# 6. SOUTH AFRICAN INDUSTRIAL COMPANIES IN CONTEXT

*In this chapter broader aspects of companies' management and their environment are discussed from a licensing perspective: broad demographics, company ethos, company accounting system, regulatory and enabling environment, sociological and organisational environment, information management, and sensitivity to the future.*

## 6.1 Overview

Companies are operating within one or more different industry sectors and markets, will have size and ownership characteristics, and be active in different geographical areas.
Survey objectives. (Results are presented in 8.1.)
It was decided to profile technology licensing within South African industry sectors, and *vis-à-vis* domestic versus export markets, company ownership and size, capital intensity of operations, automation and capabilities of research and development, design, development and commercialisation.

## 6.2 Company economic ethos

Any one company will have particular objectives, explicitly stated or implicit, derived from general attitudes and historic behaviour. Whereas the neo-classical theory of economics contends, in its simplest form, that companies will strive to maximise profits, many scholars do not accept this simplistic view as the complete truth. Noble (1984: 321), for example, contends that it is a common confusion on the part of those trained or unduly influenced by formal economics that capitalism is a system of profit-motivated, efficient production.

The intensity of use is unfortunately not reported. The seeming dominance of "Legal and regulatory" may reflect circumstances in the USA which has a reputation for stressing legalities.

Contractor (1981: 65) empirically found that organisation of licensing fell along a continuum defined by three typologies:

> Type A. Licensing is entirely decentralized. At most, a central department performs a monitoring function - checking compliance of licensees with agreements, auditing and recording licensing receipts from each licensee, watching for patent infringement in important nations, and so forth.
>
> Type B. The licensing department performs both a monitoring and a coordinating role. It also ensures that licensing decisions are made in the context of an overall international or nation-by-nation market-entry plan and that licensing is a part of a technology- or product development policy.
>
> Type C. In its most centralized form, licensing is designated as a profit center, in addition to performing all the functions listed in the other types.

Goldscheider (1982:100), echoing also Ford and Ryan from the opening paragraph hereof, adds that it sometimes seems that licensing is not optimally situated in the corporate hierarchy because it is frequently not an important income generator for the corporation. But how much income it does generate is not only a function of the importance with which technology marketing is viewed by senior management but also, to some extent, of its position in the organisation.

Goldscheider also describes the three types found by Contractor.

According to Goldscheider a licensing department may be placed within an organisation in two major ways.
(i) It can be grouped with similar departments, *e.g.* patent, legal and R&D and all reporting to the same executive who could even be head of an existing staff department if licensing's role is purely administrative.
(ii) It can also be placed under the executive that can best make use of it, *e.g.* if the profit centre approach is followed the sales executive or head of an international division or a senior

Instead, he suggests that capitalism's goal has always been domination. It should also be borne in mind that any one company is set within a greater whole, be it provincial, national or military/strategic and that the company and the whole will continually influence each other's goals. For example, deep uncertainty accompanies the outcome of a new venture and companies will attempt to dilute risk. In simple terms, the maintenance engineer will strive for no break-downs, the production engineer for excess capacity, the safety engineer for all kinds of protection, the financial manager for least expenditure and the chief excutive officer perhaps for eco- and public-friendliness. A company may decide to be a pioneer in a market, or a follower. The embodied goals, explicit or implicit, drive the direction and strategy of companies.

> Firms' innovative behaviours are strongly influenced by the ways in which their performance is judged and rewarded (or punished). Methods of judgement and reward vary considerably amongst countries, according to their national systems of *corporate governance*. (Tidd *et al*, 1997, 75 - 86.)

| Characteristics | Anglo-Saxon | Nippon-Rheinland |
|---|---|---|
| Ownership | Individuals, pension funds, insurers. | Companies, individuals, banks. |
| Control | Dispersed, arm's length. | Concentrated, close and direct. |
| Management | Business schools (USA), accountants (UK). | Engineers with business training. |
| Evaluation of R&D | Published information. | Insider knowledge. |
| Strengths | Responsive to radically new technological opportunities. Efficient use of capital. | Higher priority to R&D than for dividends for shareholders. Remedial investment in failing firms. |
| Weaknesses | Short-termism. Inability to evaluate firm-specific intangible assets. | Slow to deal with poor investment choices. Slow to exploit radically new technologies. |

**Figure 14. The effects of corporate governance on innovative activities.**
(Tidd, Bessant and Pavitt, p85)

Tidd *et al* refer to the "Anglo-Saxon" and the "Nippon-Rheinland" systems which are respectively practised in the USA and UK, and Japan, Germany, Sweden and Switzerland and list some differences while noting that a lively debate about the essential characteristics and performance of the two systems is continuing.

They point out that the influence of national systems of innovation is pervasive, so much so that only about 10% of the innovative activities of the world's largest 500 technologically active firms were located outside their home countries in the 1980s, compared to about 25% of their production and much larger shares of sales.

> The way in which many large companies define success and punish failure in new product development is one of the biggest impediments to expeditionary marketing. Verdicts of new product failure rarely distinguish between arrows aimed at the wrong target and arrows that simply fell short of the target. And because failure is personalized - if the new product or service doesn't live up to internal expectations it must be somebody's fault - there is more often a search for culprits than for lessons … (Prahalad and Hamel, 1994.)

