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1. INTRODUCTION

Précis

> All too frequently technology sales are the part-time responsibility of top management. The marketing of a technology during all the stages of its [technology life cycle] requires specialized decisions usually beyond the expertise of top corporate managers as well as conventional product marketers. Our research suggests that this marketing function be separated both from a company's overall strategic planners and from its regular marketing staff. Only after the specialists have carried out detailed analyses of a technology and its potential markets should their work be integrated with that of general strategic planners. (Ford and Ryan, 1996 : 117.)

The volume, sophistication and complexity of technology are ever-increasing while it is already omnipresent, influencing the lives of everybody. It can metaphorically be regarded as the key that will unlock the door to a prosperous future for those who employ it correctly. But it threatens disaster to those who ignore it or try to ignore it. It is a key strategic resource and should be properly strategically managed and the management should include its innovative creation and appropriation; and acquisition and disposition, also on the technology market.

The acquisition and disposition of technology, whether by outright sale or purchase or by licensing its application, are indeed special, the results of a complicated underlying process; and of strategic import. Aspects of this multi-functional, multi-disciplinary field have received the attention of several scholars. Surveys have been conducted to establish its morphology in national and international contexts, mostly in developed countries. Its function within strategic technology management has been studied. Proposals have been put forward regarding improved organisational forms and staffing.

However no comprehensive and systematic information about its morphology and function in South African context was available. Neither, in general, had deserved attention been given to its dynamics. This research set out to redress the deficiency regarding South Africa and to explore the notion that manufacturing companies can deliberately organise some organisational characteristics to optimise, reduce or increase licensing activity.

*   *   *   *   *

Background and overview of licensing environment

The already vast and varied body of technology in the world is being expanded at an ever increasing rate under ever more competitive conditions. A regular quantitative pattern resulted in 1964 in "Moore's Law" concerning the annual doubling of the number of components on microchips. In three decades the doubling time of computer power per US dollar has fallen from two years to one year. (Pretoria News, 1 September 1998: Itechnology supplement: p5.) In semiconductor engineering it is estimated that the half-life of a newly minted Ph.D. is about seven years. (Maidique and Hayes, 1996 : 24.)

The cost of generating technology is escalating, placing various development and exploitation pressures on organisations. It took Motorola 15 years and $150m to bring cellular telephones to market. (Lynn, Morone, Paulson, 1996: 371.) At the same time however, product prices can drop significantly. The price of a 4-function calculator was $250 in 1972 and $10 a few years later. (Roger, 1983: 214.) Recoupment of the development cost of an electro-mechanical Siemens telephone switch required capture of about half the German market in the 1960s. By the 1980s recoupment of the cost of newer generation digital switches needed the whole German market plus a good portion of the broader European market. The next generation of switches may require capture of a 20% share of the global market to break even. (Prahalad and Hamel, 1994: 272.)

Increasing complexity, lengthening development times, shortening product lines, and the need to contain cost characterise industry and the markets. These are forcing specialisation in development, in industrialisation, in production and also rapid expansion of flexible domestic and international logistic supply arrangements. Specialisation can lead to increasing isolation, or a debilitating formation of islands of expertise. Cross-fertilisation among companies, industries and functions should be managed properly and stimulated to maximise returns. In the extreme a company can find itself with no technology, as three writers warned:

> The trend in international business towards what Miles and Snow call dynamic networks - characterized by vertical disintegration and contracting - ought thus to be viewed with concern. (*Business Week*, March

> 3, 1986 has referred to the same phenomenon as the Hollow Corporation.) Dynamic networks may not so much reflect innovative organizational forms, but the dissembly of the modern corporation because of deterioration in national capacities, manufacturing in particular, which are complementary to technological innovation. Dynamic networks may therefore signal not so much the rejuvenation of American enterprise, but its piecemeal demise. (Teece, 1996: 249.)

Technology impacts everybody, be they generators or users thereof, including the young and old, the small and large, natural and legal persons, governments, universities and technicons.

In industry, every company creates and applies technology, whether manufacturer or service provider, large or small. The technology can originate from various sources and be applied in many places and ways. Although not all companies will have a formal approach or view their technology origination activities as research and development, perhaps preferring a more modest description, most of them are indulging in renewal activities resulting in new methods and products. Likewise, whether or not they prefer to be, they are exposed to and dependent on the application of technology from elsewhere. The literature abounds with chronicles concerning the rise and fall of major and minor companies and in most cases the root causes include the correct or lackadaisical management of technology, new or old. Companies are immersed in technology and it is incumbent upon them to structure themselves organisationally and operationally to manage any technology, defensively or aggressively as the case may be, to optimum effect to attain their broader goal of creating wealth.

An industrial company functions within an environment and is surrounded by and interacts with many, ever-changing, structures, forces and influences including a technology market. Technology is simultaneously a result and a determinant of these and of a company's own actions. A company therefore has to understand its encompassing as well as its technology environment to plan its competitive strategy including its own technology strategy which can be visualised as interposed between the company and its technology sources and market. Overall alignment of the company's goals and actions with its macro or external and micro or transactional environments is a prerequisite.

Innovation by companies, *i.e.* renewal of themselves, is essential for their prosperity and indeed, their survival in the modern world. Their innovation must certainly include but must not be limited to innovative technology in the perhaps general sense that new products, service and production technology should be found and applied. Their renewal must also encompass the innovative application in and acquisition from the technology market of such technology - innovative technology should be traded with innovative managerial technology for many reasons which can be conveniently grouped as strategic, operational and financial.

The acquisition and disposition of technology and its intentional or unintentional diffusion from and to several diverse sources and applications form an important subset of technology management. It involves many methods, traditional or innovative, that are available to companies to acquire, use and divest technology, including employment and separation of people, developing it and selling or buying or licensing it in an organised manner. Several industry leaders have realised this and are actively involved in amongst others systematic processes of identification and transfer of technology between the various sources and markets and themselves. Unfortunately, many have failed or are failing to do this, to their detriment and even at their peril.

* * * * *

Licensing inwards as well as outwards assumes an important role in the management of technology acquisition and disposition. The President of the Engineering Association of South Africa has described as a great tragedy the foreign payments South Africa makes for royalties and licence agreements. He stated that it was high time that South African firms realised that they should be owning their own intellectual property. (Financial Mail, March 8 2002, p29.) The South African Reserve Bank does not publish details but annual royalty payments of all kinds have been estimated at up to R $2{,}5 \times 10^9$ per year. This is implicit support for Ford and Ryan’s call to put management mechanisms in place and into operation deliberately to achieve success through selling and buying technology and licensing-in and licensing-out technology. (Précis, p1.)

Not only are excessive outflows of funds undesirable. Of even greater and strategic import is that national economies of “technology colonies” (De Wet, 2001) such as South Africa are at risk to reductions and other changes in their markets in the developed world. Consequently there is a compelling need for “technology colonies” to diminish their “colonial” status which is characterised by predominant industrial activity at the manufacturing and trading end of the business cycle, limited research, large flow of technology from the developed world to them, and severely limited flow of technology from the local research and development community. Proposed strategies include backward integration, beneficiation, solving local problems, clustering and establishment of businesses altogether novel to the colony. De Wet suggests that awareness and development of these will be advanced by reorienting engineering education, adapting the functions of scientific institutions and focussing the National Systems of Innovation.

A national system of innovation for South Africa was first proposed in 1996 in the Government's Department of Arts, Culture, Science and Technology's White Paper on Science and Technology, subtitled *Preparing for the 21st Century*. In this policy instrument, which followed on widespread consultations and intensive discussions of the prior green paper, reference was made to plans to improve South Africa's intellectual property protection system and to bring it more in line with those of other countries, while it clearly recognised other shortcomings regarding the use and acquisition of technology. (1996: 24 and 36, 37, underscore added.)

> The capacity of firms to innovate is to some extent determined by both horizontal and vertical linkages between firms. For instance, the differentiation of a product line is often informed and driven by customer feedback, whereas close co-operation with suppliers may well result in economies of production…….
>
> The DTI [Department of Trade and Industry] is currently involved in several studies which are designed to result in concrete and sector-specific measures to enhance inter-firm linkages.
>
> Efforts to support SMMEs [Small, Medium and Micro enterprises] around the world have led to programmes responding to five generic needs of those enterprises. These are:
> access to finance;
> access to markets and market information;
> improved management;
> skills upgrading for members of the work-force;
> best-practice technology.
>
> … to date, most of the attention has been focused on the first four needs listed above. The time has now arrived to put significantly increased emphasis on addressing the technological needs of SMMEs.

The Director of The Institute for Technological Innovation of the University of Pretoria commented that the proposed National System of Innovation was a step in the right direction on the national level, but pointed out that the time had come to implement the management of technology at company level in a formal way. (Pistorius, 1996: 1.) Both the need for information on innovation practices and government's serious intent with the System were illustrated when, also in 1996, the first national Survey of Innovation in South Africa was carried out to gather insights into South African practices. This proved both worthwhile and lacking in some respects and was followed by a second national survey covering the period 1998 – 2000.

While innovation in its widest sense is generally recognised as an important generator of new technology, licensing can be viewed as one of its important concomitant or inherent instruments, generally operating at company level. This and the general importance of licensing are evident from various studies and surveys in and regarding various parts of the world. Several authors have paid attention to the role of licensing. Ford (1988) clearly identifies its position and role in technology acquisition and exploitation. Kim (1997) proposes strategic management perspectives to suppliers and recipients of technology further to his contention that transfer cannot be stopped. Roberts and Berry (1985) position it regarding the selection of strategies to enter new business. Tidd, Bessant and Pavitt (1997) discuss collaboration in the development of new technologies, products and processes including technology transfer and the role of licensing is clearly discernible. Likewise types of licenses such as horizontal and vertical (Barton, Dellenbach and Kuruk, 1988) and exclusivity and the content of licenses (Ishii and Fujino, 1994; Degnan and Horton, 1997; Contractor 1981) have been examined and discussed.

Various useful initiatives concerning licensing have over the years been launched in South Africa to meet expressed and sensed needs. These include lectures by the South African chapter of the Licensing Executives Society, those of universities, the Intellectual Property Institute, *ad hoc* published articles and various initiatives by the Council for Scientific and Industrial Research which also included the founding of the South African Inventions Development Corporation as far back as 1962. The seeming continuing need for information and education was again demonstrated by a recent action to improve the situation through the formation of the Southern African Research and Innovation Management Association (SARIMA) whose expressed main aim would be to move knowledge and inventions from the laboratories which absorb about R1x10^9 in government research funding per year into the market, by educating and training researchers in all aspects of research and intellectual property management. (Financial Mail, ibid.)

Lack of information and directed study

Licensing is an important element of the management of acquisition and disposition of technology, also during the process of innovation. It should itself be managed properly to avoid harmful consequences and to maximise advantages, at company as well as national level. To be able to do so requires insight which in turn requires facts and an understanding gained from the study of these and their import.

- It has become apparent, through personal experience and the seeming scarcity of learned and comprehensive writing on the subject, that the morphology and function of the multi-functional, multi-disciplinary field of licensing has in respect of South Africa not been given the formal attention necessary to understand its operation as is evidenced by unanswerable questions. Examples are*:* Why do South African companies license? Why not? To what extent? What encourages them or bothers them? How do they compare to companies in other countries? The lack of basic information renders comparisons and understanding and study of licensing practices and views impossible while possible formulation of policy to enhance conditions and practices at company and national level may be seriously impaired.

- As part of the study of licensing in general, proposals towards improving organisation and management of licensing have been made (Contractor, 1981, Goldscheider, 1990; Teece, 1996; Ford and Ryan, 1996). These proposals imply that companies can deliberately organise to optimise, reduce or increase licensing, which is multi-disciplinary and multi-functional and if executed properly, the end result of complex interactions. However the dynamics of licensing have been neglected and questions arise: Which inherent or acquired company characteristics will promote or hinder licensing? Which are most influential?

Research framework

Objectives

Three objectives were pursued to redress the deficiencies defined above:

1. Empirically obtain a profile of technology licensing practices and views of South African manufacturing companies; and contrast them where possible and useful with international practice. Summaries of profiled aspects appear in Chapter 7: Methodology at 7.1.1, p110.
2. Explore the notion that manufacturing companies can deliberately use some organisational characteristics to act as drivers to influence licensing activity. A summary of characteristics appears in Chapter 7: Methodology 7.1.2, p111.
3. Identify and present aspects of both to stimulate further research and discussion.

The term "manufacturing companies" refers to companies in industry known to have or to have had at least one licence agreement or patent or trade mark and specifically excludes statutory bodies, science councils, universities, merchants, the retail trade and technology brokers. A company-level as opposed to a national-level approach is followed. Licences involving only trademarks, trade names, copyright, franchising and distribution rights are excluded.

Research logic

Meeting the objectives required descriptive and exploratory research. It was decided that empirical data would be gathered through a cross section survey by written questionnaire. For purposes of the survey, characteristics profiling licensing practice had to be identified and a selection from these pragmatically made with the objective of limiting the questionnaire to what was considered a manageable scope while including the most important characteristics. From these in turn a selection had to be made and some aggregates synthesised to be tested as notional determinants of licensing. A guiding consideration was to strive for a quantitative/positivistic rather than a qualitative/ethnographic approach. The technology licensing and technology management literature was examined to evolve the set of characteristics used, which appears in most easily understood form in the questionnaire which is attached as Annexure A.

The research logic is further described in detail in Chapter 7.

Structure of thesis

The thesis is structured to accommodate as far as possible the multi-dimensional discussion required because of the interaction between a company's characteristics, its operating and regulatory environment, its management and its technology licensing practices. Its Chapter sequence, shown below with summarised content, further reflects and explains the research logic.

Chapter 1	Outline of information available and needed; why needed; delineation of research problems and objectives; research framework.
Chapter 2	Basic morphology of the licensing field through definitions of technology, licensing, techno-economic networks and innovation; licensing positioned as business function.
Chapters 3 - 6	Evolvement of the theoretical framework for the research through theory and literature investigation and development aimed at the identification of attributes that were important and thus were to be surveyed relevant to licensing; and synthesis of drivers. The evolvement follows a topical order allowing the prior clarification of terminology and concepts, and introduction of basic definitions required to facilitate subsequent discussion: building on chapter 2, technology migration, intellectual property strategy, the licensing market and overall company attributes relating to licensing activities are discussed.
Chapter 7	Methodology.
Chapter 8	Results accompanied by brief comments where deemed necessary.
Chapter 9	Conclusion: Salient findings with comments; recommendations.

2. MORPHOLOGICAL DEMARCATION

In this chapter the central concepts technology and licensing are defined; the licensing function and technology trading are positioned within management of technology within a company; the concept of techno-economic networks is introduced; and the concept of innovation is defined.

2.1 Technology defined

> A good starting point to understanding Technology Strategy is to affirm that the core of a company is what it knows and what it can do, rather than the products that it has or the markets it serves. Technology Strategy centres on this knowledge and these abilities. It consists of policies, plans and procedures for acquiring knowledge and ability, managing that knowledge and ability within the company and exploiting them for profit. (Ford, 1988: 85.)

Technology can be and has been defined in various ways, depending amongst other things on the reason a definition is required. Ford is implicitly proposing that a company's knowledge and abilities form its technology. This is acceptable as an approximation although it lacks the utility aspect as an integral characteristic. In his case utility or profit is an output of the technology *strategy*.

Van Wyk (1988: 342) in discussing new frameworks for the management of technology alludes to the existence of several different definitions of technology. For the admittedly specific purposes of his discussion he finds the following useful as a starting point:

> Technology is created capability: it is manifested in artefacts the purpose of which is to augment human skill. ……. Artefacts are the repositories of capability. They are to the study of technology what organisms are to the study of biology.

He confirms that technology, being created, does not come about by itself and that it is the utile product of deliberate action aimed at augmentation of human skill, or utility.

He also ties technology to an artefact. The New Oxford Illustrated Dictionary (1976) defines artefact as "Object, ….. made by human workmanship". Interpretation of this definition according to the ordinary meaning of the words would appear to limit Van Wyk's definition to the concrete or physical. It must be extended to include purely abstract "repositories" such as computer programmes, to retain the validity of the above definition of Van Wyk and to avoid returning to earlier views of technology:

> To a very large degree the early studies on technology and organization equated technology with equipment, and so excluded the disembodied knowledge, the spatial forms and materials. (Clark and Staunton, 1989: 213.)

Van Wyk's contention during discussion of his definition that technology does not come about by itself but is created should also be circumscribed. The discovered – not created - mathematical fact or algorithm, when applied to problem solving, becomes part of an artefact or repository. Its discovery will however have required human action – which added value.

Smith (1990: 156) states that technology can be formally viewed as the collection of knowledge underlying abstract or material tools with which natural capabilities are enhanced.

This description seems encompassing at first glance but it seems to imply that technology is abstract and it does not specifically include the technology that is part of, or is contained in, the material tools mentioned. An iterative process in the creation of the tools is not addressed.

Other views close to Smith's have been proposed:

> The word 'technology' is often used as a synonym for a 'technological artifact'. However, technology is the 'systematic application of knowledge to practical tasks' (as defined in the Oxford Advanced Learners Dictionary). As such it is a systems concept which covers the function, process and structure of human behaviour during actions of intent ..... Seen within the context of a *systems concept*, it is clear that there are close interrelations between the technological environment of an organisation and the other facets of

> the organisation's operating environment. (Institute for Futures Research, 1994: 3 – 4.)

There is confusion regarding the relationship between technology and arte(i)fact. Simplistically stated, one school of thought views artefacts as technology and *vice versa*, another views artefacts as repositories of technology, yet another defines technology without reference to artefacts as a carrier.

Metcalfe and Boden prefer to follow a dualistic approach, distinguishing technology as knowledge from technology as artefact. They do not focus on selection of artefacts but on selection of performance characteristics embodied in artefacts. Regarding the latter they say:

> The artefact dimensions of technology relate directly to the idea of technology as a transformation process in which energy and materials in one form are translated to energy and materials in different forms of a higher economic value. (1992: 56–58.)

