenda. In addition, the DTI's own supply-sided measures programme include a number of Manufacturing Technology Centres (MTCs) to support the acquisition of technological capabilities in SMEs.

Bell is probably typical of much of South African industry in that it has had no links with the Science Councils, its links to and use of the products of the tertiary education sector have been weak, it has not participated in any of the sector specific government support programmes such as the Support Programme for Industrial Innovation (SPII), and its past links with the science and technology infrastructure have not been strong and have largely been confined to the externalisation of stress analysis on its designs.¹³ This reflects both its path of evolution (an expanding family firm) and the lack of outreach and relevance of most of these previous technology support programmes, which have invariably been directed and implemented in the heartland of South African industry (the

Reef, some distance from Richards Bay where Bell is located, as well as from the growing industrial base in the Natal coastal province).

For Bell to make this transition to adulthood will therefore undoubtedly require the greater scientisation of its design and development programme. For this to be successful, it will therefore have to liaise far more closely with the science and technology system than has hitherto been the case. And for this to be successful will require not only concerted action by corporate management, but also the design of appropriate policies for technology support which are both attractive and available to the firm and, in all likelihood, include a large measure of sectoral focus (see above). Almost certainly it will also require of the science and technology system a far greater degree of decentralisation and sensitivity to industry's needs than has hitherto been the case.

Conclusion

In this paper we have charted the growth from infancy to adulthood of a medium-sized firm operating in demanding global markets. We have shown how, on the base of excellent family-entrepreneurship and a long-term commitment to innovation, it benefited from a range of external factors which have enabled it to become not only a dominant producer in the domestic market, but also an active participant in external markets. In this sense Bell represents a role-model for South African industry as it struggles to make the transition from a closed to an open economy.

Two sets of broad conclusions can be derived from this experience. One - less interesting - issue concerns the extent to which Bell's fate depends upon favourable contextual factors in the domestic economy. In the short-medium term, if the already modest growth rate of the South African economy declines, this will not help Bell's growth. On the other hand, having grown to adolescence, it is likely that Bell will be able to sustain a significant and profitable operations on the back of its global market. It is even possible that a declining domestic market may push it further into an expansion of external markets and hence strengthen its long-term viability. More problematic for Bell will be either a rapidly appreciating exchange rate and/or major political instability. These factors may lead it into an expansion of production abroad. But, given the close family-orientation of its present owners, this transition may not occur for another generation.

More interesting are the implications of Bell's experience for industrial policy in general. We have argued in the previous section that Bell's development provides important insights into the role of industrial policy. Here it is important to separate the contextual, and non-repeatable elements of Bell's experience,

from those which are generalisable across space, time and sector. We believe that our analysis does identify those elements of this particular company's experience which need to be taken into consideration in the design and implementation of policies to aid all sectors. These include: a policy of support both in local and external markets which fades-out over time; addressing the functioning of the South African capital market to ensure that it meets the needs of innovative companies over a long time horizon; policies to upgrade the supply-chain of SMEs (which are particularly weak in South Africa); policies to upgrade human resources; and S&T policies. It is only when policies such as these are introduced to complement the effective functioning of both factor and product markets that industrial progress providing for sustainable income growth can be achieved in South Africa.

If we relate these observations to the issue raised in the introductory paragraph to this paper, our conclusions clearly fit into a framework which sees an important role for the state in the development of industrial competence. Left to markets alone, Bell would not have grown to its present size; the infant industry policies from which it benefited (perhaps inadvertently) were particularly important, as were the fact that they tailed-off over time. However, this experience suggests a nuanced view of the role to be played by state policies. It is equally clear from the foregoing analysis that whilst the South African state may have influenced the context in which resource allocation took place, the development and growth of this firm was a result of entrepreneurial energy. Any industrial policies which crushed this entrepreneurialism would simultaneously fail to deliver industrial growth. Here the problem is a complex one, since most of those factors which effect entrepreneurship are outside the domain of industrial policy.