The concept of technology colonies brings yet another perspective to the economic ethos of a company. Even though many countries gained political independence from their respective colonial powers they remained technology colonies. (De Wet, 2001). The divide is between first world and developing world and South Africa is in the latter. General features of them proposed by De Wet are briefly that the predominant industrial activity is at the manufacturing and final products trading end of the business cycle, there is limited research, there is a large flow of technology from the developed world into them, often implemented in subsidiaries and there is almost insignificant flow of technology from the local research and development community to local industry. He distinguishes between two basic types, *viz.* colonies that derive their competitive advantages from mainly human skills and colonies that derive it from their natural resources. De Wet convincingly argues that these features are a result of the mind-set of expatriate industrialists, indigenous industrialists and the academic community.

Survey objectives. (Results are presented in 8.4.)

It was decided to profile South African manufacturing companies' perception of self regarding risk taking versus conservatism and pioneering versus following. These perceptions were to be tested against use of national funds for technology development and innovative activities reported as analysed in 2.4 above. It was further notionally proposed that increased risk taking and pioneering will correlate positively with licensing activity; and that increased conservatism and following will correlate negatively with licensing activity.

Although the proposed indicants are easily understood content validity and reliability will probably be influenced by subjective judgements by respondents.

### 6.3 Company accounting system

A study of accountancy practices shows that these have changed over time and that companies do their financial reckoning in different ways although it always concerns profit. Thus it has been proposed that though adequate for those involved, accounting practice in the early 19th century US papermaking industry had the effect of hiding capitalization. (McGaw, 1985.) It is clear that if accountancy practice highlights a particular cost type, innovation may be channelled to reduce that cost. Thus labour cost accentuation may accelerate automation. Capital saving technologies on the other hand will possibly be faced by a barrier.

Differing accounting practices rooted in the systems of corporate governance have also attracted attention. In the UK and the USA on the one hand and Japan on the other profit seems to have been defined differently or at least interpreted differently. It is argued that in the former financial performance measures, such as divisional profit, create an illusion of objectivity and precision while they may become the focus of opportunistic behaviour by divisional managers that can manipulate them in ways that do not enhance the long term competitive position. (Kaplan, 1984: 415.) Japanese firms on the other hand have been said to seemingly use management accounting systems more to motivate employees to act in accordance with long term manufacturing strategies than to provide senior management with precise data on costs, variances and profits. (Hiromoto, 1988: 22.) A possible reason, considering their rise, could arguably be that Japanese and Korean companies are striving at domination. (Noble, 1984: 321.)

In 1993 the Managing Director of consultancy Global Synergy Associates in Tokyo, formerly Managing Director of Intel, Japan pointed out some of the underlying dynamics and a seemingly different situation. He stated that the world was witnessing a major upheaval in management practices on both sides of the Pacific. Prior so-called Japanese management practices were fast becoming obsolete. The so-called Heisei recession brought an end to time honoured traditions. Simultaneously American business had been learning much from the Japanese, and not manufacturing expertise as they had expected, but that the most significant

cause of the Japanese success was management methodologies. He rejected the notion that Japanese and American firms were becoming more like each other quite strongly.

> …. As a consultant, I have clients who are large, multinational Japanese, American and European firms. My observation is that the Europeans are the most truly global. The Japanese have worn out the expression "internationalization" but they have no idea what it really means. The most ironic fact is that, while the US is characterized as the melting pot of world cultures, it is quite insular in its mentality. (Kangs, 1993.)

It appears that there is consensus that particular accents in accounting systems will influence company and employee performance. Arguably such accents will be tied to licensing views and practice.

Survey objectives. (Results are presented in 8.5.)

It was decided to delineate South African manufacturing companies' accounting systems: divisional, product line, detailed cost, short or long term, explicit encouragement of innovation, imposition by parent.

## 6.4 Regulatory and enabling environment

### 6.4.1 WTO, treaties

The new order of international trade under the World Trade Organisation (WTO) will make it difficult for smaller and emerging countries such as South Africa to protect their relatively small domestic markets. It is already almost impossible to protect an infant industry while it is learning and the WTO's new regime to liberalise domestic markets for product, service and investment will allow multinational companies an easier foothold. Although the Department of Trade and Industry agrees that funding in terms of its Support Programme for Industrial Innovation should sometimes stretch beyond the so-called pre-competitive phase, WTO rules prohibit it.

South Africa and its industry have to plan to honour their commitments under TRIPS (Agreement on Trade Related aspects of Intellectual Property Rights) of the WTO.

Intellectual property rights protection will restrict duplicative imitation of foreign technologies. It will be increasingly difficult for emerging countries to reverse engineer foreign products for cloning as the world becomes more formalised. China, for example, faces enormous pressure from the United States to honour intellectual property rights, which Japan, Korea and Taiwan did not encounter in their early stages of industrialisation. (Kim, 1997: 239.) In its attempt to make generic medicines more freely available South Africa found itself on a "watch" list of the USA. South Africa's health ministry's legislation and actions would reputedly infringe patent law and violate South Africa's commitment to honour international conventions.

South Africa's trademarks act has been amended to enable applicants to apply for registration of and thus monopolistic rights to a trade name, on the basis of a trade name being "well known". McDonalds fast foods recently did that although it had not even used its name before in South Africa. Another registered owner of the name was ordered to stop using it while full registration was granted to McDonalds. Disaster can overtake a local company using a trade name in good faith.