In parallel, they see technology as knowledge which they describe as the concepts, theories and actions enabling a transformation process. "This knowledge is necessarily contained in the minds of individuals …..". They argue that it is here that the link between technology and the science knowledge data base is found, as well as distinctions between different kinds of technological knowledge.

It transpires that technology consists of both the concrete and the abstract which are used in combination in a useful systems context. Thus metallurgical knowledge turns into metallurgical technology which becomes part of a hardened screw driver which is used as artefact without conscious consideration of its hardened point by applying muscles via an algorithm.

It would be completely unrealistic to expect all South African manufacturing companies to have considered technology as deeply as the learned scholars referred to above. It was however necessary to strive to establish a common understanding of the meaning of technology for purposes of the survey. The following practical definition of technology was therefore used to orientate respondents. Because it is inclusive rather than exclusive some specific exclusions were likewise shared with respondents:

Technology is regarded as the knowledge, concretely or abstractly embodied,

underlying machinery, equipment and processes severally and jointly and by means of which productive systems, products or services are constructed, operated, manufactured and supplied, as well as used, for economic benefit.

Excluded are

- **fruits of the mind or intellect such as works of fine art, music, poems and the like because of their aesthetic rather than industrial character,**
- **fine arts such as music, literature and paintwork except in so far as they may be employed for commercial purposes such as image building and the advertising of other goods or services and**
- **scientific knowledge whether known or still undiscovered if at least potential or dormant added value has not been added to it, through human intervention.**

2.2 Technology trading by an industrial company

2.2.1 Definition of licensing

To sell something usually means relinquishing and transferring ownership thereof in exchange for remuneration of some kind. It is obvious that the seller must have ownership before the sale while the buyer has ownership following the sale. Technology can be "sold" outright in this manner. It is even possible to sell technology many times over, as in the student-teacher relationship or the artisan selling his services. The latter two transaction types are excluded from further discussion.

To license means to grant leave or permission: "Licence *n*. 1. Leave, permission; …."(The New Oxford Illustrated Dictionary". 1976). To be able to grant permission means that the grantor must have some authoritative position from which the permission is being granted. In the case of technology the authority mostly subsists in ownership of some kind but can alternatively and perhaps as well, subsist in some derived authority such as a usufruct but mostly a licensed right. In the latter case the terms "sub-licence"(noun) and "sub-license" (verb) arise. The owner of technology becomes a licensor when permission to employ its technology in some way is granted to another who becomes the licensee: the licensor licenses the licensee. Similarly the licensee could grant a sub-licence: the licensee then sub-licenses a further licensee who becomes a sub-licensee.

A technology licence therefore is in the first place the grant of permission by an owner or proprietor of technology to another to use the owner's proprietary technology. Even more synoptic, a licence is a right-to-use granted by the proprietor of technology. Ownership is not transferred. Secondly it can be permission granted by a licensee to a further licensee – a sub-licensee. It is abstract and it and the other facts surrounding the licensing transaction form the licence agreement which is usually recorded in writing.

Numerous refinements elaborating on the above definition are possible. These are basically intended to define the scope, technically, commercially and in time and the cost of the right(s) granted.

In return for the right to use, remuneration of some kind is agreed upon, including lump sums upon conclusion or later during the validity of agreements, deferred payment or payment in instalments of lump sums and so-called royalties which usually become payable in proportion to the use taking place.

Remuneration could even partially or fully take the form of a licence regarding some other technology in return. In such cases, involving two or more parties, the concept of cross-licensing arises.

Technology licensing should not be confused with licensing by authorities such as national or local governments although common elements do exist.

Although reference is frequently made to the "selling" of licences such a concept is irreconcilable with the above framework and in fact is nonsensical because at least two parties - the licensor and the licensee - are involved in a resultant relationship over time in any one licence. Licences could be offered but not sold. Licences can of course be "sold" in the sense that an existing party to a licence transfers all the granted rights to a third party which takes the selling licensee’s or licensor’s place. Technically the conferred rights rather than the licence are sold.

Similarly, reference is made to the selling of technology when licensing is meant. This is also technically incorrect but acceptable in the practical world where the technology or rights to parts thereof are being offered to other parties.

2.2.2 Positioning the technology trading function

A technology licensing practitioner in 1970 argued that licensing had traditionally been cast in a legalistic sense and that such a bias on its true function should be avoided. (King, 1970.) The business and technical functions of business also need representation. This contrasts with as well as complements the suggestion of Ford and Ryan in the quotation in Chapter 1, p1 that the *marketing* of technology should be seen and treated as special. King suggested that thinking about licensing in many cases focused on the patents, contracts and fees which are merely the end result of a long chain of events. He called upon practitioners to adopt the systems engineering approach which he defined for the purpose of his discussion as an examination of all the forces that influence a problem or goal. He mentioned as examples that these forces could be basic needs, economic, political, ethnic, business, technical and scientific, legal and ultimate usage. He made the point that annual license-out revenue of $3 million, taken as 5% profit after tax in an operating company could be seen as involving $60 million of sales, many employees and a capital investment of $20 million at 15% return – a sizable concern or substantial profit centre.

His approach together with that of Ford and Ryan is worthy of support and indeed both represent but a small step in the right direction. The in- and out-licensing and selling of technology by industrial companies, *i.e.* the trading of technology as defined in 2.1 above, deserves pertinent attention and it clearly has multiple management aspects involving extensive interconnections to the other functions and the various disciplines within the organisation and the world outside it. Although it can be viewed morphologically as an entity it cannot function independently of the company because its *raison d'etre* is the attainment of integrated goals set by the company as a whole, while it is dependent on the company in its many facets. Because its function has technology in its various forms as core it can readily be classified as an element of the management of technology (MOT). Further, because MOT in industrial companies ultimately serves, through a technology strategy, to define and attain the business goals of the companies MOT in turn is an element of the technology strategy; which is an element of business management which involves the business environment and the firm as such.

MOT is an intricate and wide-ranging field of study and studies have resulted in taxonomies of characteristics of MOT from the topical, process and functional points of view. From the topical point of view aspects such as technology's dynamics, capability, technological innovation and learning and its environment are relevant. From the process and functional points of view aspects such as its identification, classification, manipulation, development, acquisition, exploitation, inbound or outbound transfer and influence between it and its environment are relevant. Figure 1 provides a simple elemental perspective of technology being managed and to some extent functioning within its environment and indicates therein the position of acquisition and disposition or exploitation of technology; and thus implicitly the sub-set technology trading or licensing and selling.

MOT is an element of an industrial company's technology strategy, influencing it and being influenced by it. No company can develop a technology strategy and thus plan the acquisition or the disposition of technology in isolation. All companies are part of the greater world and subject to influences from many directions and at many levels. Whether they are always aware of it or not, the macro environment with its diversity of structural and dynamic characteristics as well as the micro environment in which transactions are effected will

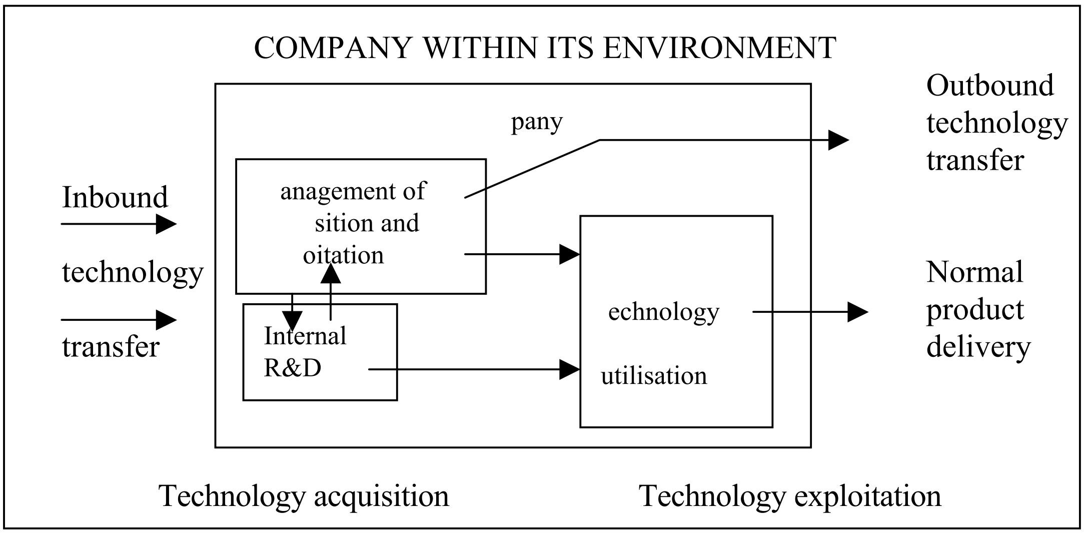


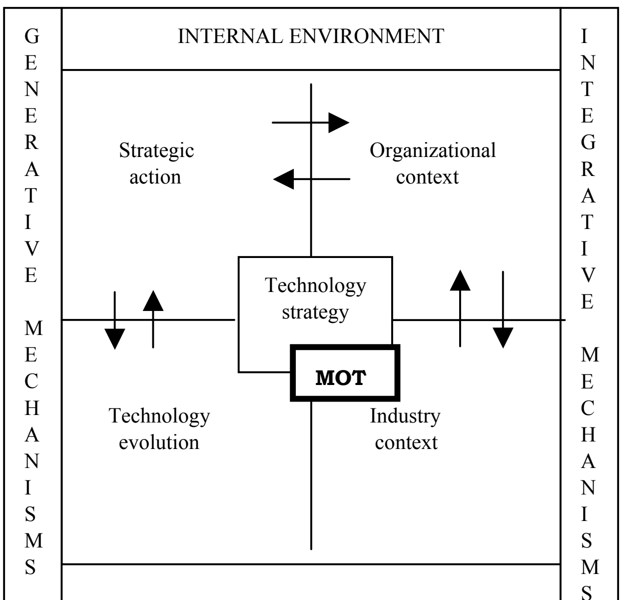
Figure 1. The elements of management of technology.
(Adapted from class notes: TLB882. University of Pretoria. 1998)

impinge directly or peripherally upon all of the company's structures, resources and plans including the seemingly simple sub-processes of structuring and organising for licensing and selling technology. Companies should be pro-active and ideally strive to be aware of these characteristics, allow for them and factor them into their overall competitive and technology strategies and licensing planning.

……………………………………………………………………………………………….

A convenient framework is available to conceptualise the internal and external evolutionary factors shaping technology strategy alone. This is presented in Figure 2. The MOT sketched in Figure 1 can be visualised as a resultant sub-set of the centrally positioned Technology strategy and has been added to the original framework.

The evolutionary factors include accounting, market and marketing, financial, legal, social, ethical, technological, emotional, hierarchical, ethnic and political factors and the organisation itself as well as various people. Not only the present is involved. The future is particularly involved and this will require forecasting which is itself problematic. Local and global views have to be taken. Some of the challenges facing companies can perhaps be appreciated better if some of the questions raised during the developmental phase of technology are considered. For example: What should its characteristics be? For whom is it? What skills do the users have? Maintenance requirements? Market characteristics? What should it do? Cost? How long should it last? Manual production or automation? Time frames? Totally self-made or partially bought out? Environmentally friendly? Packaging attractive? Disposability? Requirements imposed by statutes, government regulations, treaties and international standards organisations? Patents? Return on investment? Money back period? What will the trade union(s) say? What is the competition doing and planning?



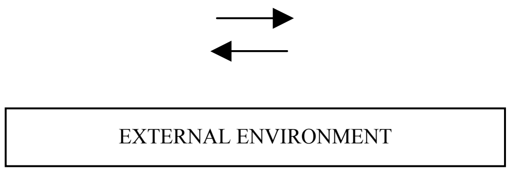


Figure 2. Determinants of technology strategy.
(Burgelman, Maidique, Wheelright, 1996: 39)

South Africa is arguably in a special situation requiring even more attention to the evolutionary factors which may be new to it in some respects. It has resumed its position as a fully-fledged member of the world as a result of the political changes since 1994 and has made great progress towards a true open economy in an era of ever greater globalisation in general. This means that new markets are potentially available but it means equally well that South Africa as a market, at various systems levels, has opened up to foreign companies including some fierce competitors. Conditions within South Africa have certainly changed and new playing fields and contestants have been added while others have changed.

Moving from a company's technology strategy to its complete competitive strategy the intricacies surrounding a technology strategy are compounded. A company's competitive strategy can then be visualised as subsuming the complete Figure 2, bringing technology licensing into overall company perspective. Tidd, Bessant and Pavitt (1997: 64-69), while discussing the development of a framework for innovation strategy, list Porter's "five forces" driving industry competition, and quote Porter (p64): "[T]he goal of competitive strategy …. is to find a position in an industry where a company can best defend itself against these competitive forces or can influence them in its favor". They then proceed to demonstrate how technology from potential entrants and substitute products, suppliers and rivals can influence all of the five forces. It becomes clear that the company cannot be isolated from technology of various types from various sources.

They agree that Porter's four generic market strategies influence and are influenced by innovation strategy which can be one of innovation leadership (requiring strong corporate commitment to creativity and risk-taking and close linkages to major sources of new knowledge as well as the needs and responses of customers) or innovation followership (requiring competitor analysis, reverse engineering, cost cutting and learning in manufacturing). Their discussion is graphically summarised in the column on the left in Figure 3.

All the elements mentioned as well as more such as financial resources, will result in a competitive strategy for the company. Adding a technology strategy which explicitly embraces elements such as an intellectual property portfolio and licensing brings greater clarity and brings licensing into proper perspective within the company as a whole. Then it can be seen that interaction among the listed six strategies and the five forces will result in a competitive strategy; and this strategy will govern and often be governed by the company's technology strategy, leading to a second, refined, competitive strategy.

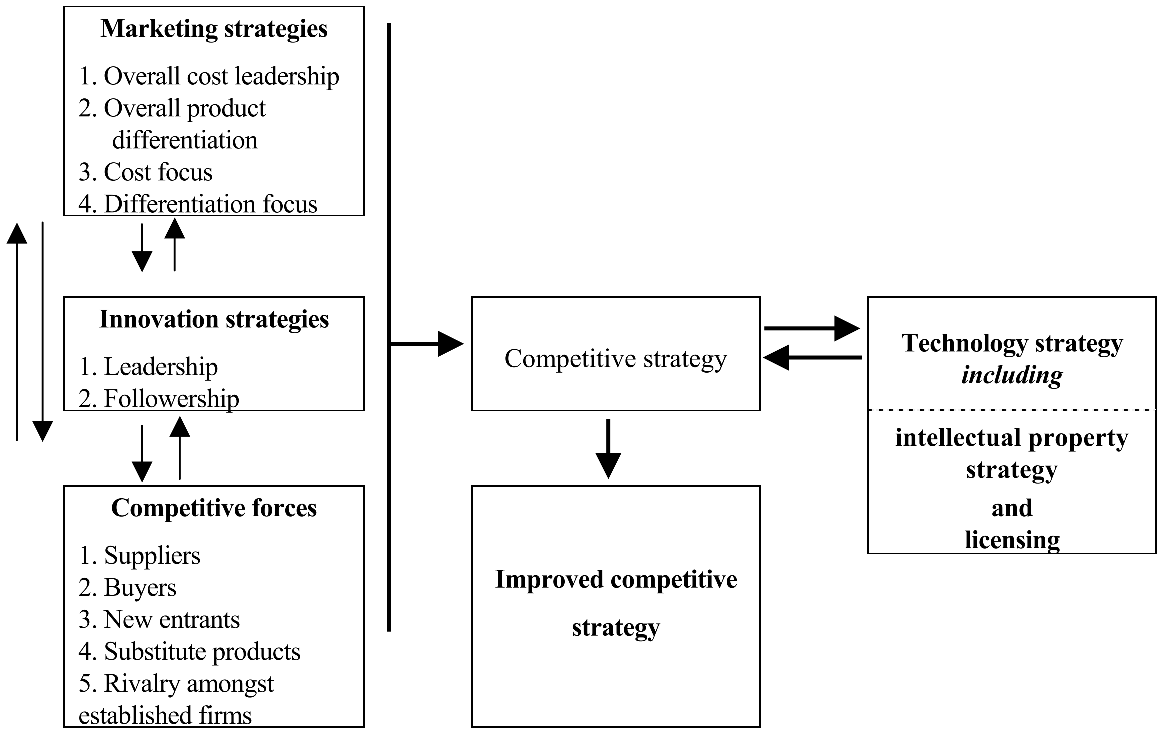


Figure 3. The shaping of technology portfolio strategy.

Whereas the first strategy will revolve around a product including services portfolio, the second will involve a technology portfolio as well - which can and should be treated like a product portfolio albeit of different "products".

The strategies have to account for many factors. A heuristic presentation identifying and grouping some of the factors to be accounted for morphologically and functionally by a technology strategy appears in Figure 4. MOT including licensing is grouped with techno-economic networks (2.3 below) at the centre of the influences and thus not as a factor or influence to be managed but as a tool.