Finally, we observed that the sustaining of global industrial competence requires that the firm commands new forms of internal and inter-firm organisation, acquires new forms of embodied technology and develops the capacity to design and innovate new products. In the case of Bell the sequencing clearly favoured the introduction of new products. But to sustain its future development, attention needs urgently to be given to the organisational issues, initially in regard to internal layout and production flow, and subsequently in relation to new forms of inter-firm relations. In other sectors the sequencing may be different, and it is our belief - based upon other sectors in which we are working - that for much of South African industry, the primary battles lie in issues of internal and inter-firm organisation, and only subsequently in the development of new products. However, this is a researchable hypothesis, open to systematic enquiry.

The lessons which can be drawn from this case-study for South African firms and for South African government policy are clearly also relevant for other LDCs, particularly middle income countries with the nascent ability to export capital goods. Moreover, the general observation that a successful process of industrial restructuring (particularly one which involves competing in demanding external markets) requires close complementarity between corporate and government policy, as well as cooperation from the labour force, has wider relevance to a much larger group of countries and sectors. It lies at the heart of the policy debate on how best to maximise industrial and sustainable income growth.

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NOTES

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2. The bases of these calculations are a Rand/\$ rate of 0.387 in 1990, 0.363 in 1991, 0.351 in 1992, 0.306 in 1993, 0.282 in 1994 and 0.275 in 1995 (all figures drawn from the IMF Financial Yearbook). Bell's financial years run until the end of February, and since most of each year's sales occur in the preceding year a convention has been established in which Bell's '1995 sales' are allocated to the year 1994, and similarly for preceding years.
3. A detailed study of Bell's performance, strengths and weaknesses as well as an assessment of the quality of its supplier base, can be obtained from Kaplinsky and Mhlongo (1996).
4. A similar process of confronting bottlenecks arising from previous phases of innovation drove the machine tool industry forward in the eighteenth and nineteenth centuries (Rosenberg, 1994).
5. Inventory turns are calculated by dividing end-of-year sales with end-of-year inventories. The higher this ratio, the lower the burden of inventories. This ratio is widely used as a proxy for manufacturing efficiency and in the industrialised countries, a ratio of less than eight (depending on the sector, of course) is widely considered as a cause of concern.
6. For a discussion of these manufacturing problems see Kaplinsky (1994), Chapter 1 and Kaplinsky and Mhlongo (1996).
7. One of Bell's distinctive features in new product innovation is that it provides products in their development stage to customers but backs this up with very close support. This not only reduces time-to-market innovation, but also ensures that customer needs are closely integrated in product design.
8. For example, work in progress management has been poor and approximately half of this is 'dead', that is, items for which there is no longer final demand. The company has not provided training for any of its workers over the past six years.
9. Although this is much lower than the R&D sales ratio of Caterpillar (three per cent) and Volvo (3.2 per cent), the R&D effort in these two firms is devoted to a much larger portfolio of products, many of which are more complex than the case and forestry equipment which Bell produces (a mature product). And, secondly, it is common in comparisons between high- and low-wage economies to underestimate the actual levels of R&D in the low-wage economies,

since its scientists and engineers are paid a fraction of those in the high-wage economies. Thus comparative R&D figures will tend to underestimate Bell's relative commitment to R&D.

10. On the other hand, high real interest rates promote the effective use of working capital and can often be the spur to better inventory management and hence the reform of production organisation.
11. For this reasons, successful entrepreneurial firms in the UK such as Virgin and The Body Shop have attempted to delist and return to private status.
12. In those market segments where Barlow Rand and Bell compete in domestic markets, Bell performs well. It has the largest market-share in ADTs (with a share of 70 per cent), lies third in excavators (Caterpillar accounts for 40 per cent and is market leader), and is second in FELs (where Caterpillar narrowly outpaces Bell).
13. In recent years, however, in recent years Bell has gained skilled design personnel and management from the former military-industrial sector.