"Euro-speak imperils SA port and sherry", read the caption to a report on page 3 of the Pretoria News Business Report of 22 July 1998. It was reported that the European Union had stepped up its drive to bar South Africa from using the words "port" and "sherry" on South African vine products sold anywhere in the world - even in South Africa. This in spite of the fact that South African producers had been using the words for 200 years and had added "South African" to them.

It can probably be expected that South African patentees will make full use of treaties such as the Patent Co-operation Treaty.

### 6.4.2 Protectionism; and governmental approval and IP control

North American, European and other protectionist policies are extensive in at least some areas, whether they are economy, politics or technology based. It was reported in 1981 that over 20 countries had enacted specific legislation to control and direct foreign capital and technology. They focused on lowering the royalties paid for foreign technology, forcing local

participation in management and ownership while increasing the government's capability to screen and direct foreign activities. (Teece, 1981: 88) Arguably, withholding tax imposed by licensee countries on royalties is aimed at effectively reducing royalty rates.

Developing countries have developed a reputation for enacting legislation aiming at appropriating technology from developed countries - and arguably achieving the opposite.

South Africa is battling to gain access to a heavily subsidised European agricultural product market. The European Union has further been called "fortress Europe" in some quarters since 1992 following its implementation of a series of product standards which must be satisfied by imports. The USA regulates the export of certain sensitive technologies in terms of its Technology Transfer Ban Act, severely restricting or prohibiting the sale of "significant" or "sensitive" technology with potential military application, while it has acquired rights to inspect South Africa's armaments industry as a result of negotiations following the change of government in 1994. Its Export Administration Act and Omnibus Trade Bill also involve "Controlled Commodities". It is notoriously difficult and expensive to obtain the required Food and Drug Administration approval to sell medical products in the USA while Underwriters' Laboratories approval may likewise impede the market launch of a new product. Import duties to protect its domestic industry attract intensive media attention from time to time.

Legal monopolies exist or have existed for some time within countries, *e.g.* fixed telephone line operator Telkom, electricity generator and supplier ESKOM and South African Airways in South Africa. These had been coming under attack more frequently around the world and privatisation efforts are under way. The South African government has allowed a third cellular telephone operator to enter the market and it is expected that Telkom will be forced to give the second fixed line operator access to considerable sections of its existing infrastructure. These developments will impact operating conditions gravely.

South African exchange control regulations stipulate that payment of royalties for the use of foreign technology requires exchange control approval from the South African Reserve Bank (SARB). When an agreement involves the local manufacture of products or the provision of certain services the Department of Trade and Industry (DTI) acts as an advisor to the SARB.

A local firm wishing to in-license certain technologies must submit an application to the DTI for its consideration and recommendation to the SARB.

In the case of the following agreements application must be made through the would-be licensee's bankers, directly to the SARB: lease, distribution, design, technical, management, software, copyright.

In general, royalties should be based on net ex-factory South African prices excluding taxes and not be linked to foreign currencies or indices. Nominal maximum royalty rates of 4% on consumer and 6% on intermediate and final capital goods have been set, after deducting in-factory landed cost of imports from the licensor. If trade marks are included a maximum royalty rate of 1,2% can be paid subject to the above-mentioned maxima.

Minimum payments and down payments are frowned upon but can be motivated. Approval is usually granted for 5-year periods and is renewable. (South African Government Form DTP 001.)

Countries, trade blocks and even companies have their own laws and regulations. Differences in legislation cause differences between, for example, their patent and trademark law and that of South Africa, even if both countries have subscribed to TRIPS. For example, the USA as well as the European Economic Community is very strict regarding restraint of trade conditions in agreements, some countries require "working" of patents within fairly short periods of grant failing which the patents may lapse and tax agreements or the absence of them may influence licence agreements. The USA's anti-trust legislation and attitude are well-known.

It is also true that cross-border collaboration has been contemplated and practised on a bilateral and multilateral basis and that this offers opportunities or threats for various involved parties. (Simon, 1991: 23.)

In Southern Africa, the Southern African Development Community (SADEC) is seen as holding promise for co-operation, while South Africa has entered into various technology co-operation and defence collaboration agreements. Likewise, the current series of agreements

following arms purchases and the imposition by South Africa of so-called off-set and industrial participation requirements as part of the purchases will offer opportunities - or threats.

Survey objectives. (Results are presented in 8.6.)

It was decided to profile South African manufacturing companies' perception of patent, design and trade mark systems, licence agreement control systems and exchange control systems.

## 6.5 Sociological factors

### 6.5.1 Cultural differences and indigenous practices

Cultural differences that hinder or prevent licensing exist in several forms. There are differences between the customs and mores of different nations. This is so among ethnic groupings of which several exist in South Africa alone. Language and even religion can be barriers. It can be expected that the culture of particular companies will be unique from industry to industry and even within industries. The culture of accountants differs from that of engineers, differs from that of sales people and so on. Different views of the role of women are held. Education levels vary widely. The literature mentions "balkanization" of various disciplines which results in neglect of problems which ought to be examined in a connective manner. (Clark and Staunton, 1989: 13.)

Countries and companies may deliberately set up systems or have systems that have grown to suit their needs or their particular preferences.

The RAND report on the FS-X project is an interesting case study and illustrates some differences and their effects. (Chang: 1994, 51-68.) Launched in 1989, the FS-X project's goal was to develop a new fighter aircraft for the Japanese Air Self-defence Forces. The intention was that the USA would in-license radar technology from Japan. Problems mentioned in the report included the following.