2.3 Techno-economic networks

An agent is necessary to evolve the various strategies and to conduct investigations and connect the various continually varying and adapting factors presented in Figure 4. The concept of techno-economic networks and in particular the dynamics of these networks provide a useful overall paradigm to understand this agent. Callon describes a techno-

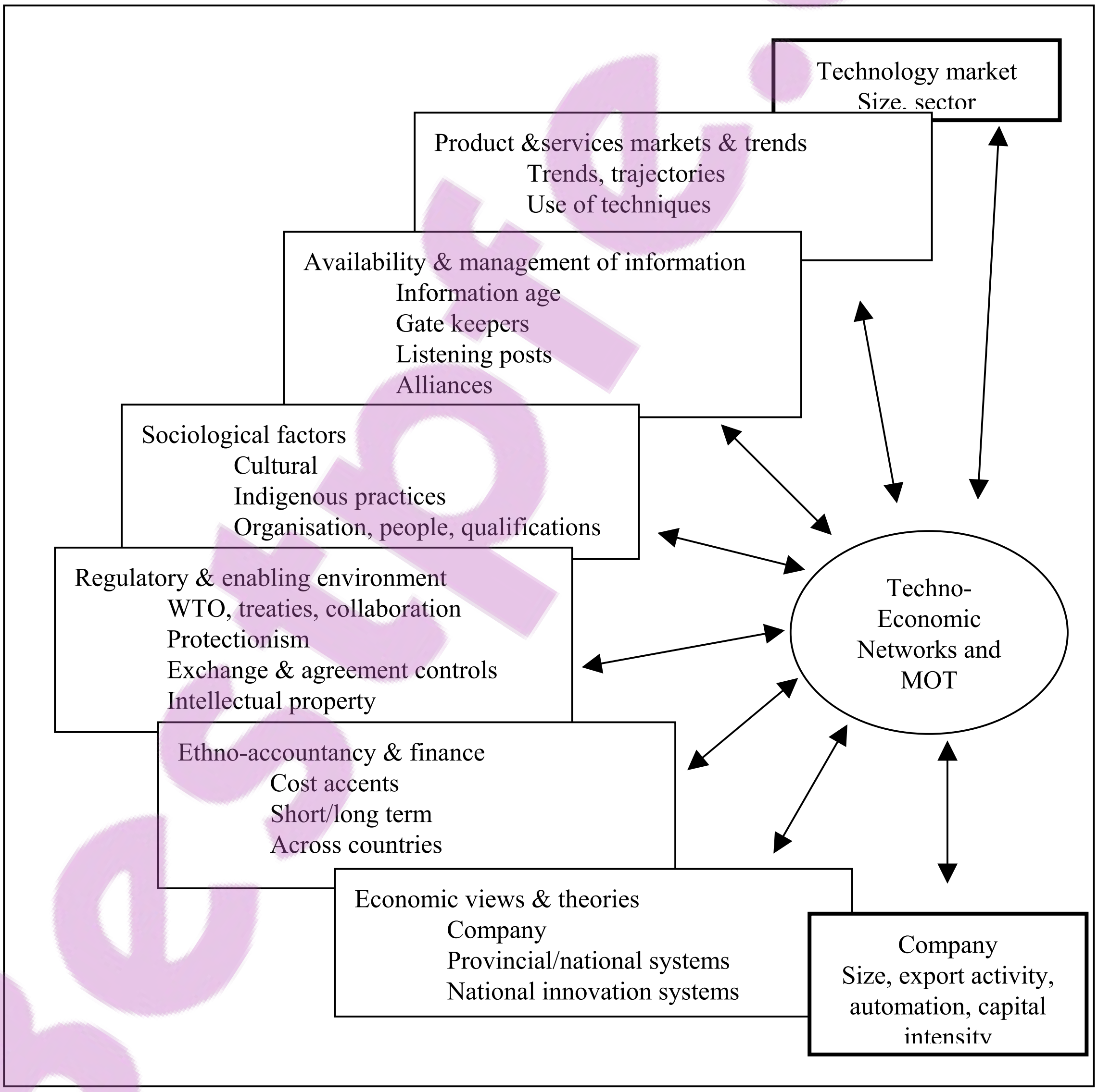


Figure 4. Heuristic presentation of factors a technology licensing company has to consider.

economic network (TEN) as a set of diverse actors such as laboratories, companies, banks, users and the government who participate collectively in the conception, development, production and distribution of products and services. He suggests that TENs are organised around three poles, *viz*. the scientific pole producing empirical knowledge, the technical pole which produces artefacts to fulfill specific purposes and the market pole which produces needs and tries to satisfy them. (Callon, 1992: 72–102.)

Although the poles may have seemingly mutually exclusive objectives their activities are nevertheless brought into relation by so-called intermediaries who both describe and compose or give form to the TEN. They include texts of various kinds on various media, technical artefacts or hardware, human beings and their skills and money in all its forms.
A TEN for an industrial company can be visualised and begins to form when three actors are aligned by interposed intermediaries. Its ultimate effect could be constructive or destructive following the synthesis of some common view. A TEN could expand or shrink and various TENs could link in various ways to form new ones. TENs can form and exist within individual companies and between separate companies, even internationally.

Survey objectives. (Results are presented in 8.3.)

The concept of a TEN was proposed as a valid construct. It is clear that a TEN will manifest through activities and results and not as a permanent person or persons or a body. Its existence therefore has to be established through indirect measurement. It was posited that the existence of a licensing TEN or TENs will manifest through the indicants awareness of competitors' successes, competitors' failures and competitors' licensing activities and the aggregate of these; top management's liking of licensing; international experience and travel abroad and the aggregate of these; and the maximisation of technology capabilities amongst disciplines, amongst functions and business units and the aggregate of these. It was further notionally proposed that there will be positive correlation between these indicants and licensing activity. The indicants represented aspects that offered acceptable content validity because they could reasonably be expected to be understood by a diversity of respondents as well as reliability because the questionnaire response menu was to be limited.

2.4 Innovation

What are innovative activities within industrial companies?

> Innovation, *n*. The action of innovating; the introduction of novelties; the alteration of what is established by the introduction of new elements or forms. (The Oxford English Dictionary. Second edition 1989.)

> Rapid and turbulent technological change gives considerable advantages to those firms most capable of dealing with novelty. (Dodgson, 1992: 136.)

It is clear that Dodgson is referring to dealing with the effects of innovation. Dodgson may imply but does not say expressly that firms should deal with the effects of innovation in an innovative manner. In a way this is so obvious and so hidden in definitions of innovation, including that of the Oxford English Dictionary, that it rarely receives proper attention. Consequently, it is neglected. But it is equally a purpose to explore innovative management of, including trading with, such technology.

The term innovation stems from the Latin "novus" which means "new". Hence the inclusion of the term "novelties" which includes the term "novel" in the above. Newness is non-negotiable in any definition of innovation. The structure of a definition should therefore rather be of the form: "Innovation is the making new of <something>." The term technological innovation is analogously perhaps placed in better perspective when it is amended to technology innovation thus clearly referring to the making new of technology.

> We consider innovation to be the rearrangement in novel ways of technical, scientific and organizational elements. The degree to which each of these elements plays a role depends on three variables: the type of technology, the type and size of the organization, and the firm's place in its own industry and the characteristics of the market. (Vergragt, 1992: 231.)

This provides a practical basis for a definition. Two aspects need accentuation. First, it must be clearly read that “organizational elements” are also subject to rearrangement in novel ways; and continuously so. A reader may easily and erroneously focus on the terms "technical" and "scientific" and see the organisational elements as merely or mundanely serving the "technical" and "scientific". The fact is that, analogous to the case with technology which is both an object and can be applied to itself, innovation should be managed innovatively. Vergragt confirms this when he includes the type and size of the organisation, its place in its own industry and the characteristics of the market, thus placing the organisation firmly back in and exposing it to the influences of the complete world. Clark and Staunton (1989) add a cautionary and confirmatory note when they say that many studies have imposed an objectification on innovations so that innovation is treated as a "thing" which is detached from its context and its pathways. They say that the plurality of players such as suppliers and users also tend to be ignored. Objectification leads to a limited and flawed understanding. There is a strong tendency to equate innovations with equipment and to neglect the knowledge which is embodied in other dimensions such as raw materials, layouts and standard operating procedures. They contend that too little attention has been given to the role of unembodied knowledges and to the application of the knowledge technology perspective (Ibid: 8). They contend that a strong bias towards innovation has resulted in almost total neglect of the problems of the removal of existing practices so that they can be replaced, or as they say, exnovation. Exnovation may require the closure of plants and production lines, staff reduction, take-overs and outplacement of certain functions (Ibid: 12). Yet another insight comes from their caution that the occurrence of innovation should not be seen as a detour which will be followed by a return to normalcy. It is not a leap ahead of rivals which is followed by stability (Ibid: 10).

Second, the term innovation should be and is usually used to include various activities such as invention, research, development, production engineering and design. It is understood for the purposes of this research that these activities should have something new, capable of commercial application, as end result. This approach would eliminate the results of what is sometimes referred to as exploratory research or research which has as its sole aim the expansion of human knowledge.

Innovation has many aspects which appear in various taxonomies. For example, although Vergragt's definition does not specifically mention it, it must be understood that the newness can be of varying degree. Clark and Staunton (1989: 10, 11) mention five levels of innovation: generic, resulting in new techno-economic paradigms (steam engine); epochal, resulting in sectoral change (automatic gear-change, Plexiglass); altering at firm level (EFTPOS); entrenching which modifies existing methods but proceeds in the same direction; and incremental in which existing inputs are reconfigured to increase output. The newness as such needs for this research not to be novel in the absolute sense but must at least be novel to some industrial company or even a part of such a company.

Various other taxonomies of innovation exist, *e.g.* Abernathy and Clark (1985) classify innovations in terms of their reinforcing or destroying effect - their transience - in one dimension on production systems and their operation and in another dimension on a firm's consumers and its markets. Yet another taxonomy describes innovation on a scale from informal to very formal.

Apart from its being innovative, innovative technology will show one or more of several other characteristics, including existing overtly or covertly, being regarded as or in fact being important or incidental, being clearly defined or not, being confidential or not and being statutorily protectable or in fact protected or not. It will be transferable, to a greater or lesser degree, which may mean easier or with difficulty.

Innovation is pervasive and can occur in the most unexpected places. Industry at large should always be alert. One metaphor visualises technology as having boundaries but a moving front edge. Likewise any particular part or sector of industry or company has its own body of perceived technology. In each case the front edge is of particular importance while the front edges of "other" bodies of technology should also be scrutinised in the quest for opportunity and to avert threats. It is at the front edge and at the nexus of different front edges - indeed often from different industrial sectors - that technological innovation exists and comes about. Thus, *e.g.*, the transistor has largely displaced the electronic valve, the personal computer has largely displaced mainframes, long range passenger aircraft largely replaced other modes of long distance transport, voice recognition technology may render the computer keyboard redundant, cell phone technology seems to offer lucrative opportunities, the video telephone may make inroads into long distance transport.

Innovative technology will be created and will exist inside as well as outside a particular company. Because of its intrinsic and perceived characteristics, it will be valuable to its current owner and practitioner and may be marketable to others, that is, be a candidate for selling or licensing.

The following practical definition was used to orientate respondents:

Innovation is the ongoing as well as recently completed rearrangement in novel ways of technical and scientific as well as organisational elements for economic benefit.

Survey objectives. (Results are presented in 8.8.)

The concept of innovation is widely acknowledged as a valid construct. Because multiple factors contribute to innovative activities it would be futile simply to ask directly how innovative a company is. Innovation levels cannot be measured by a one-dimensional parameter such as number of patent applications filed in a given period. Multiple aspects contribute to innovative activities and thus innovation levels. For example, number of patent applications filed could be viewed as one result of innovation levels.

It was posited that the existence and strength of innovation will manifest through the indicants use of various governmental funds for technology development; international co-development and countertrade or offset activities; aspiration to become an own brand manufacturer; and encouragement of innovative activities in products and processes, production, logistics and management. It was further notionally proposed that there will be positive correlation between these indicants and licensing activity. The indicants probe activities which go beyond routine production while offering acceptable content validity because they could reasonably be expected to be understood by a diversity of respondents as well as reliability because the questionnaire response menu was to be limited.

3. TECHNOLOGY MIGRATION AND TRADE

In this chapter it is confirmed that technology is valuable; that its migration cannot be stopped and should rather be managed; that learning determines transfer; and that appropriability can be crucial.

3.1 Technology is valuable

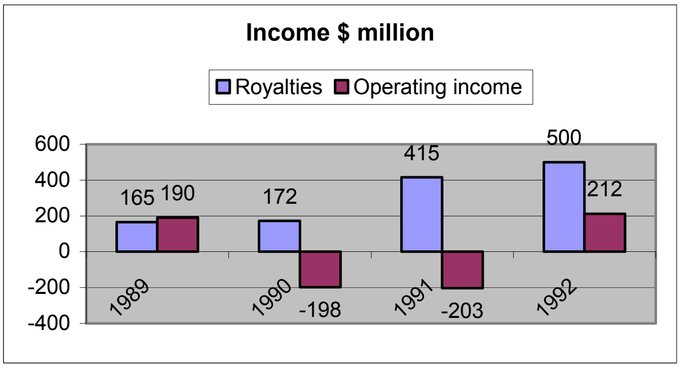
The value of technology in its encompassing sense has long been acknowledged and is demonstrated by the fact that technology is traded in various forms including product-, process- or person-embodied and by licensing. It is generally accepted that technology is at least one of the major drivers of economic prosperity, if not the dominant one. Without technology a company may find itself gutted. Former technology leader AECI's competitive abilities were eroded severely by the loss of its research facility when shareholder ICI withdrew in 1992 and moved its international research interests to Canada, running down those of AECI. AECI had a licence on explosives from ICI but would now lose the ability to develop new generation explosives, lacking other technology partners. It was hoped that technology synergies with Sasol would put Sasol in a good position to restructure AECI. (Pretoria News, Business Report, 24 September 1998, p3.)

Four days later the Competition Board refused to allow Sasol to take over AECI's explosives and fertiliser business and AECI's share price immediately dropped by 42% from R23-95 while Sasol's share price increased by 7½%. The value placed by the stock market on even the promise of new technology is clearly demonstrated.

Not only competitive abilities as explosives manufacturer were necessarily lost. The ability to develop an own technology was lost; as was the concomitant possibility to out-license it.

In joint ventures of various kinds technology is often explicitly recognised as an asset contributed by one or more of the parties and appropriately valued. Information technology companies have especially during the first half of 1998 effectively sold their purported knowledge in terms of a share premium when listing on the Johannesburg Securities Exchange. Goodwill, generally vested in well-known brands or trade marks – and also in the Coca Cola concentrate recipe - have commanded huge amounts of money.

Texas Instruments showed what monetary awards are obtainable, following enforcement and subsequent licensing of its master patents for integrated circuits:



Merryll Lynch from Lawrenson, 1992: 340)
Figure 5. Texas Instruments royalty and semiconductor income.

This example is not intended to imply that huge profits are to be made from all licence agreements. Many render small profits and several result in losses. Ford and Ryan argue that a company must plan for the fullest market exploitation of all its technologies to maximise returns on its technology investment. The technology may but need not be incorporated in that company's own products, processes or services. Considering the growth of lower cost Third World producers, companies in the developed world will find it increasingly difficult to exploit their technologies through their own production alone. (Ford and Ryan, 1996: 107.) NEC was reported as planning to expand its traditional use of its patents to defend itself. It would be pro-active and hoped to earn US$375 million per year from licensing its patents. NEC is the biggest patent holder in Japan and the second biggest in the USA, with respectively 38509 and 1966 patents. (Beeld, 4 April 2002, p7.)

Indicative international royalty amounts that could be statistically suspect but give a good idea of volumes and the value of technology traded are presented in Table 1 and can be contrasted to some extent with South Africa's payments of up to R2,5x 10^9 mentioned in the Introduction. It is interesting to note that of the countries listed, all but the developed USA are net importers of technology. At the same time it should be noted that Japan is almost breaking even and is only bettered by the UK.

Country	Royalties earned ($bill.)	Royalties paid ($bill.)	Earned/paid	Year
Japan	3,20	3,40	0,94	1991
USA	19,10	3,99	4,78	1991
Germany	1,70	3,76	0,45	1991
France	1,73	2,60	0,67	1990
UK	2,36	2,47	0,96	1989

* Exchange rate used was $1 = Y115.

Table 1. Royalties paid and received.

(Ishii and Fujino, 1994: 130)

There is more behind Japan's position and to be a net importer is not necessarily not good. In the 1950s Japan entered into 2500 in-licences with the USA and Europe. These contributed crucially to Japan's industrial and economic success. This was similar to the transformation of US industry following substantial purchases of technology from Europe earlier in the 20th century. The countries and economies whose manufacturing industries had shown the greatest strength during the 1980s, Japan and Germany, had been net importers in contrast with the UK. (Lawrenson, 1992: 342.)

3.2 Migration of technology is unstoppable

Not only is technology highly valued. It is actually not possible to stop technology transfer. In stead of trying to do so, it is better to manage the transfer.

> Domestic firms seem able to circumvent restrictions on the export of know-how, while foreign firms can engage in "reverse engineering of products and designs" to circumvent many controls. (Teece, 1981: 95.)

Kim (1997: 221 *et seq.*) shows succinctly how Korea expedited technological learning by acquiring foreign technologies through formal and informal mechanisms and then poses the question whether international firms should and can stop technology transfers to "catching-up" countries - of which South Africa can be argued to be one - to prevent any long term negative effect on themselves. He convincingly sets about answering the question in the negative. Restricting foreign direct investment may jeopardise the global strategy of multinational firms while restricting foreign licences risks shortening the economic life cycle of their technologies and products. Further, if one supplier firm or nation refuses to transfer technology, a sophisticated buyer of technology in catching-up countries can usually turn to an alternative source. Reverse engineering can also be employed or retired foreign experts can be hired as consultants. South Africa's armaments industry for example showed that technology can be obtained even though a comprehensive arms embargo against it was in place.

Attempting to limit transfers by passive supply of *e.g.* capital goods appears also to be self-defeating. Korean firms seem to have learned more from imported capital goods than from other types of technology transfer.

Firms in advanced countries are dependent on original equipment manufacture in catching-up countries to sustain price competitiveness in both domestic and international markets and they cannot stop activities such as observation and reading.

On the supply side, alternative sources of technology are proliferating and the firms that possess it may have to transfer it to expand sales and extend the economic life of their technologies to maximise their return. (See also 3.4, p35: Appropriability.) On the demand side, catching-up firms have developed increasing capabilities to master imported technologies and to undertake research and development to create their own innovations. Only through continual innovation can technology suppliers in advanced countries maintain their position of leadership.