The project was Department of Defense driven and a Technology Symposium which was unprecedented in inviting access to Japanese military technology was held. Although the

attendees included a group of defence firms and government organisations, numerous high-level managers in small US firms whose business was highly related to some of the technologies knew nothing of the possibly dual-purpose cutting edge technology on offer, even months after the symposium. Communication failed miserably.

Complex bureaucratic rules and procedures governing the transfer of military items between the two countries resulted in confusion. Japan's Ministry of International Trade and Industry is singled out but similar confusion on the US side is acknowledged. National goals and vested procedures interfered.

Japan's Defence Agency owned technology at the systems level while contractors owned lower tier process and design technologies; the latter being of most interest to US companies. Tensions arose because of the conflict between contractors' proprietary interests and bilateral political interests. Groupings with different frames of reference existed within Japan.

Large Japanese conglomerates rely on long-standing relationships within vast networks of sub-contractors to provide tooling and other process inputs. These are critical to quality assurance. They are however not easily transferable across national borders. Time is required to build reliance based on trust and personal honour.

It was found that US managers were uncertain whether foreign technology would be accepted in domestic markets while switching costs could be high. Does this mean the US is not familiar with in-licensing; or does it perhaps point to the existence of the so-called not-invented-here syndrome - even on a national level?

Commercial and military production were shared in the lower tier Japanese industry, giving larger volumes for increased automation while the US produced low dedicated volumes in "manual" fashion. This was the result of Japan's technology strategy after World War II.

Common or usual practices exist and vary as are also discernible from 6.5.1. Just-in-time parts management (JIT) is widely held to have arisen in Japan where it has been generally practised and whence it has spread to other countries. To be really successful sub-contractors have to be absolutely reliable and almost "part of the family". This could be problematic in the West,

where independence assumes a greater role and could lead to a breakdown in co-operative efforts as happened with the FS-X project.

The very fact that JIT is generally considered a Japanese innovation underscores differences in practice and outlook. Henry Ford describes throughout his book how Ford effectively practised JIT in the 1920s. Somehow USA practice blinded the USA itself to this management tool! (Ford, 1926).

The legal fraternity plays a very prominent role in the USA and consumer safety is very important. This contrasts with hand-shake agreements in some other countries.

A six-day week is common in Korea. A week of 40 hours and even less is common in the West. What happens when two engineers have to work together?

Remuneration rates and labour law and practices differ, ecological sensitivity varies. Weather conditions result in different requirements regarding buildings and erection methods and so on.

### 6.5.2 Organisation, people and qualifications

Foster contends that the Chief Executive Officer need not be up to date on all technologies but that an understanding of what may appear to be obscure technical detail is necessary to ensure a favourable outcome of a market battle. These details dictate the range of management options.

> The man who translates the CEO's vision and balance into an R&D program is the Chief Technical Officer. The strength of his relationship with the CEO is thus important. (Foster, 1987: 243.)

The logic of a close relationship between the two mentioned functionaries is incontrovertible. Naturally, this does not discount the involvement of other functionaries such as marketers and financiers - it restores a very necessary balance: Foster reports that from a sample of 400 of the largest US companies it was established that in only one case in five was the head of R&D considered a member of top management. In contrast, he refers to Ken Ohmae's statement that in Japan the Chief Technical Officer would make the list of key advisors 80% of the time. Put

differently, this would place him third in stead of eleventh in the rankings of influential advisors of the CEO - of which the CEO himself is considered to be first. He questions competitive ability if the executives who know most about the technology are not close to those who control the funds and people inside the company. (Ibid. 244).

Indeed, even within top management there is a hiatus which at the very least seriously demotes technology. It is possible that communication difficulties - the gulf between two different mind sets - cause the distance and that the distance causes further communication difficulties, and so on. A deliberate effort should be made to encourage communication and this effort will doubtless include the two functionaries getting to understand each other's frame of mind.

The literature abounds with discussions of the debilitating effects of organisational structure. There seems to be consensus that functional organisation structures, which generally develop as organisations grow in size, can be a major impediment to renewal and product development. Organising and leading an effective development effort is a major undertaking, especially for organisations whose traditionally stable markets and environments come under threat from new entrants, technologies and rapidly changing customer demands. (Clark and Wheelwright, 1996: 758.)

The worrying implication of the above statements is that even within any one function development is impeded. Complacency and even structural rigidity can set in very easily.

Should a large company be organised into strategic business units (SBUs), it runs the risk of imprisoned resources and bounded innovation. The bigger development, perhaps across SBUs and that may need true corporate resources, may fall by the wayside. (Prahalad and Hamel, 1996: 64 - 76.)

Acknowledging the problems and to help solve some of them so-called light-weight, heavyweight and autonomous team structures have been tried with varying degrees of success. (Clark and Wheelwright, 1996.) The fact remained that organisational structure can hamstring a company and it appears that an enabling structure will not by itself solve problems. Only the people involved can make it a success.

The wider question of how firms and markets should be organised for optimal performance has long been central in the field of industrial organisation. Two approaches can be discerned, namely analyses regarding organisation of firms and markets to solve the static problem of resource allocation optimally versus organisational forms most conducive to rapid technological progress. Exploring why industries differ in the degree to which they undertake innovative activity, empirical researchers are reported to have classified explanatory variables in three groups, namely product market demand, technological opportunity and appropriability conditions, but made relatively little progress in specifying and quantifying their influence. One suggested reason for this relative neglect has been the profession's pre-occupation with the effects of firm size and market structure, exploring two hypotheses associated with Schumpeter: (1) innovation increases more than proportionately with firm size and (2) innovation increases with market concentration. (Cohen and Levin, 1989: 1079 and 1060.)