Kim's summary of his discussion from the suppliers' point of view appears in the matrix in Figure 6.

Strategy for suppliers of technology		Absorptive capacity of recipients	
		High	Low
Suppliers willing to transfer technology to recipients through formal mechanisms	Yes	Technology transfer takes place. Both suppliers and recipients gain. (1)	Technology transfer takes place. Suppliers gain but recipients become dependent. (2)
	No	Technology transfer takes place. Suppliers lose but recipients gain. (3)	Technology transfer does not take place. Neither suppliers nor recipients gain. (4)

Figure 6. Technology transfer strategy for suppliers of technology.
(Kim, 1997: 224)

It is in quadrants 1 and 3 that technology suppliers worry about backfiring effects of transfer. But whether they supply or not, catching-up countries will be able to acquire technology.

Suppliers should consider foreign direct investment as well as licensing to extend the economic life of their technologies.

Kim's matrix summary of his equivalent discussion from the recipients' point of view appears in Figure 7. Recipients who invest aggressively in acquiring technology should take care when getting involved in joint ventures and foreign equity participation, to avoid conflicts. (Quadrant 3). Non-aggressive recipients can benefit from such ventures but risks becoming totally dependent on the parent company. (Quadrant 4).

Strategy for recipients of technology			
		Strategy for technological learning	
		Aggressive	Unaggressive
Association with foreign firms	Inde-pen-dent	Slow initial learning but dynamic long-run learning. (1)	Slow learning throughout. (2)
	Joint ven-ture	Rapid initial learning. Conflicts restrict dynamic long-run learning. (3)	Learning at the pace of the parent firm's strategy. Dependancy. (4)

Figure 7. Technology transfer strategy for recipients of technology.
(Kim, 1997: 226)

In 1987 Hyundai's Excel became the best selling import car of the year in the USA. Inspired by the second oil crisis, Hyundai had decided to make a major investment to develop the next generation front engine front wheel drive car (FF) for North America. It approached major car makers such as Volkswagen, Renault and Alfa Romeo for FF technology. These wanted equity and management participation while viewing Hyundai as a local assembly subsidiary for their own FF cars. In the end Mitsubishi licensed engine, transaxle, chassis and emission technology for a 10% equity share in Hyundai. Hyundai reserved the right to import, the right to technology from Mitsubishi's competitors and the right to compete directly in Mitsubishi's own markets. It sourced body styling from Italdesign and constant velocity joint technology from British GKN and Japanese NTN. (Kim: 117.)

During 1985 Hyundai entered into 54 licences: Japan 22 (only half from Mitsubishi), UK 14, US 5, Italy 5, West Germany 3 and 5 others. Hyundai's independence or unstoppability in acquiring technological expertise is abundantly clear. It is also clear that it searched far and wide as an aspiring acquirer.

Kim contends that creative imitation is not only more abundant than innovation but also a much more prevalent and smarter strategy for growth and profit. Licensing could be one way to limit and control competitors' urge to imitate creatively and thus to manage the imitation.

The Hyundai example illustrates that technology acquisition in an ethical manner is and will be advantageous. The intensification and spread of global competition even across sectors are incontrovertible and South Africa, with its newly open economy, cannot expect to escape. To become and remain competitive industrial companies will need ever more complex skills sets, in shorter time spans; while keeping a rein on cost. Few if any firms have or can develop for themselves the multitude of capabilities they will need to compete effectively, including new product and market ideas, access to markets, management and operational disciplines and critical technologies. Most need to complement internal capabilities and to bolster core capabilities. There are various ways to do so, including hiring personnel, joint venturing and forming strategic alliances. They will also need to acquire technology through buying and in-licensing.

It also illustrates the futility of refusing disposition of technology. Technology disposition is and will be desirable. Different companies including South African industrial companies possess various types of technology which are continually augmented and used to advance their own products and services that are of value to their customers as well as to their competitors or would-be competitors. They should guard against erosion.

Although there are many companies that are not technology-trading sensitive, many such as Hyundai are and the sole business of several consists of selling or licensing technology, which they may develop themselves or obtain from inventors and developers. Examples of these non-industrial companies which are specifically excluded from this research are Technifin (Pty) Ltd in South Africa and BTG of the United Kingdom.

3.3 Transfer of technology and learning

Technology trading and licensing is but a part of, or a tool related to, technology transfer.

> Technology transfer …… refers to the application of technology to a new use, or to a new user for

economic gain. (Gee, 1981 as quoted by Agmon and Von Glinow, 1991: 1.)

Again, as is the case with technology and innovation as such, the value added aspect which is included should be noted. Transfer of technology does not take place or is not planned for curiosity's sake.

Agmon and Von Glinow further point out that technology transfer is mostly seen as product-, process- or person-embodied and that emphasis in research and practitioner literature has been on the latter two types. They correctly point out that these types of transfer cannot occur without an overarching organisational framework and if this is added to the first three types the processes of international business and those of technology transfer become virtually inseparable.

A valid admonition is to think things and not words to deal effectively with the application of industrial innovation; or the transfer of technology. The things tend to become obscured by the phrase ‘the transfer of technology” which suggests that “technology” is

> ….some sort of chromosome consommé that can be drawn from the veins of one society and injected into the arteries of another where it will faithfully replicate the skills of the transferor in the activities of the transferee. Worse: by using the one-way verb “transfer” the magic phrase hints that transfusing …..requires only action by the transferor and entails no corresponding effort on the part of the transferee. (Mr Justice Holmes as quoted by Murphy, 1986: 1129.)

Technology transfer is indeed an integral and continuing part of transnational business - as well as domestic business. A firm seeking to transfer, in or out, some comparative advantage it possesses, or hopes to obtain, will have to align the overall effectiveness of its products, people, processes and organisation. It must do this with both the macro and transaction environment in mind. It is clear that the transfer process is only complete when the transferee is applying the technology for economic gain.

A taxonomy of technology transfer could be considered to include the following elements (Aharoni, 1991: 84):

(i) The technology donor or source - could include government, a university, a commercial firm or an individual.

(ii) The recipient - could be as varied as the donor and be at various levels of education or skills.

(iii) The type of technology - could range from a single complete machine sale at the one extreme to at the other extreme transfer in a process of joint development at the preference of the recipient with in-between various degrees of intensity involving amongst others technical data, drawings, patents, trade marks, copyright, visits and lectures. It could be classified as civilian, or military or dual purpose.

(iv) The technology life-cycle stage.

(v) The channels of transfer - could include foreign direct investment, joint ventures which could stand alone, turn-key projects, licence agreements including cross-licensing, co-production, marketing agreements and training.

(vi) The cost of transfer.

Technology transfer is a complex process and it is doubtful that any two transactions will ever be the same, although common characteristics will be identifiable. From a global perspective Simon (1991: 7) identifies five generic transfer categories:

(i) The international and domestic technology market which is made up of independent buyers and suppliers.

(ii) Intrafirm transfer involving joint ventures or subsidiaries.

(iii) Government-directed agreements or exchanges involving public or private actors.

(iv) Education, training and conferences.

(v) Pirating or reverse engineering at the expense of the proprietary rights of the owner of the technology.

Technology transfer, also through licensing, implies collaboration between at least the provider and the recipient, one important objective being to convey information. For this to be successful learning has to take place. A systematic effort is required to reduce organisational obstacles to learning, to prevent this strategic priority being buried under the daily operational pressures. The objective could be seen to be the prevention of loss of control over the technological domain of each of the companies which may be involved, which may even lead to the loss of the company. (Pucik (1991: 128, 135.) See also Figure 12 at 4.3.2, p55 which indicates the position of learning schematically.

Some reasons impeding learning in competitive collaboration, which were identified from Western joint ventures with Japan and others, appear in Figure 8. Their classification and nature clearly show that they have their roots in strategic planning or in other words, that they originate from the higher hierarchical levels of a company.

Pucik provides valuable insights in his discussion of them but it is clear even from the listing that encompassing and intensive consideration should be given as part of competitive and technology strategy to the challenge of attaining effective learning in the technology transfer, and thus licensing, process.

Functional areas	**Principal barriers**
Strategic planning	[1] Short term and static planning horizon [2] No appreciation of incremental learning [3] Strategic intent not communicated [4] Low priority of learning activities [5] Fragmentation of the learning process
Human resource planning	[6] Lack of involvement of the human resource function [7] Insufficient lead-time for staffing decisions [8] Resource-poor human resource strategy [9] Surrendering control over the human resource function [10] Staffing dependence on the partner
Management development	[11] Low quality of staff assigned to the alliance [12] Lack of cross-cultural competence [13] Unidirectional personnel transfer [14] Career structure not conducive to learning [15] Poor climate for transfer of knowledge
Control systems	[16] Responsibility for learning not clear [17] Short-term performance measures [18] Limited incentives for learning [19] Tolerance of learning barriers [20] Rewards not tied to global strategy

Figure 8. Barriers to organisational learning in strategic alliances
(Pucik, 1991 : 128)

Survey objectives. (Results are presented in 8.9.)

While several elements such as agreements and intellectual property are required in the transfer process, it was proposed that learning by licensees is dominant. Such learning was therefore to be profiled and characteristics proposed were planning horizon, communication, priority, involvement of Human Resources, process of staffing assignments, quality of team members, exercise of control, dependence on partner, cross-cultural competence, cross-disciplinary competence, career structure plan, responsibility for learning, performance measures, rewards and tolerance of learning barriers.

3.4 Appropriability

Any company showing or having technological leadership at any moment in time cannot be certain that it will reap the economic benefits of that leadership and certainly will not do so automatically. Well-documented examples of losses are the large-scale De Havilland Comet system which lost to Boeing and the consumer durable BETA video recorder from Sony which lost to JVC/Matsushita's VHS design. On the other hand, a company like Pilkington capitalised on its float glass process and Microsoft can be said to have been built around the DOS source code.

> The aim of this article is to explain why a fast second or even a slow third might outperform the innovator. The message is particularly pertinent to those science- and engineering-driven companies that harbour the mistaken illusion that developing new products which meet consumer needs will ensure fabulous success. It may possibly do so for the product, but not for the innovator. (Teece, 1996: 232.)

Teece develops his explanatory theory around three main themes, *viz*. appropriability, dominant design and complementary assets.

The term "appropriability" can refer to two closely intertwined aspects, *viz*. the reaping of profits from the exploitation of technology by the owner either through his own use thereof or his licensing or selling thereof, or through the reservation of ownership - which is a pre-requisite for the first aspect. Put differently: it can refer to the reaping of profits through pro-active application or through preventing others from applying the technology; both cases based on reserved ownership.

Ownership can be reserved by making use of legal instruments or the inherent characteristics of the technology. Teece presents a simple taxonomy of legal instruments which has been expanded to some extent to create Table 2 ('Nature of technology' column added).

Legal instruments	Nature of technology
[Petty] Patents	Product
Copyright	Process
Trade secrets	Tacit
[Trade marks/names]	Codified
[Designs]	

Table 2. Appropriability regime: key dimensions
(Teece, 1996: 233)

Each method of appropriation is characterised by various advantages and disadvantages, again depending on the technology as such, as well as on the intended application. They are not mutually exclusive. The protection can also be placed in one of two classes: one that can and one that cannot invoke statutory protection. The first class would comprise patents and petty patents, registered designs of both the functional and aesthetic types, trade marks and copyright. The technology in the second class is generally known as "know-how" and may include trade secrets.

The would-be protectee has to take steps to reserve ownership. Except for copyright which vests automatically, technology is not automatically statutorily protected. Official steps are required to obtain official legal protection through patenting, and trade mark and design registration. In general, application has to be made in prescribed manner to a government institution in each country in which protection is desired, to obtain a limited monopoly which is enforceable through civil proceedings at the initiative of the protectee or often, its exclusive licensee. Many arguments have been conducted and will be conducted concerning the value or not of the available instruments. Even a single instrument such as a patent is not equally enforceable but dependent on many factors including the underlying technology, the specification drafting process, the law in a particular country and the will and means to enforce.

Action is likewise required to keep secret knowledge secret, at least for limited durations and to build a specific tacit knowledge. This kind of knowledge could include the know-how of a tradesman. The tradesman sells his time and with it the know-how or a part thereof by doing a job for remuneration. Process technology could also nominally be in the public domain but still be sold in a "show-how" transaction. This kind of transaction underlies the teacher – student relationship. The knowledge could also factually be secret or confidential to the would-be offeror as chemical process technologies often are. Even if the constituents in an end product could be identified it would not necessarily be apparent how they came together. But also seemingly very simple technologies could be involved:

> It is pathetic to watch the endless efforts - equipped with microscopy and chemistry, with mathematics and electronics - to reproduce a single violin of the kind the half literate Stradivarius turned out as a matter of routine more than 200 years ago. (Polanyi as quoted by Teece, 1981: 86.)

A first goal of reservation of ownership is to be in a position to influence and steer the evolution of the dominant design, that is to say be in control during the pre-paradigmatic phase and ideally, to be in sole position to supply or have the market supplied once the paradigmatic phase is reached or the dominant design emerges. Thus, simply, reserve for own use or for trading, with the realisation that without actual or deemed appropriation technology as such will not be tradeable for profit. The would-be seller or licensor of technology must be in a position to offer value which must be wanted by the buyer or licensee to render a mutually acceptable agreement feasible. Implicitly the licensee must perceive that the subject technology has economic value and that the offeror has some ownership or licensed rights to it. Appropriation and the perception thereof is a pre-condition to all these actions.

A second goal of appropriation is to manage the delivery of the dominant design, that is evolution around complementary assets. Almost always, the innovative technology cannot be exploited without the use of other capabilities or assets including manufacturing, marketing and support capabilities. Teece defines complementary assets in four classes. Generic assets are general purpose and need not be tailored to the innovation in question. Specialised assets are those where there is unilateral dependence between innovation and complementary asset. In one class the asset is dependent on the innovation (coking coal is used in steelmaking) and in the other the innovation is dependent on the asset (software requires a processor). Co-specialised assets are those where bilateral dependence exists, such as between containers and their specialised handling equipment and the Wankel rotary engine and its repair facilities.

Teece correctly argues that as the leading design or designs are revealed by the market, islands of specialised capital will begin to appear in industry. Especially if the core technology is easy to imitate, specialised and co-specialised assets, which likely involve irreversible investments, become increasingly important as competition increases. So, for example, personal computer manufacturers are competing for a very important specialised asset, *viz*. shelf space.

Amongst many other forms of contracting and alliance and strategic partnering, technology trading and thus licensing, built on appropriability, emerge as important methods to manage complementary assets, be it design or production capacity or distribution or advertising means and methods, or credibility and reputation.

Pilkington licensed its (proprietary in important respects) float glass technology under close control and aggressively continued developing it, thus maintaining a technological lead and effectively tying producers and would-be developers into its capital intensive process. JVC and its parent Matsushita widely and pre-emptively licensed other potential manufacturers and even and especially distributors applying their own brands, thus drawing the industry into using its technology while Matsushita excelled in supplying at low cost. Sony at first refused to rope in others to its design and its initially leading BETA design lost out in what was a vast market. The Comet was perhaps unfortunate in that it suffered metal fatigue leading to a loss of reputation. Its already sunk investment in specialized assets could however not be changed in time to meet Boeing's challenge. IBM ceded control of its personal computer operating system to Microsoft (and of its microprocessor architectures to Intel) who had free reign to use it and make it available to other manufacturers, thus helping it on its way to becoming the *de facto* operating system and allowing a host of clone manufacturers into the market, eroding IBM's position. Microsoft has also very successfully established its Windows operating system as a widely used standard.

The system for the legal protection by statute and otherwise of technology is evolving through the efforts of amongst others the World Intellectual Property Organisation (WIPO) and becoming ever more encompassing and sophisticated. This simplifies matters to some extent in that it brings more global certainty while increasing awareness. However, sophisticated legal systems and requirements in turn require sophisticated interpretation and application. In other cases, the real or technological world can be said to be outrunning the legal world. For example, a most interesting puzzle regarding ownership of the various parts of multimedia to be found on the Internet already exists.

Intensive and extensive global competition is in many cases resulting in huge investments in complementary assets, sometimes with great success and sometimes with disastrous consequences, as transpires from the examples above.

Means of utilising appropriated assets, also to extend control, is discussed in more detail in 4.2, p45 and 4.3, p50 below.

It is clear that South African industrial companies should take cognisance of and plan for the appropriability of core technology as well as complementary assets to be successful in licensing technology.

Survey objectives. (Results are presented in 8.10.)

It was deemed necessary to establish South African manufacturing companies' appropriability awareness in terms of the intensity and spread of use of appropriability instruments and their relevant organisation. Characteristics surveyed included intellectual property (IP) holdings, presence of IP data bases, IP planning, confidentiality agreements, use of lawyers and international use of patent systems.

4. INTELLECTUAL PROPERTY STRATEGY

In this chapter the need for and structuring of an intellectual property portfolio is broached; its possible strategic deployment is outlined; and licensing strategy; and reasons to license or not are discussed.

4.1 Intellectual property portfolio

Preferably underpinning a technology strategy (Figure 3, p19) but in isolation if need be, companies should be aware of and have a policy to govern their intellectual property (IP) or appropriated assets as defined in 3.4, p35 above to at least prevent them falling prey to competitors and to position them for growth. Once IP is given its deserved recognition the possibilities of trading with it will become apparent. Such a policy could be quite informal, depending on size and sophistication of companies but it should encompass the following aspects which will orient a company and position it *vis-à-vis* its actual and potential competitors:

(i) IP is an asset and must be protected to the advantage of the company. The company will therefore take care of, grow and protect its own IP and will enforce its rights when necessary.

(ii) The company will be aware of and take care not to infringe the rights of others.

(iii) Communication within the company and with its suppliers and customers and transfer of information are unavoidable. Awareness, sensitivity and care by each employee handling information form the basis of protection of the company's IP.

(iv) IP will be acquired and sold or licensed as part of company strategy.

Notably, IP is recognised as an *asset* that albeit immaterial, confers the advantages of assets and the concept of tradeability is pertinently attached to it, the *rights of others* are recognised and the company is *alerted*. No distinction is made between statutory and non-statutory IP.

The process of developing an IP portfolio begins with identifying a company's valuable intangible assets and developing an IP portfolio strategy that dovetails with business goals. Identification and awareness of these assets will focus attention on their value and will in the first place raise questions about protecting them.

How does a company protect itself against the dangerous possibility that a single employee can walk out of the company's premises with very valuable assets such as blueprints in his pocket or even in his head? Physical protection is not possible. Patenting is an option. When General Electric and Hitachi began using magnetic resonance imaging medical equipment technology invented by Raymond V. Damadian, this founder of Fonar Inc. fought back against his powerhouse competitors with a patent infringement lawsuit. Hitachi settled, but GE decided to take its chances in court. The gamble cost GE dearly and Fonar, at the time a $15 million company, put the damages received toward funding research and development and expanding the company. Patents are not the only kind of intellectual property that can be used to protect IP. When the recent launch of Viagra, the impotence drug from Pfizer, was followed by the introduction of two similarly named products, the company quickly defended its investment in the Viagra name by filing suit for trademark infringement. (Practising USA lawyers Conlin and Schutz, 1998.) Or enforce copyright:

> **Cartoonist in the bucks**
>
> A Paris court yesterday ordered the publisher Dargaud to pay 5,5 million francs (about R6,2 million) in damages to Asterix cartoonist Albert Uderzo, ending a dispute over royalties. (Pretoria News 10 September 1998, p8.)

It can be argued that Chief Executive Officers are not sufficiently or even not at all aware that IP assets such as patents, copyright and trade marks are corporate resources that confer competitive advantage and revenues. Not protecting and managing them can risk or harm revenue and shareholder value. Often responsibility for managing them is given to someone else and then forgotten. It is necessary that the Chief Executive Officer should understand the issues and be able to focus and motivate the management of the IP.

The protection obtainable should not be seen in a defensive role, in the narrow sense of the word. It extends in two directions. It offers defence of technology, market share and a company's position; and importantly, a protected springboard or base enabling action aimed at generating new business as was partially shown at 3.1 above. Managing both options is necessary to prevent IP management sinking to reactive defensive monitoring and prosecution, rather than adding creative initiatives to boost return on investment. Doubtlessly, many companies - often of the kind that can be called middle-tech - which may have none or a few patents or trade marks but still enough IP of the various kinds to assemble a portfolio, miss out on opportunities to use intellectual property to enhance revenues and earnings in various ways including through trading.

For small companies, individual inventors and large companies alike, protection of IP assets can be critically important because the patent or trade secret may represent a primary asset. Expropriation of the invention or idea could destroy the company or ruin an inventor's life's work. The Brown v. Shimano case involved the Japanese bicycle components manufacturer Shimano using gear-shifting technology without a licence from the technology's inventor after he attempted to license it to Shimano. The inventor's financial position and even his health were affected, until he vindicated his invention through lengthy litigation.

In the field of non-statutorily protected IP General Motors provided a notable example of enforcing a non-competition agreement when it successfully prosecuted Jose Ignacio Lopez de Arriortua after he left GM with seven of his executives to join Volkswagen - taking many of GM's purchasing secrets with him.

The IP assets portfolio should be constructed strategically and deliberately to lay a firm base for the deployment in many ways including out-licensing and selling of IP. It should involve iterative consideration of at least the following aspects, interactively with those mentioned in 4.2, p45 and 4.3, p50 below:
Does the company know its important technology? And needs?
Why is it, or is it not, protecting its assets through patenting, copyrighting, trademarking and secrecy? Defend? Protect? Trade?
Do the necessary arrangements with suppliers exist to ensure ownership or usage rights?
Are there confidentiality and ownership agreements with employees? With suppliers and customers?
Are there adequate security measures in place so that if an employee leaves with a company secret the company will be able to win a lawsuit? Restraint of trade arrangements?
Does the company conduct right-to-use searches before launching into new projects or business? Is it aware of major actual or potential threats to its IP? Is it informed regarding the competition's IP?
What limitations does it suffer or has it imposed as part of licensing?
Is it on guard when approached by would-be inventors?

Who is responsible for the portfolio?

IP-smart companies, such as Honeywell, Unocal and Fonar annually evaluate their patent portfolios for patents that should be licensed, sold, or otherwise used to produce revenue. Their plans have revenue targets for patent managers to achieve and involve discussions of potential litigation their companies might face during the coming year and how their firms plan to handle them using existing patent portfolios. Their CEOs receive an annual presentation from in-house counsel that discusses how their companies protect trademarks from theft or from becoming generic terms. (Conlin and Schutz ,1998.)

The value of trademarks should not be underrated. The world's five most valuable brands, according to Financial World magazine's sixth yearly rankings in 1997 were Coca Cola, Marlboro, IBM, McDonald's and Disney at values respectively in US$ billion, rounded, of 48, 48, 24, 20 and 17. (Sunday Times survey, October 25, 1998: 24.)

> ….. it is essential for companies to value their brands. The value of intellectual property is as important for effective management decision making as the value of the firm's assets. (Owen Dean, patent attorney, Spoor & Fischer, ibid.)

Awareness will prevent trademarks being used in such a manner as to become the common name for goods, that is, become generic and fall into the public domain. Aspirin, linoleum and escalator are examples. Brand owners will also be more alert to misuse through counterfeiting or parallel importing where non-related products are offered under their trademarks.

Digital Equipment Corporation (DEC) provided an example of organising an IP portfolio. In 1995 it decided to categorise DEC's patent portfolio and related technology for licensing potential. (Drinkwater, 1997: 1-3.) DEC had over 2000 patents and applications at the time. The goals were three-fold:
(i) Identify intellectual property that could be profitably exploited through licensing.
(ii) Create a repository of information to facilitate responses to licence inquiries.
(iii) Use DEC's personnel and financial resources efficiently.

The DEC IP database included the following substantive contents:

(i) Technology description.

A simple explanation of the problem solved by the technology.

A simple explanation of how the technology works.

A list of companies and industries that the technology would benefit.

Other technologies owned by the company that are related.

A list of competing technologies.

(ii) Intellectual property.

List of all forms of protection for the technology: patents, copyright, trade secret, trademark..

List of available documents for the technology.

(iii) Proprietary status.

Will the company license the technology?

Is the company using the technology?

Has the technology been licensed to a standards body?

(iv) Licensing status.

Are there currently licensees?

Are there any known companies that might be interested in licensing the technology?

The database included three sets of information:

(i) The above data.

(ii) Specific fields from DEC's law department's database (patent prosecution status).

(iii) Information derived from a compact disc produced by the US Patent Office (classification, title, etc.)

The relational capability of the database allowed various searches and sorts.

Survey objectives. (Results are presented in 8.11.)

It was decided to establish the presence and nature of intellectual property (IP) data bases in literal and abstract format by surveying quality of IP data bases and IP planning, research and development with objective to license, and quality of technology strategy and core competence audits. It was also notionally proposed that there will be positive correlation between these indicants and licensing activity.

The concept of IP is widely acknowledged as a valid construct. Several indicants are available to measure a company's IP activity. An example would be number of patents. Its reliability as measurement of IP awareness may be problematic if company size is not factored out. Qualitative characteristics mentioned above were therefore proposed as indicants of the existence and intensity of IP awareness. These indicants represent aspects that offer acceptable content validity because they are very simple and can be reasonably expected to be understood by a diversity of respondents or not at all by ignorant respondents. Reliability may be doubtful because of possible central tendency responses.

4.2 Deployment of intellectual property portfolio

IP practice has evolved from what may be seen as simple appropriation of and protection of and by IP to shrewd deployment. An industrial company's IP and rights to IP are valuable and useful assets that can be deployed (i) for straightforward enforcement as illustrated by the Honeywell, Brown vs Shimano, GE, Viagra and other cases mentioned above, (ii) in several strategic and tactical ways to a company's advantage and (iii) in simple licensing of the concomitant monopolistic rights.

The first two deployment classes may or may not involve licensing and selling. In so far as licensing and selling may play an important role, they are discussed in 4.3 below from a licensing and selling point of view. Strategic and tactical deployment are introduced in this section 4.2.

Arguably, most patents are not technology driven and not the result of great new technology. Instead, most patents and certainly trade marks and designs are product driven. That is, when a new product or service is planned, the providers want to inhibit or control competition by legitimate means. Therefore, the providers adopt a strategy to fight the competition that they know will develop. If possible, the strategy includes IP strategies, which in turn include patent strategies, if the providers are so fortunate. The IP including patents are then developed to protect the product or service in the market according to the planned strategy. At the same time any company should bear in mind that its own IP can come under attack.

These attack and defence strategies have even been named and are described in the literature.

(Glazier, 1995) They include inventing around, the picket fence strategy, the toll gate strategy, the submarine strategy, the counter-attack strategy, the stealth counter-attack strategy, the cut your exposure strategy, and the bargaining chip strategy.

Inventing around can be viewed as inventing around everything that went before. Thus, inventing around the competition's patent is just a more focused and immediate application of a broader inventing project. The invent around strategy can follow a company becoming aware of the existence of potentially problematic patents and also is a bona fide response to threats of patent infringement claims by competitors and is one of several strategies including accepting a licence that might be pursued in response to a letter or other notification from patent holders to cease and desist from alleged infringement. Invention around or invention-on-demand with the objective to develop and possibly patent another product that does not infringe the competitor's patent, yet still penetrates the same basic market and customer base, has been well-developed. There are even rules for what has also been called "virtual invention": (i) Eliminate a part. (ii) Do not add parts. (iii) Use a lean design team. (iv) Focus the product. (v) Exploit components with new low prices. (vi) Make old equipment smart. (vii) Exploit new communication devices and services. (viii) Computerise a manual process. (ix) Use new materials. (x) Focus on the software. (xi) Mind the aesthetics. Interestingly, inventing around may underlie leapfrogging in the market.

Another patent strategy is the picket fence strategy. When a competitor has a key fundamental patent, a company may obtain a series of patents that represent small incremental innovations around the core technology. The incremental innovations represent the preferred products in which the core technology may be used commercially. They then become a barrier to the effective use of the technology by the owner of the original technology. The owner of the picket fence then is in a position to force a cross-licence of patents to acquire the core technology for its own use. The picket fence invention strategy is relatively straight forward. It can be facilitated by close contact between the patent team and the marketing and manufacturing divisions regarding the consumer's perceived needs to commercialise the core technology.

The toll gate strategy is another possible invention strategy in response to a competitor's patent. In this approach, the entire body of prior art, not just the competitor's, is reviewed and generally conceptualised to identify the direction in which it is developing. A company then projects the trend to anticipate future developments. Finally, it leapfrogs the current developments to file the first patent application with very broad claims for the next generation of improvements, even if only a vague concept of the best products to implement these improvements exists. Upon its issue this patent can then act as a toll gate to the industry when its actual products develop to that level of advancement.

The toll gate strategy was sometimes combined with the submarine strategy in the USA where, historically, pending patent applications were secret until issue. The traditional submarine strategy involved filing a broad patent application and then keeping it pending, and secret, with a string of claim amendments zeroing in on specific product developments. Once the market and the patent application had developed with specific products, the patent would be allowed to issue, or to surface like a submarine for all to see. A long application process could also result by chance and not by specific intent. The traditional submarine strategy has been changed and largely ruled out by recent amendments to the US patent statute, following the General Agreement on Tariffs and Trade with TRIPs agreements. In amended form it can still be practised under the Patent Co-operation Treaty which leaves uncertainty regarding countries in which protection is or will be sought.

In South Africa filing of a provisional patent application establishes a priority date or date after which others cannot obtain protection of the same subject matter. The contents of the provisional application remain secret until the complete application is laid open for inspection and this can be delayed at the election of the applicant. The submarine can thus remain submerged for a long time before surprising the unwary third party user of the subject technology. Scanning the titles of provisional patent applications in the Patent Journal may help to defend against this situation.

The counter-attack strategy involves attacking a competitor's problem patent. The attack may be based on the fact that patents may have been improperly issued and can be subject to efforts to cancel or restrict them. The first step of this strategy is to find a potentially fatal weakness in a competitor's patent by studying the prior art to determine what practices preceded the patent. Another research step is to study the patent application file to determine if any administrative irregularity occurred.

The stealth counter-attack can be followed in the USA. A cheaper, and perhaps faster, method than action in the federal court, where it is available, is to file a request for re-examination in the US Patent Office requesting that the competitor's patent be limited or cancelled. To do this, a request for re-examination should be filed with the Patent Office citing published references that create a new issue of patentability. The request for re-examination may be filed by a patent attorney. Therefore, any business relationship of the requesting party with the patent holder need not be undermined by the re-examination. A further advantage is that, in contrast to the case with the direct attack, the onus of proof is on the patent applicant and not the requesting party. A risk is that the re-examination may result in a stronger rather than weaker patent.

The cut your exposure strategy involves a company obtaining, for its own product, an outside patent attorney's written opinion of non-infringement of the competitor's patent. Such a written opinion may reduce the liability exposure of an infringer in those instances where patent infringement liability is subsequently found.

The bargaining chip strategy may also be pursued against a troublesome patent of a competitor. This involves developing bargaining chips in the form of a company's own patent portfolio that may be cross-licensed or traded with the competitor for a licence under its patent. One way to initiate this programme is to execute an intellectual property audit. This reviews the existing and planned products and technologies of a company to ascertain what might be patented to create future problems for the competitor.

The smokescreen strategy can be seen as a variation of the picket fence strategy. It involves a patentee filing several patent applications with the objective of making interpretation of what is really protected virtually impossible for would-be users and forcing them to follow the licensing route instead. Monopolies have found this useful to promote self-perpetuation. A variety of patents which they do not intend to use or license keep entry cost and difficulty up. (Gilbert and Newbery, 1982.)

The Nomura Research Institute found that Japanese firms could be divided into four categories in terms of their approach to intellectual property. See Table 3. Murakami and

Nakata conducted a survey of intellectual property managers at 1800 major Japanese firms in all industries, except for financial institutions, in 1992. The survey had a response rate of 26,5% and while Nomura states that the statistical accuracy may be suspect, the results nevertheless are informative.

In the first category firms are described as defending against intellectual property-related attacks from their competitors, thus securing freedom in their technical and product development activities. They have centralised processes for submitting large numbers of patent applications for applied technologies that relate to, or would be used to commercialise a particular invention. This process limits the ability of the original inventor to exert his patent rights. In other words, they practise the picket fence strategy.

Category	**Current (%)**	**Future (%)**
Defensive	60,7	28,7
Monopoly seeking	27,3	35,5
Deterring others	8,4	19,4
Royalty seeking	1,6	14,9
Other or combinations of above	1,9	1,5

Table 3. Japanese firms' present and future patent strategies.
(Murakami and Nakata, 1994: 129)

The second category aims to obtain a monopoly position based on truly novel and creative patents - the original intention behind the patent system and perhaps leading to the toll-gate strategy.

The third category tries to deter others from entering a field by filing patent applications in a specific field as a way to signal that they are very active therein and it would not be worthwhile for others to enter the field. This is a variation of the smoke-screen strategy because it may become difficult for would-be entrants to identify really meaningful patents.

The fourth category of firms selectively publicises patents and seeks to earn royalties. They generally have several so-called sleeping patents that are not applicable in their own operations.

It is quite clear from this sample that Japanese industry was planning to deploy its intellectual property, in the form of patents, much more aggressively.

Sometimes strategies or circumstances may become very entangled:

> Over the past year, such companies as Exxon Chemical, Dow Chemical Co., Hoechst AG, Mobil Chemical, BP Chemicals Ltd., and Mitsui Petrochemicals have retrofitted gas-phase, slurry, and high-pressure reactors to produce such staples as linear low density polyethylene (LLDPE) and polypropylene (PP) via metallocene catalysis. What is drawing polymer producers, and turning rivals into partners is the lure …… The patent situation is another reason why companies are forming joint ventures to exploit metallocene catalysts for licensing. According to Roland Hingmann, a research scientist at BASF, there have been so many unpublished metallocene patents that commercialization is a risk. (Chowdhury, Fouhy and Shanley, 1996.)

Survey objectives. (Results are presented in 8.12.)`

It was decided to establish whether South African manufacturing companies' broad use of IP is to monopolise, deter, earn royalties or to defend if sued.

4.3 Licensing strategy

4.3.1 Licensing is a mainstay of managing technology transfer

An industrial company needs a technology strategy for survival and growth; technology transfer will be an integral part of the strategy; and licensing is one of the transfer methods. Patentees, having been granted an enforceable monopoly right by the state to an invention in return for disclosing the subject invention or technology, license their patents, *i.e.* allow others controlled access to their monopoly. Likewise trade marks, designs and copyright - bestowing enforceable monopoly rights - and secret know-how are licensed. The sale of a book actually constitutes licensed access to its copyright protected contents. Carefully composed and controlled bundles of technology are more and more frequently licensed in what is called franchising. It could be argued that business consultants, when installing systems, are selling franchises. Rights to each other's technology increasingly form explicit parts of strategic alliances.

Licensing can, has been, will be and ought to be an action of choice for a variety of reasons which range from the truly strategic to the tactical and certainly do not involve only quick increases of income or a quick agreement to pay royalties. Knowing what shortages or surpluses of technology exist, remedial or exploitative action by a company should include consideration of the option of licensing which is but one way to use, obtain or to divest technology. Instead of being merely reactive, the possibility to license in or out should *ab initio* form a deliberately integral part of the overall competitive decision framework of industrial companies.