Twiss offers a taxonomy that can be adapted and expanded as required to be used as a tool to systematically assess the suitability of various organisational forms against criteria considered important. Note that many more criteria can be listed and even the ones listed can be re-defined. It is apparent that one form to satisfy all needs is at best elusive. Criterion 6 is especially important in the context of this research. It is not clear why project and venture structures cannot be made successful and the taxonomy seems rigid.

| | **Possible criteria to be satisfied** | **Degree of satisfaction of organizational criterion in the structure** | | | | |
|---|---|---|---|---|---|---|
| | | Organiza-tion by discipline | Project manage-ment | Product line organi-zation | Matrix organi-zation | Venture manage-ment |
| 1 | Development of technological capital | High | Medium | Low to medium | Medium | Low |
| 2 | Professional development of staff | High | Medium | Low to medium | Medium | Low |
| 3 | Managerial development of staff | Low | Medium | Medium | High | Very high |
| 4 | Achievement of short term project goals | Low | Medium | Medium to high | Medium to high | Very high |
| 5 | Involvement of marketing, production and financial | Low | Low | Medium | Medium to high | High |

| | | | | | | |
|---|---|---|---|---|---|---|
| | staff | | | | | |
| 6 | Technology transfer | High | Medium | Low to medium | Medium | Low |
| 7 | Corporate identification | Low | Low | Medium | Medium | Medium to high |

**Table 32. Characteristics of organisational structure.**
(Twiss, 1987: 199)

Abernathy and Utterback, in discussing the innovation S-curve (6.7, p.108) with its fluid, transitional and specific stages of evolution, more reasonably but more complicatedly point out that each stage demands a different organisation. The demands can be deduced from Table 33.

What can be seen as three axes along which organisation structures should be developed appear: (i) performance criteria, (ii) stages of development and (iii) size and market concentration. The immensity of the challenge should inspire companies to seek the best organisation structure from time to time by challenging its form and characteristics bearing in mind its objectives to be innovative and not lapse into an unmotivated steady state.

| | **Fluid pattern** | **Transitional pattern** | **Specific pattern** |
|---|---|---|---|
| Competive emphasis on | Functional product performance | Product variation | Cost reduction |
| Innovation stimulated by | Information on users' needs and users' technical inputs | Opportunities created by expanding internal technical capability | Pressure to reduce cost and improve quality |
| Predominant type of innovation | Frequent major changes in products | Major process changes required by rising volume | Incremental for product and process, with cumulative improvement in product and quality |
| Product line | Diverse, often including custom designs | Includes at least one product design stable enough to have significant production volume | Mostly undifferentiated standard products |
| Production processes | Flexible and inefficient; major | Becoming more rigid with changes occurring | Efficient, capital intensive and rigid; |

| | Fluid pattern | Transitional pattern | Specific pattern |
|---|---|---|---|
| | changes easily accommodated | in major steps | cost of change is high |
| Equipment | General purpose, requiring highly skilled labour | Some sub-processes automated, creating "islands of automation" | Special purpose, mostly automatic with labour tasks mainly monitoring and control |
| Materials | Inputs are limited to generally available materials | Specialized materials may be demanded from some suppliers | Specialized materials will be demanded. If not available, vertical integration will be extensive |
| Plant | Small scale, located near user or source of technology | General purpose with specialized sections | Large scale, highly specific to particular products |
| Organizational control is | Informal and entrepreneurial | Through liaison relationships, project and task groups | Through emphasis on structure, goals and rules |

**Table 33. Competitive strategy, production capabilities and organisational characteristics of productive unit at each innovation stage.**
(Abernathy and Utterback, 1975: 632)

> In the last analysis the quality of endeavour depends upon the quality of the people involved. No amount of organizational technique will make up for lack of integrity, intelligence, persistence, imagination, and the ability to help, enthuse, and understand one's fellows. Nevertheless, better organization should enable them to function more effectively. (F. Doyle, Research Director, The Beecham Group as quoted by Twiss, 1987: 198.)

Survey objectives. (Results are presented in 8.2.)

It was decided to profile South African manufacturing companies' organisation structures in terms of geographical spread, for research and development, for attempts to meld various units and disciplines to enhance technological productivity, and their perception of the prevalence of the Not Invented Syndrome.

The survey objectives herein for what is a very important concomitant aspect to licensing were limited in order not to detract from the main purpose of this research and to limit length and complexity of the questionnaire.

### 6.6 Availability and management of information

What has become known as the information age is well under way. The volume of data, or

non-ordered pieces of information, has and is increasing rapidly and data are much more readily available. Because of the volume thereof large parts can also go astray. The challenge is to sift through everything available and to extract and structure what matters coherently or put differently, to make sense of the amorphous mass. South Africa forms part of the new information world and aspires to trade globally. This means that local companies have to ensure that they are informed regarding both markets and technology and factor their knowledge about these as well as their lack thereof into their planning processes as sketched in 6.7 or drop out. Learning from technology transfer is discussed in 3.3. There are many other ways to gather information.

For example, the concept of "gate keepers", *i.e.* persons or sections being deliberately assigned the responsibility to scan for and introduce relevant information to the organisation is known and ought to be systematically planned.