The advantages of licensing would arguably be a function of (i) the characteristics of the technology involved, considering that licenses will rarely be used if the transfer involves a core technology of the licensor rather than a peripheral one; they will be more frequent for old technologies than for newer ones, except if the pace of technological change is sufficiently fast so that the leader can stay ahead even if he cannot stop competitors from copying it; (ii) the size of the firm considering that small firms will tend to use licensing more than larger ones, because they lack the necessary resources for foreign direct investment; (iii) the maturity of the product, considering that licences will be more willingly granted for relatively old products, except if technological feedback or reciprocity looks good even for newer products; (iv) the firm's degree of experience in international operations and risk considerations; comparative pace of response for licensing and foreign direct investment; transaction costs relative to licensing; (v) constraints related to host countries and to countries of origin, such as barriers to entry of foreign direct investors; an opportunity cost of capital which is higher in the host country than in the country of the potential licensor which would be detrimental to licensing since the licensee would thus enjoy a lower value on the flow of rents expected from the technology than would the owner of the technology himself. (Bonin, 1987: 76.) Bonin continues, and quotes Telesio, 1979: OECD 1984:

> Given these advantages, one would expect licensing, and more generally new forms of international investment, to become increasingly important. Besides licensing, the latter would include franchising, management contracts, turnkey operations, co-production agreements, international contracting-out and joint equity ventures in which equity participation would be 50% or less.

Ford (1988) uses the three-fold functional typology of technology acquisition, exploitation and management, also presented in Figure 1, p16 to look at continuing, regular technology strategy development under different positions in which a company may find itself.

He distinguishes four basic methods of acquiring technology and shows their applicability under different circumstances (Figure 9). Thus, licensing-in should definitely be considered where the company has a weaker standing in the technology, there is a high urgency to obtain it, it is relatively mature and it is relatively distinctive (has intrinsic value); and the investment required is low. Note that the technology could be of the high level system type or of the component or even material type.

Acquisition method	Company's relative standing	Urgency of acquisition	Commitment/ investment involved in acquisition	Technology life-cycle position	Categories of technology
Internal R&D	High	Lowest	Highest	Earliest	Most distinctive or critical
Joint venture		Lower		Early	Distinctive or basic
Contracted-out R&D		Low		Early	Distinctive or basic
License-in		**High**	**Lowest**	**Later**	**Distinctive or basic**
Non-acquisition. Buy final product.	Low	High	No commitment/ investment	All stages	External

Figure 9. Factors affecting technology acquisition decisions.
(Ford, 1988 : 91)

Ford also considers four different methods of exploitation of technology (Figure 10). A company should consider granting licences when it has a high standing in the technology, the urgency of exploitation is high, little support technology is necessary, the technology is mature, it is peripheral and has wide application; and little investment is required.

Although Bonin states that relatively old and non-core technology would be licensed more readily he does allow for exceptions. Such technology can be found in Ford's matrix where the licensor has high standing and the urgency of exploitation is high. Analysing the automotive components sector in South Africa in global context Barnes and Kaplinsky (2000) found that effective global sourcing by vehicle assemblers requires component manufacturers with significant design and technological capability. These, with suitable own or arranged production capacity are sought after as and become first tier suppliers to the assemblers. To meet assemblers' stringent quality and delivery requirements these first tier suppliers will arrange manufacture in close proximity to major assembler plants. The authors opine that the restructuring problems facing global components suppliers will turn them to joint venturing and licensing, away from establishing owned subsidiaries. Clearly the latest technology will be involved.

	Company's relative standing	Urgency of exploi-tation	Need for support techno-logies	Commit-ment/invest-ment involved	Technology life-cycle position	Categories of technology	Potential application
Employ in own production or products	Lowest	Lowest	Lowest	Highest	Earliest	Most distinctive or critical	Narrowest
Contracted-out manufacture or marketing	Lower	High	High		Early		Narrow
Joint venture	High	Low	High		Early		Wide
License-out	**High**	**Highest**	**Low**	**Lowest**	**Later**	**Least distinctive or critical; peripheral**	**Widest**

Figure 10. Factors affecting technology exploitation decisions.
(Ford, 1988 : 92)

Ford's typology represents a very valuable heuristic tool but it is clear that the various circumstance factors he lists are not necessarily exhaustive and are subject to tight definition or understanding by would-be users. In real life they probably will not fall into neatly graded groups as his typology may suggest. For example, it is possible that a company will have a high relative standing in a technology as well as high urgency to acquire. This apparent conflict could be due to inexact definition and could be ameliorated by focussing on subsets of the technology presumably suffering it. A high standing in electrical motors does not necessarily imply a high standing in stators.

Entering new business requires strategy also. Roberts and Berry (1985) developed another useful matrix to assist in strategy selection (Figure 11).

Market factors	New unfamiliar	Joint ventures	Venture capital or venture nurturing or educational acquisitions	Venture capital or venture nurturing or educational acquisitions
	New familiar	Internal market developments or acquisitions (or joint venture)	Internal ventures or acquisitions or licensing	Venture capital or venture nurturing or educational acquisitions
	Base	Internal base developments (or acquisition)	Internal product developments or acquisition or licensing	New style joint ventures
		Base	New familiar	New unfamiliar
		Technologies or services embodied in the product		

Figure 11. Optimum entry strategies.
(Roberts and Berry, 1985: 551)

The conditions for simple licensing are clearly discernible from this. In addition, licensing can logically also form a part of any of the other strategies.

4.3.2 Basic function of licensing

Cross-licensing resulted when computer manufacturer Acer responded to a Lucent Technologies lawsuit with a countersuit, alleging that Lucent violated several Acer patents. Acer sought a cross-licensing agreement with Lucent to resolve the costly litigation. The widely reported Digital Equipment (DEC) lawsuit against Intel also involved allegations of infringement by both companies. It ended in an unusual settlement in which Intel and DEC entered into a 10 year patent cross-license agreement and Intel purchased DEC's semiconductor operations. Strategic actions included or resulted in licensing.

Also, licensing and selling *per se* will or should be considered pro-actively in most instances to establish their viability as part of a company's broader competitive strategy (4.2, p45). In this context the use of licensing is contingent on the topic of the formation of domestic or international, small or large, alliances as transpires from 4.2. The formation of these in essence revolves around the dovetailing or assembly of assets that are deemed complementary as part of company structure or company competitive accoutrements. An IP licence on its own may be a simple form of alliance, or it may be a small part of a much greater whole.

Licensing itself is multi-dimensional and can be approached from several different directions depending on the purpose of discussion - *e.g.* why, how and what. Some taxonomies in addition to those offered by Kim (Figures 6 and 7 - p29) and Ford (Figures 9 and 10 – p52) are presented in Figure 12 and Table 4.

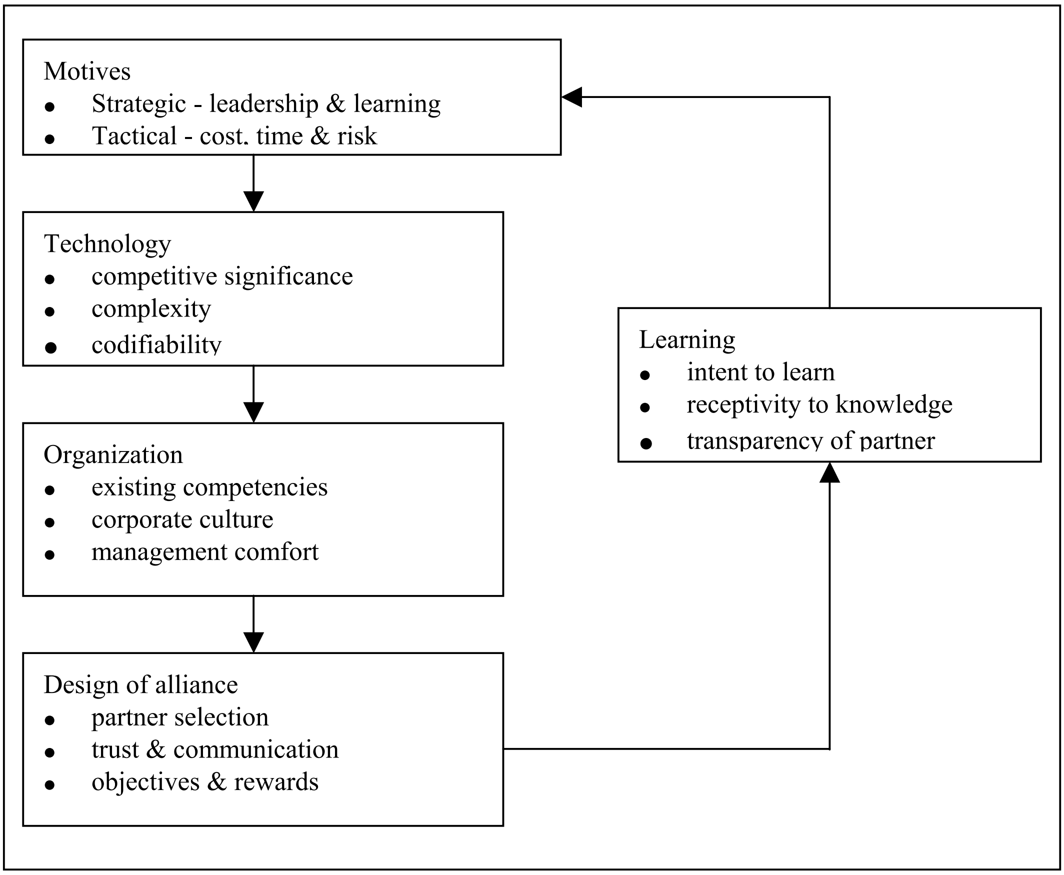


Figure 12. A model for collaboration.

(Tidd *et a*l, 1997: 199)

Tidd *et al* (1997: 198) examine the role of collaboration in the development of new technologies, products and processes and recognising that in any specific case a firm is likely to have multiple motives for an alliance suggest that it may be useful to group the rationale for collaboration into technological, market and organisational motives and do so in the taxonomy appearing in Figure 12. It can be seen that transfer of technology and the managing thereof and thus licensing can assume an important role.

A second taxonomy appearing in Table 4, distinguishing two basic types of licensing, *viz.* vertical in which a company licenses another to use the technology and market the resulting products and horizontal which involves cross-licensing among competitors, is suggested by Barton, Dellenbach and Kuruk (1988).

Vertical licensing		Horizontal licensing
Reasons for: licensor	Reasons for: licensee	Reasons
Size	Size	Industry structure issues, eg. Cost/risk Complexity Time Joint venturing
Cash flow	Cash flow	
Market entry considerations	Risk diversification	
Technological factors	Patent restrictions	
International factors	Technological education	Standardisation questions
Legal factors		Legal issues
		Political issues

Table 4. A vertical/horizontal licensing taxonomy.
(Barton, Dellenbach and Kuruk, 1988)

The generalised and simpler taxonomy presented in Table 5 was deemed more suitable and practical as a starting point for the purposes of this research. Although reasons for and against licensing, which term includes selling as defined in 3.5 above, appear in what may be termed disentangled form it should be borne in mind that a combination of reasons will usually drive any particular transaction. The two taxonomies presented also point to this.

	Reasons for	Reasons against
License out	4.3.4 below.	4.3.6 below.
License in	4.3.5 below.	4.3.7 below.

Table 5. A practical taxonomy for analysing in- and out-licensing.

Furthermore any one reason as listed should always be considered against the simultaneous motivation of the second party to any transaction. It can be expected that an eventual agreement will take the form of some compromise between offeror and offeree. It is equally important whether the licence is independent or forms part of greater collaboration or is vertical or horizontal.

Patents, trademarks, designs, copyright and non-statutory IP are all involved as the subject matter of licensing.

Degnan and Horton conducted a world-wide patent licensing survey in 1997 and analysed companies' involvement in technology transfer and their superordinate reasons. They mailed 2100 patent licensing questionnaires to members of the Licensing Executives Society and received 428 useful responses. Three out of four of the respondents worked in for-profit businesses and the remainder in academia, research or government. Over 70% were from the USA and Canada, 15% from Europe, 3% from Japan and 3% from Australia. Of the for-profit respondents 40% worked for companies with less than $50 million in gross income, 5% for companies grossing between $51 million and $100 million, and 18% for companies grossing between $101 million and $1 billion. Some 17% of the respondents had 5 or fewer technology licensing agreements, 46% between 6 and 50, and 37% had more than 50. Agreements were not necessarily at arms length. They reported their results as shown in Tables 6 and 7.

The authors note that 71% of the respondents licensed both in and out.

Technology transfer type	Respondents involved (%)
Licensing-out	88
Licensing-in	68
Co-development	61
Strategic alliances	58
Joint ventures	54
Cross licensing	40

Table 6. Involvement in technology transfer areas
(Degnan and Horton, 1997: 91)

Patent licensing reason	Respondents involved (%)
Royalty income	61
Developing a business advantage	54
Product profit maximization	44
Increased technical proficiency	32
Defensive	20
Deterring or delaying others	13

Table 7. Reasons for technology licensing
(Ibid: 92)

4.3.3 Some reasons for licensing out

The superordinate reasons appearing above may be dissected to varying degrees.

(i) License out to make use of technology developed for use by the company but which is also useful in a different field; or is not relevant to or the market is too small, or even too big, for the company's operations. The use of the technology could be restricted to that field. This would represent making use of technology that might otherwise not have been used. The risk of direct investment can be eliminated as well.

The objective would be to earn royalties and the technology could also be entrusted to a firm or firms that purchase, market and license patents and other IP that otherwise would decay in a company's possession, to realise revenues that would have been lost, at minimal expense.

Telular Corporation was founded in 1986 to exploit an obscure patent involving connecting wired telephones to cellular systems. Telular had to defend its patents over several years and financed its legal cost by selling rights to pieces of its basic patent. (Samuels, 1994: 62.)

> Many years ago, Sohio, a major energy company in the United States, developed a chemical compound called acrolein. .. no one knew any commercial use. Rather than spend its own money …… Sohio embarked on a program to license its use to others…. And rather than ask ….. royalties … required them to grant back to Sohio the rights in any technology developed by them. (Rein, 1995: 87.)

Acrolein currently is an important raw material for the feed additive DL-methiomine.

Or license the use of the trademark "ZOZO", well-known in South Africa in connection with site and Wendy huts, to be used in connection with gymnasium equipment; or license manufacturers to make "Micky Mouse" coffee mugs.

(ii) License use of the technology in a different place, for example, offshore. An offshore company which may be an independent company, a joint venture or even a subsidiary or parent company may then be licensed. This might represent making use of technology without the need for capital investment while expanding markets geographically. The technology itself could also be used to obtain an equity stake.

The purpose could be to obtain a toe-hold in a new market.

Tacey (1988: 41) expressed the opinion that traditional process industry licence deals, in which a company that does not know how to go about making something, buys this know-how from a company that does, may be going out of fashion. Instead, licensee and licensor, or the licensor's agent in the form of a contractor, are entering into more collaborative deals or forming joint ventures. He referred to both BP and ICI saying that licensing represented a very small part of their total business. But the contractors such as Foster Wheeler, Costain Petrocarbon and John Brown were relying very heavily on selling licensed technology. The MD of John Brown was quoted as saying that that could be the way forward for technology owners. Their technology could be their contribution to a joint venture. This method is certainly widely used as is evident from the quotation at the end of 4.2 (p45) above and is also practised by the South African process industry.

(iii) License out to prevent others including competitors from entering or flooding a market by locking a licensee into the licensed product also through licensed trade mark use or by building sufficient volume to render a market unattractive for third parties. When a concomitant patent expires the licensor's competition in the licensee country would be his selected licensee.

Two classic cases demonstrating the effectiveness of the strategic mixing of licensing with tangible product manufacture are those of Pilkington and Dolby. Following a risky and expensive development programme Pilkington introduced its revolutionary float flat glass process in the 1960s. The licence income was used to good effect to boost manufacturing and for research and development to ensure the future soundness of the company. A small family company grew into an international force.

Dolby worked towards creating a world-wide standard to establish demand for both licences and hardware. Manufacturers were manoeuvred into a position where they had little option but to maintain full compatibility of products by using Dolby techniques. (Lawrenson, 1992: 340.)

A US manufacturer had an excellent line of products but no distribution in Europe. It had no patents to license its specific designs and manufacturing specifications constituted "know-how" which is usually protectable under the laws regarding trade secrecy. A licensing company in the US was able to identify several European stove manufacturers with excess capacity, who ultimately in-licensed the US company's designs throughout Europe. The licensees got the benefit that they did not have to develop new designs. The licensor got the benefit of revenues from a new market and prevented the licensees from becoming own design manufacturers. (Rein, 1995: 87.)

(iv) License out to attain control over a technology or market by saturating it in an effort to establish the dominant design, also through standards setting and licensed trade mark use or by licensing on condition that improvements be granted back by the licensee.

See the Pilkington and Dolby examples under (iii) above. Trade mark licensing could be used to good effect to establish the licensor's mark and hence its standards and lock in the licensee.

(v) License out to avoid anti-trust or monopoly prosecution; win trust of customers.

If Microsoft had initially licensed its Windows source code, it could possibly have avoided being attacked by the government (probably at the instigation of its competitors) and being forced to lay it open.

The artificial sweetener Aspartame was licensed solely to offer potential customers afraid of relying on a monopoly supplier more than one supplier.

(vi) License out to showcase co-operation - the forerunner to greater business. Mutual learning could also be the goal.

(vii) License out to satisfy local "patent working" requirements. This could apply where entry has to be gained into a country with a restrictive IP regime or to avoid trade limitations such as high tariff barriers.

It could apply where the technology has to be adapted to fit the market.

(viii) License out to settle litigation.

See the DEC : Intel 10 year cross-licence example at 4.3.2, p54.

(ix) License out for administrative purposes, such as to sort out a multi-national company's research and development cost or to receive tax friendly income where the licensor could be based in a jurisdiction with attractive reciprocal tax agreements.

4.3.4 Some reasons for licensing in

(i) License in to eliminate cost, time and risk of development. Jump to future technology.

Unable to afford or unwilling to risk the huge development costs of Siemens and Motorola referred to in Chapter 1 and Pilkington (4.3.3, (iii) - p59) a licensee would be able to supply or part-supply lucrative markets without any risky up-front expenditures.