The far reaching actions of Korean electronics firms - actions that would appear to have borne fruit – are informative. Given the policy environment and increasingly dynamic market, they have drastically expanded in-house research and development ventures, establishing several laboratories. LG Electronics developed an extensive research and development network consisting of 10 independent, six product specific and five overseas centres: one each in Japan, Ireland and Germany and two in the USA. These facilities monitor technological change at the frontier, seek opportunities to develop strategic alliances with local firms and develop state of the art products through advanced research and development.

Samsung has research and development operations in San Jose, Boston, Tokyo, Osaka, Sendai, London, Frankfurt and Moscow. (Kim, 1997: 142 – 143.)

To look at the quality and quantity of Samsung Electronics' research and development activities is enlightening.

| R&D activities at Samsung Electronics | | | | | |
|---|---|---|---|---|---|
| | 1975 | 1980 | 1985 | 1990 | 1994 |
| Total sales (W 100m) | 244 | 2513 | 12985 | 44523 | 115181 |
| R&D investment (W 100m) | NA | 56 | 388 | 1862 | 7133 |
| R&D/total sales (%) | NA | 2.1 | 3.0 | 4.2 | 6.2 |
| R&D personnel | NA | 690 | 1821 | 6686 | 8919 |
| Local patent applications | NA | 18 | 309 | 1732 | 2802 |
| Local patents granted | 0 | 4 | 17 | 640 | 1413 |

| | | | | | |
|---|---|---|---|---|---|
| Foreign patent applications | 0 | 0 | 32 | 1145 | 1478 |
| Foreign patents granted | 0 | 0 | 2 | 128 | 752 |

**Table 34. R & D activities at Samsung Electronics.**
(Kim, 1997: 143)

The research and development investment has increased from 2,1% to 6,2% of sales; and a formidable patent portfolio is being built up.

Mergers and acquisitions are also used by Korean firms to globalise research and development. Hyundai is said to have been the most aggressive at acquiring equity stakes in foreign firms as a way to gain access to cutting edge technologies - five US firms. Samsung acquired a controlling share in AST Research, a large US PC maker in 1995. Apart from placing Samsung among the five largest PC makers in the world Samsung gained access to more than 190 AST patents and its strategic alliances with IBM, Apple and Compaq. Samsung also bought majority stakes in Union Optical of Japan and Rollei of Germany, enhancing its competitiveness in camera and optical equipment making. (Kim: 143 – 144.)

Within a generation the Korean electronics industry developed from scratch into the fourth largest producer in the world.

Learning by watching refers to activities directed to the acquisition, assimilation and improvement of external knowledge. It requires organisation-wide external linkages and information systems to acquire generic, industry specific knowledge. Activities include widespread technology surveillance, hiring of specialists, visiting trade shows and foreign suppliers, collection of catalogues and manuals from competitors, sending engineers and managers to foreign universities, translating technical journals and attending professional meetings. Advantages of this method is the ability to "read" the growing market better, to select improved technologies and to enter markets at better times.

Reported slogans from Canon highlight the importance of patent literature as information source.

> Just about this time [1945] there was a slogan at Canon that said: "Read patents, rather than technical papers!" Patents are of course written by the specialist of the discipline. Therefore, patents have descriptions of the progress of the technological development of the field, and have detailed comments on

> where the disadvantage of the technology used to be, and how this patent tried to overcome this. It turns out that patents were the best way to fill up the past years of technical vacuum.
>
> …. At this time [1955] Canon started to encourage their engineers by the following two slogans: "Write patents rather than technical papers!" and "Patents are the monuments for engineers!" (Yamaji, 1995.)

The accent change at Canon was in conjunction with Japan's progress from original equipment manufacturer to own brand manufacturer. (See last quotation in 6.7, p108)

It is in this kind of competitive environment that South African industrial companies have to ensure that they are informed. Well planned, aggressive and continual gathering of information regarding markets and techologies is a *sine qua non* for success.

Survey objectives. (Results are presented in 8.18.)

It was decided to establish intensity of use of information sources by South African manufacturing companies. It was further notionally proposed that increased use of information sources will correlate positively with licensing activity.

Information sources are extremely varied and it was proposed to measure the intensity and spread of use by aggregating the 18 characteristics (question 7 in the questionnaire, Annexure A) into a single indicant. Construct validity is sound in theory but content validity to some extent and reliability may suffer from subjective responses.

As with 6.5: sociological factors, the survey objectives were limited.

### 6.7 The future, technological trends and forecasting

Companies' planning processes must take cognisance of all the manifestations referred to before and then visualise themselves and other players plus the manifestations and more at various points in the future. Visualisation is perhaps the most daunting challenge but some aids are available.

It is widely accepted that technological trends or even trajectories do exist or form over time.

Following the launch of long range passenger air transport there was a move away from the use of ships by passengers. Following the development of the transistor, miniaturization of electronic components burst upon the scene, leading to a rash of products embodying smaller components. Even the stone, iron and information "ages" can be viewed as forming patterns. Tidd *et al* (1997: 108) introduce the concept of trajectories existing for five types of business, *viz.* supplier dominated, scale intensive, information intensive, science based and specialized and show how each has typical core technologies, sources of technology and how their technology strategies differ.

Generally the curves are man-made and are continually being re-shaped. Changes in the definition of the productive unit and TENs doubtlessly influence their formation while they lead inexorably into the unknowable future. Technological trajectories have been described as self-fulfilling prophesies. The phenomenon of path dependency is well known. The more technologies are adopted, the more they are improved. Persistent patterns of technological change are persistent in part because technologists and others believe they will be persistent. (MacKenzie, 1992: 32.) South African engineers may tend to select mechanization above labour when designing a process to enhance stability in the workplace, the "information technology age" influences the environment, once facsimile machines were being used by a threshold number of users well nigh everybody else had to use them or be left behind. Personal computer technology seems to be having the same effect. Will electronic mail replace facsimile machines? And what role will emerging technologies that route voice calls over internal data networks or even the Internet play?

More detailed models which could be considered more practical have also been developed. Two which attempt to describe the rise and decline of technologies are briefly discussed below. These models are or can be of varying value to today's companies trying to navigate to a secure and profitable future. They contribute to the arena of paradigm forming, where a paradigm may be described as a heuristic outlook establishing how a set of problems should be interpreted and the means through which solutions should be sought. It defines the regime of problem solving.

Abernathy and Utterback (1975) proffer a model (Table 33, p100) describing how a company alias "productive unit's" capacity for and methods of innovation depend critically on and

follow the unit's evolution from a small technology based enterprise to a high volume producer. They describe the unit's competitive strategy, production capabilities and organizational characteristics as the technology which is the subject of innovation evolves through three stages which they term the fluid, transitional and specific stages during which innovation is respectively tentative, then rife and finally tapers off as a "standard" or "mature" product is derived. They differentiate between product and process life-cycles which they take together for a unit - process innovation usually lags on product innovation but follows a similar pattern. The product can also be a service which would in turn be supported by a process. For a depiction see Figure 15, p108. Foster (1987) argues that the graph of the relationship between the cumulative effort put into improving a product or process (X-axis) and the cumulative results obtained for that investment (Y-axis) show that (again) limited results are at first obtained; then results blossom; and finally they taper off as it becomes increasingly difficult to effect improvements. The resulting graph reflects an "S" leaning to the right and has become known as an S-curve. These results echo those of Abernathy and Utterback. Foster additionally and pertinently points out that the diminishing returns are due to the fact that some technological limit is approached, *e.g.* current material technology will not affordably allow running internal combustion engines at known higher and more efficient temperatures. Foster simultaneously introduces the concept of technological potential: this reduces as progress is made along the S-curve and can be described as limit minus actual. Reaching the technological limit does not necessarily imply a cessation of sales, *i.e.* the cumulative sales curve may continue to show an increase if another technology has not displaced the practically fully developed technology.

Both the above life-cycle models are convincingly motivated and the application of these paradigms could be economically useful. Unfortunately, they can only be developed reliably and the attendant fluid, transition and specific stages of the deliverable identified *ex post facto*. Whereas this may be of intellectual and historic interest it is of severely limited economic value to an operating company. The company has to visualise its current – and future – position *vis-à-vis* perhaps several evolving S-curves.

Forecasting is required and this gives rise to at least two problems, namely that of delimiting the technology to be considered and plotting a "returns" curve into the unknowable future, possibly extending an existing partial, presumably correct, curve.

Regarding the first it is obvious that the "technology" can be chosen at several distinctly different system levels, *e.g.* the "passenger" versus "air passenger" versus "businessman air passenger" industry. It can be generic involving "semi-conductors" or firm-specific involving "transistors." This fact is highlighted by the originators of the model defining the unit of analysis as a "productive unit" which can be a company or a division of a company. The productive unit should be defined very deliberately, having regard to the proposed use of the analysis and bearing in mind the inherent delimiting effects.

Visualising future conditions is more difficult and success seems elusive:

> There is no law, nor even an inherent tendency, for products to exhibit the growth implied by these formulations. *In fact, most new products fail*. (Author's emphasis.) Nearly every study that has looked at the issue has concluded that most new products never make it. They never progress through any of these patterns. They never make it out of stage one [of the S-curve]. (Schnaars, 1989: 59).

Apart from commodity price surprises and likes of customers, forecasting can be the victim of what Schnaars (61-139) terms the *Zeitgeist*. He illustrates the influence of dominant themes of the day by reference to the jet engine, the space race, the nuclear age and the energy crisis of the 1970s. He points out that innovation comes from the outside: calculators substituting for slide rules, ball point pens replacing fountain pens, disposable ball point pens replacing ball point pens, video games coming from a private inventor and not from the makers of board games and Swiss watchmakers ignoring digital watches at first. He refers to Derek Abell's notion of "Strategic Windows". This holds that opportunities are created for some firms and taken away from others as the world moves forward. There is a strong implication that markets are not created but identified. It also implies that markets are driven largely by outside forces. Timing becomes paramount. It is speculated that the less efficient QWERTY keyboard became entrenched because the very little effort required to retrain operators to use the more efficient DVORAK keyboard was seen as too much. Schnaars lists several examples of forecasts gone wrong. Diesel-powered cars were very popular in the USA following the second oil crisis in 1979 because diesel was cheaper than petrol. In peak year 1981 car manufacturers in Detroit sold 500 000 and then sales slumped. Consumers considered the cars dirty and temperamental, while petrol became cheaper than diesel. In 1972 plastic paper, a substitute for pulp-based paper, cost about twice what pulp-based paper did, but it was

predicted that "the price curves are going to cross as early as 1980". This was overly optimistic as the price of petroleum, the feedstock for plastic, increased. No-frill foods exploded into popularity in the USA from the mid-70s and it was uniformly predicted that this bare-bones approach would also be followed in warehouses. Both faded with the economic recovery of 1983. All of a sudden, consumers wanted something different.