South Africa's Atlas Aircraft Corporation licensed Italian airframe technology to supply a rather restricted market centering on South Africa and its neighbours as well as for strategic reasons.

(ii) License in to access a market quickly and with minimal or no risk. Diversify.

South Africa's Atlantis Diesel Engines started manufacturing German automotive engines under licence. It was provided with complete manufacturing know-how and allowed to use the respected trade mark in exchange for essentially a running royalty.

The licensee could also be the recipient of rights obtained, perhaps under favourable conditions, following local patent working requirements compelling a patentee to license.

Trade mark licensing offers the possibility of supplying already well-known goods or services to a market. During 1996/7 MacDonalds fast foods of the USA was involved in court battles to have the registration of its name by a South African nullified and to have it re-registered in its own name. It forms the core of its franchising package.

The advantages offered by famous trade marks are so great that even the threat of legal action does not deter many concerns from being illegally active on the so-called grey market.

(iii) License in to acknowledge a dominant patent position

The Brown vs Shimano gear-shift case (4.1 – p42) demonstrated the risk to even a fair sized company using patented technology without the permission of the patentee.

Several unpublished metallocene patents resulted in cross-licensing among several large chemical companies (4.2 – p49/50).

(iv) License in to settle litigation (DEC: 4.3.2 – p54).

(v) License in to augment a company's technology stock and to learn.

This strategy as followed by Korean companies is discussed at Figure 15 – p.108.

(vi) License in to show-case co-operation.

4.3.5 Some reasons for not licensing out.

Perhaps the culture is not helpful:

> …. Traditionally, companies have given a low priority to out-licensing. There are a number of reasons for this. The business imperative … is to introduce new products. Outlicensing is seen to divert resources. It gets the lowest priority in legal departments when other deals are being done. It can be seen as failure by R&D departments trying to develop products for the company. And company executives may be concerned they might give away rights the company will need later. (Schafer, 1993: 119.)

(i) Out-licensing may reveal own know-how.

Chemical process technology and even Stradivarius manufacturing techniques can be kept confidential (3.4, p35). A South African research institute proposed the radically cheaper and easier use of chlorine gas in stead of hypochlorite in wool treatment. A patent issued but the technology was practised behind closed factory doors and the patent proved unenforceable. Any one factory could have kept the technology to itself for at least a number of years if the technology were not disclosed through the patent system.

(ii) Out-licensing may lead to loss of close control

(iii) Out-licensing may dilute a company's own market.

A licence may return about 25% of the net income that may accrue to a licensor exploiting its own technology. Assessed opportunity plus transfer cost may be prohibitive.

(iv) Out-licensing may debilitate own R&D.

Market and product feedback from licensees will tend to be less intense, leaving the R&D function isolated. The R&D department may also be demotivated - see quotation above.

(v) Out-licensing may be seen as an administrative burden.

Some companies may decide that the search for licensees and negotiation with licensees, technology transfer activities required and on-going monitoring are non-productive.

4.3.6 Some reasons for not licensing in.

A cursory look at the reasons for granting licences may tend to suggest that licensees could often be difficult to find. Nevertheless licensees have their reasons for taking licenses, some of which are set out in 4.3.4, p61. Some situations requiring a wary licensee can be mentioned.

(i) Build licensor's trademark.

When a licensor demands that licensed goods or services be marketed under its trademark there is a real risk that the licensee may find itself unable to terminate the license agreement without losing the relevant market which can then relatively easily be supplied by the licensor or another licensee.

(ii) Danger of subjugation.

A single licence may lead to a passive licensee attitude and thus loss of licensee capability because the licensor guarantees a working technology. In contrast, when a recipient acquires technologies from various sources and assumes responsibility for integration, it is at risk and the consequent crisis forces learning.

A wise licensee will rather see a single or restricted (field of use or market) licence as too little and may then set in motion suitable plans to overcome the possible hurdle.

(iii) Excessive grant-back.

A licensor may require a licensee to grant even ownership of new technologies developed by the licensee and more or less relevant to the first-licensed technology, to the licensor. This can debilitate a licensee.

Survey objectives. (Results are presented in 8.1 and 8.14.)

It was decided to establish South African manufacturing companies' reasons for licensing and not licensing inwards and outwards (detail in question 11 in the questionnaire – Annexure A), the broad nature of the technology transfer relationship where a licence is involved, size of the other party, extent of technology adaptation required, whether research and development cost is regarded as sunk, whether transfer cost is pertinently charged and whether their Boards are sufficiently knowledgeable in relevant technology.

5. LICENSING MARKET

In this chapter the licensing market is outlined; the role of licence agreements is sketched; the contents of agreements; and sourcing and valuation of technology are discussed.

5.1 Background

In the licensing market can be found technology which shows particular characteristics and which is receptive to or a candidate for licensing and selling. Such technology has been alluded to in Chapter 2.

Some of the reasons for licensing and selling as well as the influence of the state of companies, their technology strategies and intellectual property policies on licensing and selling actions and licensing strategies *per se* have been discussed in 4.2, p45 and 4.3, p50.

Operational aspects including the how, when, where and who can best be elucidated in the context of the licensing market place. This market forms part of the greater technology market which in turn is part of the total environment within which South African industrial companies have to practise licensing and selling and which is sketched in Chapter 6. The licensing market place is a highly specialised, yet wide ranging, subset of the technology market. The following quotation gives, in an eloquent manner, an inkling of what is involved:

> It has been said that the ideal technology management consultant (TMC) possesses a conglomeration of the following attributes: Independence of mind, a broad technical education and background, legal training, market research and technical research experience, a knowledge of patents, trademarks and copyrights, an understanding of what constitutes valuable trade secrets and know-how combined with an ability to "package" such information effectively, knowledge of financial tools to value technologies and the companies that own them, an understanding of the different forms of technology transfer agreements, the ability to get along with people, salesmanship, negotiating experience and enjoyment of the process, public speaking ability, foreign language abilities, an appreciation of different cultures, a bent toward scholarship and the habit of omnivorous reading, physical stamina, resistance to jet lag, the ability to hold one's liquor, an appreciation of the importance of discretion including the necessity of keeping one's mouth shut at certain times. This list is not exhaustive. It should be readily apparent, however, that no-one possesses all of the foregoing attributes to a high degree. This does not detract from the pertinence of the listing. (Goldscheider, 1990: 77.)

Goldscheider is an esteemed practising technology transfer consultant and it can be assumed that his concept of a TMC is biased towards technology transfer and licensing. It can thus be said that he is listing the attributes necessary to license and sell technology effectively. And the list is indicative of the various aspects and intricacy of the licensing market place. The TMC can be seen as representing the functionaries in the licensing market place, who are identifying proprietory technology and its sources, needs and their whereabouts and matching them through suitable arrangements and agreements, all the while accommodating a host of influences to which Goldscheider points.

Although the market as a concept and structure is important and intricate, success therein is ultimately dependent on the influence of the functionaries involved, as Teece concludes after discussing, in the context of profiting from technological innovation, the implications for integration, collaboration, licensing and public policy. He says that the product life cycle model of international trade can be expected to play itself out differently in different industries and markets, influenced by appropriability regimes and the nature of the assets required for successfully commercialising a technology and adds:

> Whatever its limitations, the approach establishes that it is not so much the structure of markets but the structure of firms, particularly the scope of their boundaries, coupled with national policies with respect to the development of complementary assets, which determines the distribution of the profits amongst innovators and imitators/followers. (Teece, 1996: 250.)

Properly executed, the licensing process should influence its environment positively. To this end, extensive methodology encompassing several instruments and techniques has been developed.

The main dimensions of the process, which is complex and non-linear, include the following:
(i) Identification of licensable technology, within company and elsewhere; and reason.
(ii) Protection of technology to be out-licensed.
(iii) Identification of potential licensees.
(iv) Promotion of offered technology.
(v) Evaluation of technology: technically, legally and commercially.
(vi) Negotiation.
(vii) Agreement conclusion.

(viii) Agreement execution.

These dimensions point to the wide-ranging supporting facilities and skills involved. These include managerial, administrative, scientific, technical, financial, economic, legal, marketing and psychological elements as listed by Goldscheider.

A taxonomy of the licensing market place could encompass all the dimensions that will be referred to in Chapter 6 (economic ethos, accountancy and finance, regulatory and enabling environment, sociological aspects, availability and management of information and the problems of futurology), as well as characteristics associated with sources and their identification, licensors, licensees, brokers, the technology itself including its maturity and valuation and cost, the mode of transfer, transactional difficulties including recognition, disclosure, agreements and whether it is free, monopolistic or oligopolistic.

5.2 Agreements

5.2.1 Qualitative aspects

Once the parties to a licensing transaction have successfully finalised their negotiations they have reached agreement. It is customary practice to reduce the agreement to writing to serve as *aide memoire* and to ensure legal certainty. This document is variously called a contract or an agreement. The latter term is used henceforth.

Examples of agreements that can involve licensing are:
Agency agreements.
Distributorship agreements.
Assembly agreements.
Joint venture agreements.
Know-how and/or patent licence agreements.
Trade mark agreements.
Franchise agreements.
Combinations of the above and other variants.
Agreements between parent and subsidiary companies.

Either independently or as part of a more encompassing agreement, a licensing agreement should come into being after at least the aspects listed below have been considered, that is to say an aspect does not have to be written into the agreement if irrelevant, but should have received considered attention. It is highly unlikely that the scope, composition and ingredients of two agreements will be the same. Some of the aspects are more important than others. They can be viewed as deal-makers or deal-breakers as opposed to what can be viewed as hygienic aspects. In the first category are scope of technology and royalty rate and in the second category force majeure and communication. Some aspects are discussed to some varying extent in 5.2.2 and correspondingly surveyed. None are discussed exhaustingly as that is not the purpose of this study. Aspects marked with an asterisk receive no further attention at all.

* Parties to the agreement.

* Preamble - explaining the background and basic reasons for the agreement.

* Definitions - of terms used.

Grant - making clear what rights are granted including territorially; exclusivity.

* Sub-licensing - not permitted or how permitted.

* Conversion to non-exclusivity - conditions under which this may be done.

Consideration - all amounts payable and timing.

Minimum royalties - as licensor guarantee and licensee stimulus.

Minimum performance - as licensor guarantee and licensee stimulus.

Payment arrangements - how.

* Accounting requirements - what, when.

Transfer of know-how – what, how, when, cost treatment.

Improvements - access of licensee and licensor to other's, including grantback.

Undertakings by licensee - meet market demand, inform of improvements, restrictions, grant back own inventions, purchase from source.

Undertakings by licensor - transfer, maintain patent, inform of improvements.

Confidentiality and secrecy.

Infringements/litigation - of subject technology: how handled, by who, cost.

* Patent rights of third parties - licensee shall not infringe/shall be responsible.

Respect for patent rights - not attack licensor's.

Quality requirements - licensee's behaviour.

* Trade marks - governing use.

* Duration of agreement.

* Termination of agreement - who, why, when.
* Consequences of termination.
* Disclaimers.
* Liability for injury from visits - either party.
* Maintenance of patents - who responsible, cost, what if unsuccessful.
* Warranty - licensor not responsible for licensee's consequential damages.
* Licensee not agent.
* Force majeure.
* Amendment of agreement scope.
* Severability and partial validity of agreement clauses.
* Waiver of breach of term.
* Assignment of rights and responsibilities of either party – whether and how.
* Applicable law.
* Language to prevail.
* Communication.
* Arbitration/mediation.

5.2.2 Quantitative aspects

The content of licence agreements is generally confidential as Ishii and Fujino (1994) point out. However, a survey by them through the Institute of Intellectual Property (IIP) of Japan by mailing 200 members of the Japanese chapter of the Licensing Executives Society resulted in a 33% response which was followed up with interviews and yielded a wealth of interesting pointers regarding the content of arms-length licence agreements involving Japan.

Respondents were from the following industries: transportation machinery, 12; pharmaceutical, 11; chemical, 9, electrical/electronic, 7; precision machinery, 6; plastics, 5; non-metal, 5; general machinery, 5; electrical machinery, 5. In- and out-licences were involved and it can reasonably be assumed that several different foreign countries were involved, although licensee foreign countries may perhaps be skewed towards less developed ones; and licensor foreign countries towards fully developed ones.

Table 8 shows noteworthy balance between in- and out-licences and domestic and foreign licences.

	Japanese	Foreign	Total
Out-licences	53	51	104
In-licences	54	53	107
Total	107	104	211

Table 8. Overall number and type of agreements.
(Ishii and Fujino, 1994: 131)

Percentage-based royalties is predominantly used as is clear from Tables 9 and 10. The writers further report that it was increasing. Per quantity based royalties are more particularly used in the case of software packages.

Licence content	Net sales % (%)	Per quantity (%)
Patent only	66	34
Know-how inclusive	69	31

Table 9. Relative use of percentage and quantity based royalties.
(Ibid.)

Royalty base	Very frequently	Frequently	Normal	Not frequently	Never	Weight (%) *
Likert point value	10	7	5	2	0	
Patent only						
Sales amount x royalty rate	5	9	17	51	24	25,2
Net sales x royalty rate	58	25	16	8	4	69,4
Profit x royalty rate	0	0	2	22	74	5,4
Total	63	34	35	81	102	100,0
Know-how inclusive						
Sales amount x royalty rate	5	7	17	50	22	24,2
Net sales x royalty rate	56	25	18	6	4	71,2
Profit x royalty rate	0	0	2	22	71	5,0
Total	61	32	37	78	97	100,0

Table 10. Royalty base
(Ibid: 133)
* Calculated from weighted points.

Degnan and Horton (see 4.3.2 – p57 for background) reported similar results using a Likert scale with 1 = never use and 5 = frequently use.

Royalty base	Use (% - rounded)
Net revenues x royalty rate	39
Fixed amount per unit	26
Gross revenues x royalty rate	21
Gros or net profit percentage	17
Fixed period amount	16

Table 11. Royalty base
(Degnan and Horton, 1997: 94)

Net sales is predominant as royalty base. This is the result of net sales being a fair measure of actual sales income and the applied percentage not being adjustable. Sales as such may include eventual returns and other revenues and profit can be manipulated.

The frequency of use of initial royalties and minimum royalties was also probed. Table 12 shows the mean values of total points scored from the Likert scale "use always" = 100 points, "use occasionally" = 50 points and "scarcely use" = 0 points. The greater commitment required from licensors and possibly the greater maturity of the technology involved in know-how licences lead to increased initial payments.

Royalty type	Patent licence only	Know-how inclusive licence
Initial	49,2	66,9
Minimum	34,2	32,4

Table 12. Frequency of use of initial and minimum royalties.
(Ishii and Fujino 1994: 131)

Degnan and Horton again found similar results, using a Likert scale with 1 = never use and 5 = frequently use.

Payment type	Use (% - rounded)
Mixture of methods	41
Up front fees	32
Running royalty only	28

Minimum annual payments	25
Lump sum payment only	22

Table 13. Type of royalty used.
(Ibid: 93)

Both surveys investigated the licence factors influencing royalty rates. (See Tables 22 and 23, pp78/79 for valuation of intrinsic value.)

Factors	Number of respondents	
	Patent only	Know-how inclusive
Exclusivity	57	51
Scope of licence	46	45
Licensed products	46	44
Licence period	38	44
Territory	37	43
Maturity of patent and know-how	29	41
Credibility of licensee	15	16
Bargaining power	16	15
Shared responsibility against third party infringement	14	11

Table 14. Factors affecting royalty rates.
(Ishii and Fujino, 1994: 133)

Exclusivity assumes central position. Maturity of know-how is important as well.

Degnan and Horton found the following, with Likert scale 1 = not important and 5 = very important. Their factors were deliberately chosen to parallel the factors being used in the US Federal Courts to determine appropriate royalty rates in patent infringement cases.

Factors	In-licence (%)	Out-licence (%)
Nature of the protection	43	42
Utility over old methods	42	42
Scope of exclusivity	41	41
Licensee's anticipated profits	30	34
Commercial success	37	37
Territorial restrictions	37	35
Comparable licence rates	36	37
Duration of protection	33	31
Licensor's anticipated profits	26	31
Commercial relationship	26	26
Tag along sales	21	21

Table 15. Factors affecting royalty rates.
(Degnan and Horton, 1997: 92)

A direct comparison with Ishii and Fujino is not possible. The importance of the nature of protection is possibly due to the possibility of USA licensees being entitled to attack their licensor's licensed patent. "Nature of protection" and "utility" possibly also overlap to some extent Ishii and Fujino's "scope" and "licensed products".

The relative importance of terms and conditions was also probed. Longer term gain and learning goals are obvious from the importance placed on improvement provisions. It is not surprising that confidentiality is most important in the case of know-how. The non-contest clause could lead to anti-trust problems in the USA and Europe.

Major licence terms	Number of respondents	
	Patent only	**Know-how incl.**
Provisions on improvements	42	45
Confidentiality, non-misappropriation	38	56
Warranty of patent validity	30	27
Non-contest clause	25	14
Provision of service	16	36
Warranty of quality of achievements	8	20
Obligation to purchase materials	4	7

Table 16. Relative importance of terms and conditions.
(Ishii and Fujino, 1994: 133)

From Table 17 greater awareness of the possible consequences of a non-contest clause is apparent. Confidentiality is again highly rated. "Administrative" aspects seem most important, albeit marginally.

Major licence terms	Respondents (% - rounded)
Governing law	93
Accounting and reporting	92
Confidentiality	90
Assignability	88
Dispute resolution	84
Warranty of ownership	80
Infringement enforcement	78
Provision for improvements	75
Warranty of non-infringement	45
Non-contest clause	20

Table 17. Relative importance of terms and conditions.
(Degnan and Horton, 1997: 93)

Outright or overt restrictions on licensees run the risk of anti-trust illegality or the illegal expansion of patent and similar monopolies and in some cases will render an agreement null and void *ab initio*. It is nevertheless interesting to note in which respects licensors were considering either restrictions or limited grants of rights, from a survey of 39 USA firms in 1977 by Contractor.