In spite of these difficulties companies have to attempt visualising the future and use of S-curves can be helpful. Overall, scenario planning and posing of fundamental questions can be helpful.

An allied fruitful use of S-curves is ‘backward” (Kim, 1997: Figure 15, p108). Although Kim discusses countries, the same dynamics apply between firms within any one country. Kim starts from Abernathy and Utterback's postulation that industries and firms in advanced countries develop along a technological trajectory made up of three stages - fluid, transition and specific, which the S-curve tracks. Catching-up countries first acquire specific state foreign technologies. Lacking local capability to develop production operations, local entrepreneurs develop production processes through the acquisition of packaged foreign technology. The relatively successful assimilation of general production technology and increased emphasis on export promotion as well as increasing skill levels result in the gradual improvement of technology.

New technologies are applied to different product lines and proceeding along this trajectory of acquisition, assimilation and improvement, firms in catching-up countries reverse the sequence of research, development and engineering. As developing countries become adept at this process they may in time apply it to new technologies in the transition stage and eventually to new technologies in the fluid stage.

This pattern depicts the strategy of progressing from Original Equipment Manufacturer (OEM) to Own Design and Manufacture (ODM) to Own Brand Manufacture (OBM). (Tidd *et al,* 1997: 84.)

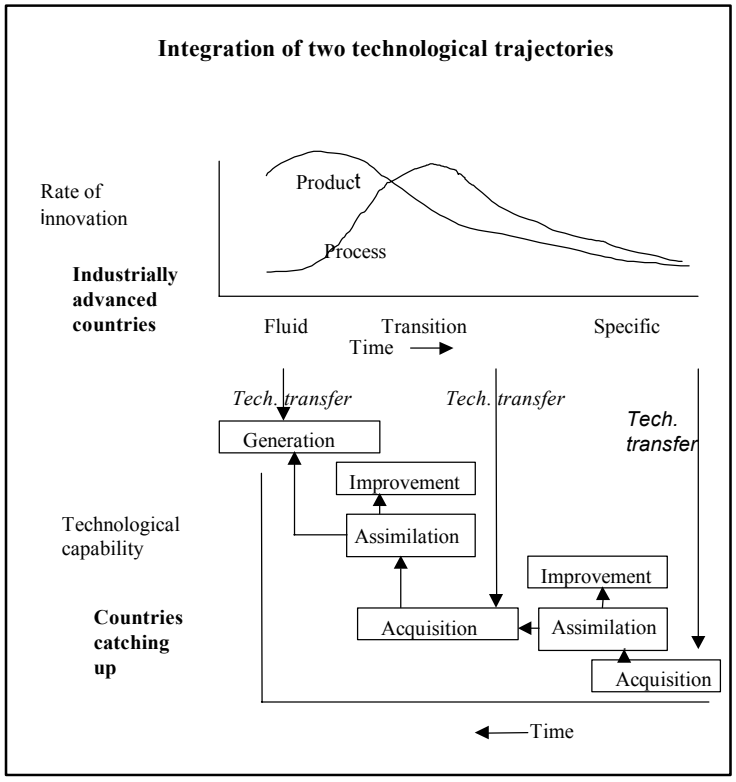


**Figure 15. Countries catching up by working backwards up the S-curve.**
(Kim,1997: 91)

This is also seen in a practical history of Japan provided by a former president of Canon:

> The first step to becoming an advanced, developed nation started after World War II ended in 1945. The situation … [no] natural resources …. [count] on human brains. Import resources, process them into products, export them, earn foreign currency. With the earned foreign currency, import food and also import more natural resources. This cycle was continued.
>
> In the meantime, we started to learn the technology and the advanced product from Western Europe and America. We absorbed these technologies and we fully digested these technologies. In other words, this was the era of nationalization.
>
> Next, from around 1955, we began to see activities to improve products, to produce international level product, so that we could promote export. For that purpose we introduced methodology that was regarded most advanced in the United States about quality control, productivity and business management theory.

> Once these were fully digested and Japanized, numbers of different international products were born. I call this period the era of quality.
>
> Since then the progress differs from corporation to corporation. …. Around 1975, Japan entered the era of originality. …. Today, I believe that Japan should enter the era of the unexplored. This era is the time that we will try to invent unexplored technology that nobody else ….. (Yamaji, K. 1995.)

Awareness of the techniques described and others available offers a great opportunity to companies to form a paradigm encompassing a heuristic outlook and most of the environmental factors, on which to partly base their competitive strategies which may involve differentiation, cost reduction, following, leading or leapfrogging.

Survey objectives. (Results are presented in 8.7.)

It was decided to profile South African manufacturing companies' environmental friendliness, intensity of market and technology competition, quality of tacit knowledge, access to complementary assets, quality of technology portfolio and quality of forward planning as measured by intensity of aggregate use of scenario planning, use of S curves or other techniques. It was further notionally postulated that the more a company chooses or is forced to plan ahead, the more licensing activity will be evident.

The construct 'forward planning' is broadly measured and content validity as well as reliability should be high, in part because the construct is so encompassingly proposed and the flexibility inherent in the response menu.