Restriction	Responding licensor firms (%)
Territorial limitation on manufacture	82,4
Limitations on licensees export quantity	14,7
Limitations on licensees export price	5,9
Export only through designated agent	23,5
Prohibition on handling competitors' products	23,5
Materials to be purchased from licensor or designated agent	11,8
Grantbacks from licensees	70,6
Quality controls on materials	29,4
Quality controls on finished products	55,9

Table 18. Summary data: Restrictions sought in agreements.
(Contractor, 1981: 61)

Survey objectives. (Results are presented in 8.15.)

It was decided to establish the prevalence of licences, technology or IP content of licences, bases on which royalties are calculated, royalty and payment types used, relative influence of licence terms and conditions on remuneration rates, desirability of restrictions and relative importance of some licence terms and conditions.

5.3 Sources of technology

A taxonomy of sources of technology could include companies of all sizes and ages, independent research laboratories, universities, inventors, and government agencies and laboratories.

Companies and inventors could be the would-be licensor itself, in the case of licensing out.

In a different dimension, another taxonomy is depicted in Table 19 (*ca* 1995).

Knowledge source	Your country	Other Europe	North America	Japan
Affiliated firms	48,9	42,9	48,2	33,6
Joint ventures	36,6	35,0	39,7	29,4
Independent suppliers	45,7	40,3	30,8	24,1
Independent customers	51,2	42,2	34,8	27,5
Public research	51,1	26,3	28,3	12,9
Reverse engineering	45,3	45,9	40,0	40,0

Table 19. Outside sources of technical knowledge for large European firms: percentage judging the source as very important.
(Tidd *et al*, 1997: 83)

Tidd draws attention to the importance European firms attach to foreign sources of technology. It was reported that European firms experience difficulty in learning from Japan, probably because of greater physical, linguistic and cultural distances.

A taxonomy of technology source media could include exhibitions, fairs, symposia and conferences, data banks, written and electronic publications including patents, trade and professional journals, contact/broadcast offices of developers, documents specifically offering an opportunity, editors, especially of trade and scientific journals, trade associations.
The electronic information age is enhancing and accelerating the total process. Tidd sets out the advantages and disadvantages of some media:

Nature of information	Some sources	Strengths	Limits
Corporate R&D expendi-tures.	Annual reports. Business Week, June. Company reports Ltd, June.	Easy access.	No detail of projects. Misses innovative activities outside R&D.
Corporate patents and scientific publica-tions.	US Patent Office. European Patent Office. Other patent offices. Consultants (CHI, Derwent).	Comparisons possible in great detail. Identifies possible entrants as well as incumbents.	Choosing relevant patent classes. Dealing with firms with several names. Non-patented innovations.
Public announce-	Conferences. Media.	Direct and detailed signal of corporate	Distortion for financial or marketing

ments and press analysis.	Trade press.	intentions.	reasons.

Table 20. Public information sources on corporate innovative activities.
(Tidd *et al*: 1997: 88)

An important indirect source and marketing channel is the multiplicity of agents or brokers assisting in matching would-be licensors and licensees and often playing an invaluable role in licensing-environment making. These may be specialists in licensing or even in a particular field of technology, may exist in firms of patent attorneys or be part of companies or universities. Several extend help specifically to so-called private inventors who lack the resources and know-how to develop and exploit their inventions optimally while some are state-owned. See also Goldscheider and description of Technology Management Consultants in 5.1, p65.

> The basic deal we offer is one where BTG USA acts as principal, not advisor. We take assignment of the technology or an exclusive license. We have the job of developing and implementing a technology marketing plan, identifying licensees and entering into licenses. We share revenue net of certain defined costs. We do not charge fees for our executive time, either up front or as a later cost. The university-based business has been and is a continuing success. About four years ago BTG decided to offer its services to companies. We created a new division called Intercorporate Licensing to do this. This activity was the major focus of BTG USA when it was set up two years ago. …. now actively marketing technology from large corporations such as American Cyanamid, Campbell Soup, Johnson & Johnson and Grumman Corporation as well as from many smaller companies. (Schafer, 1993: 119.)

BTG USA was founded to mirror BTG UK which had evolved from the National Research Development Corporation which was founded in the 1960s. The South African equivalent then was the South African Inventions Development Corporation and now is Technifin (Pty) Ltd.

Note the big companies that have entrusted at least part of their technology available for licensing to BTG.

The intercession of people is ineluctable and Tidd quotes Levin, Klevorick, Nelson and Winter from the Brookings Papers on Economic Activity, *ca*. 1987, as shown in Table 21.

Tidd points out that learning does not come cheaply - the three top methods are the most expensive. It is also noteworthy that licensing is considered 96% and 92% as important as the top method, for respectively processes and products.

Method of learning	Overall sample means *	
	Processes	**Products**
Independent R&D	4,76	5,00
Reverse engineering	4,07	4,83
Licensing	4,58	4,62
Hiring employees from innovating firm	4,02	4,08
Publications of open technical meetings	4,07	4,07
Patent disclosures	3,88	4,01
Consultations with employees of the innovating firm	3,64	3,64

Table 21. Effectiveness of learning in large US corporations.
(Tidd *et al*, 1997: 92)
* Range: 1 = not at all effective; 7 = very effective.

Bigger companies often refuse submissions without a waiver of confidentiality from the would-be licensor. Although this is irritating to the licensor it is perfectly understandable against the bigger companies' experience that unsolicited offers seldom are worthwhile and the risk of being sued for misappropriation of the licensor's technology.

Survey objectives. (Results are presented in 8.17.)

It was decided to establish the frequency of occurrence of sources of technology in general and of occurrence of sources of in-licensable technology.

5.4 Cost and valuation

Much has been written about the intrinsic valuation of technology involved in licence agreements, including the following wry comment:

> Trying to explain the factors that go into the valuation of an invention or technology only convinces people that licensing is three parts witchcraft and one part common sense. Inventors and top management

want to know what their technology is worth to their organizations. Prospective patent licensees want to know what to pay for such technology. Licensing executives understand that the answer to these questions, from both sides, is that it depends. (Degnan and Horton, 1997: 91.)

Tables 14 and 15, p72 list some licensing factors that influence royalties.

The IIP and the Degnan and Horton (D&H) surveys (see respectively 5.2.2 - p69 and 4.3.2 – p54, also for the profile of respondent companies) provided some interesting insights regarding the final outcome of valuation and negotiation.

As D&H point out, there are many factors determining a running royalty for a willing licensee and a willing licensor including the development status of the technology, its ingeniousness and commercial success, its profitability and the ease of designing around any patent.

They asked their respondents "Does your organization license-in technologies that are not completely developed?" 10% said never, 52% said sometimes and 37% said frequently. They were then asked what discount they would apply to technologies still in the pipeline and a further three defined three phases. An immaturity discount would render a running royalty as shown in Table 22.

Maturity of patented technology	**Relative royalty rate**
Fully developed.	10
Pilot or prototype phase. Prototype has been tested and product test marketed. Regulatory approvals being sought.	8,0
Detailed design phase. Engineering designs completed and protection applied for.	6,5
Lab phase. Research is completed and concept has been reduced to practice.	5.0

Table 22. Discount of royalty from fully developed technology rate.
(Degnan and Horton, 1997: 94)

D&H tested for the effect of innovativeness defining an innovativeness scale as follows:

Revolutionary: Satisfies a long felt need or creates a whole new industry.

Major improvement: Significantly enhances quality or product superiority in an existing product, process or service.

Minor improvement: Creates an incremental improvement in an existing product, process or service.

Respondents were then asked to list the range of running royalties they licensed in or out during the previous year: from a low x% through a high y% against each of the three categories of the innovativeness scale provided. In Table 23 the 7 in "revolutionary/ low" is the average of x while 5 is its median.

Technology type	Licensing in				Licensing out			
	Average (%)		Median (%)		Average (%)		Median (%)	
	Low	High	Low	High	Low	High	Low	High
Revolutionary	7	13	5	10	7	14	5	10
Major improvement	4	8	3	7	5	9	4	8
Minor improvement	2	5	1	4	3	6	2	5

Table 23. Average and median running royalties.
(Degnan and Horton, 1997: 94/5)

A considerable gap exists between the lowest and highest royalty rates. D&H report that this is partly due to the fact that pharmaceuticals populate the high end and systems involving several patents the lower end.

Royalty rate (%)	1	2	3	4	5	6/7	8/more
Respondents	23	18	46	32	22	11	18

Table 24. Favoured royalty rates.
(Ishii and Fujino, 1994: 133)

D&H also asked for information regarding the financial measures organisations used in determining appropriate royalties - as starting points for negotiations, to determine a range or to fine-tune final figures.

Financial measure	In-licensing (%)	Out-licensing (%)
Discounted cash flow	56	49
Profit sharing analysis	52	54
Return on assets	38	27
"25% rule" as starting point	24	30
Capital asset pricing model	11	10
Excess return analysis	8	7

Table 25. Financial measures used to determine appropriate royalties.
(Degnan and Horton, 1997: 92)

The first two, which are perhaps routinely used in investment evaluation decisions, may be preferred because information is more readily available. The 25% rule which assigns 25% of net profit from exploitation to the licensor, may be attractive for smaller, less sophisticated organisations. The last two methods may be too sophisticated and difficult to present to the other side.

Contractor (1981) points out that a technology transfer is properly viewed as a relationship over time. He further reports that he found a standard accounting format for suppliers is possible despite an infinite diversity of products and processes transferred and despite agreements being tailored to suit specific circumstances. The format showing returns and costs that have to be taken into account appears in Table 26.

Note that Contractor includes also the following costs in his listing: Total of sunk or developmental cost for the product or process transferred, up to inception of agreement; and opportunity cost, for example losing export sales or direct investment opportunities in licensee's country or other territories.

Returns to supplier in year *t*	**Cost incurred by supplier firm in year *t***
Front-end or lump sum fees.	Technical services (direct and overhead).
Royalties.	Legal cost (direct and overhead).
Technical assistance fees.	Marketing assistance to recipient.
Fees for other specific services.	Travel and management personnel cost not include above.
Payment in equity of recipient plus dividend thereon.	Other direct cost.
Net margins and commissions on materials or goods supplied or received.	
Value of grantbacks.	
Tax savings.	

Table 26. Cost and return categories for supplier firms over life of an agreement.
(Contractor, 1981: 35)

He also presents a useful construct of the remuneration relationship between licensor and licensee (Fig. 13).

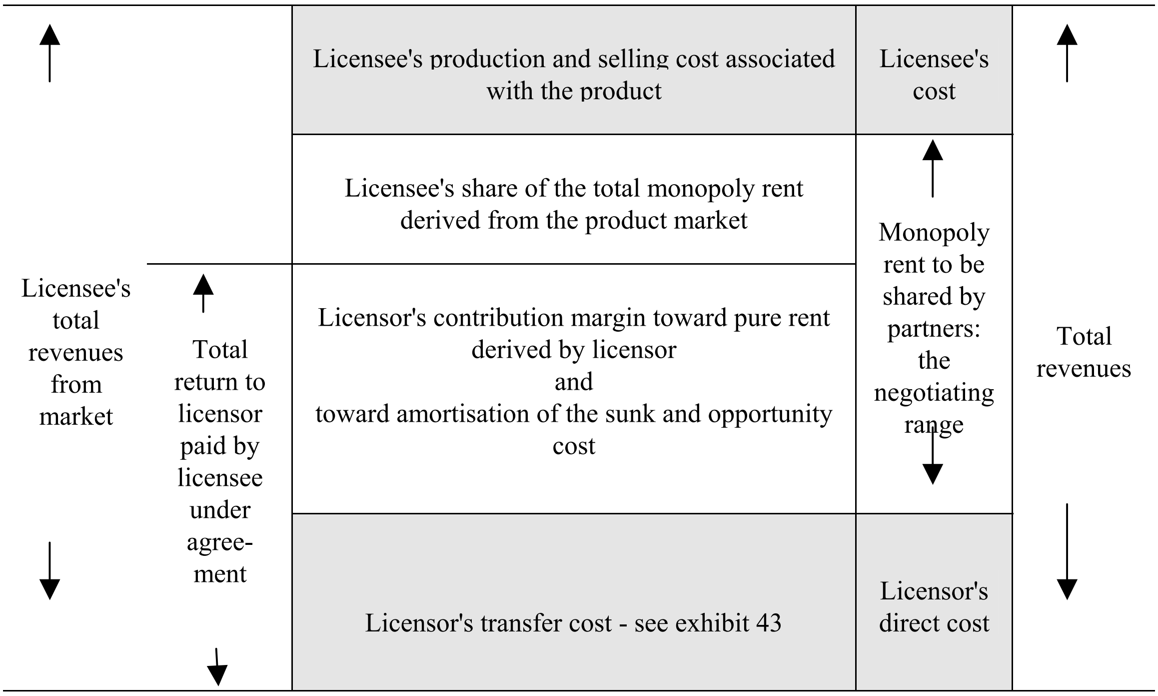


Figure 13. Allocation of licensee's revenues from sales of licensed product.
(Ibid: 41)

Contractor normatively argues that the following factors influence the bargaining process.

Agreement-specific factors	**Contextual factors**
Territorial coverage and exportability of product.	Licensee's government's intervention.
Exclusivity of the licence.	Extent of competition in the product market in licensee's market.
The life of the agreement.	Extent of competition among international suppliers of same or similar technology.
The life of the patent.	Political and busines risk in licensee nation.
Trademark rights.	Product and industry licensing norms.
Commercial age of the technology.	
Adaptation of the technology for the licensee.	
The relative scale of licensee's plant.	
Grantback provisions.	
Tie-in provisions.	

Table 27. Factors affecting licence agreement bargaining process - normative.
(Ibid: 46/7)

Contractor subsequently tested which considerations were actually used to set prices or returns of agreements. The most important criterion could have been viewed by respondents as more encompassing than it was possibly intended but its deemed importance certainly draws attention to the sensitivity of licensors to out of pocket and transaction cost and dilution of appropriability.

Criteria (offered at random in questionnaire)	Score	Rank
Depends on amount of technical and other services provided to licensee.	127	1
Industry norms e.g. royalty %.	105	2
Licensee's market size and profitability.	102	3
Take what's available.	61	4
R&D expenditure	50	5
Returns must at least equal those from exporting or direct investment.	28	6
Less for old or obsolescent technology.	27	7
Less when patent expiring.	10	8
Other: patent coverage, grantbacks.	8	9

Table 28. Criteria affecting licence agreement bargaining process - actual.
(Ibid: 46/7)

The combined importance of the first three criteria seems to indicate that complicated calculations regarding the instant capital value of the technology were not regarded seriously. Nothing to indicate use thereof was mentioned under "other" either. The significant drop in frequency to criterion 4 almost renders the other criteria also rans and reinforces the impression that the accounting calculations involved tended to be rather coarse and perhaps of the "feel right" type. That the approach was pragmatic is also clear from in-depth interviews with 12 of the respondent firms from which Contractor determined that research and development costs are almost always regarded as sunk. The major reasons seemed to be the difficulty of calculation and the mooted impossibility of allocation to individual agreements. Sometimes these costs, which it can be argued will be saved by the licensee, are estimated for the licensee merely as an aid in negotiation.

Opportunity cost could be discounted to some extent in the top criterion. On the other hand the "opportunity" involves much more than immediate money. Would-be licensors would presumably consider their options carefully, taking cognisance of the strategic factors mentioned in Chapters 3 and 4 above, before attempting licensing.

Considering only costs in Table 26, p80 and factors in Table 27, p81, bearing in mind that this list can be extended and each factor can also be dissected in turn and should be viewed from licensor and licensee perspectives; as well as the extended periods of time usually attendant on licence agreements, it becomes clear that any *de rigueur* attempt to calculate a royalty rate must be viewed with healthy scepticism. There are simply too many economic, legal and technology unknowns requiring assumptions, and variables. However, this does not rule out the necessity and wisdom of acquiring a sound understanding of the arena nor the involvement of accountants. Licensees will certainly develop *pro forma* statements assessing a licence opportunity and licensors should also attempt to do so even if their knowledge of the licensee and its markets is imperfect. In this manner a starting range of remuneration can at least be developed and the numbers understood in context.

Contractor concludes that licensors' behaviour is satisficing rather than revenue maximising. Both parties to an agreement must be satisfied with the transaction, otherwise its viability is seriously questionable.

Survey objectives. (Results are presented in 8.16.)

It was decided to establish methods used to calculate royalties, maturity or obsolescence discounts and the relative value placed on patents, trademarks and know-how.

5.5 Licensing organisation and functionaries

From the descriptions of a Technology Management Consultant and the licensing process in 5.1, p65 above an idea can be formed of the aspects that need to be considered when licensing manpower is deployed.

In a survey in 1992 of 1800 major Japanese firms in all industries except for financial institutions, with a response rate of 26,5%, the following was found:

Functional department responsible	%
Research and development	39,8
Special patent department	26,0
Administrative	9,4

Special intellectual property department	9,2
Legal department	8,1
Other	7,4

Table 29. Responsibility for intellectual property.
(Murakami and Nakata, 1994:128)

The diverse nature of the intellectual property function is also underlined by the fact that patent attorneys and solicitors made up only 3,8% of the total manpower devoted to this function (fraction 0,54/14,19 in Table 30):

	3 years ago	Current	3 years from now
Total personnel (average)	11,30	14,19	15,78
Total personnel (largest)	300	360	400
Lawyers and patent solicitors (average)	0,48	0,54	0,83
Lawyers and patent solicitors (largest)	15	20	25

Table 30. Manpower devoted to intellectual property.
(Murakami and Nakata, 1994:128)

The authors note that the patent solicitor's examination in Japan is extremely demanding and concentrates only on the patent application process while companies do not afford such people special treatment.

The number of departments involved in the negotiation, evaluation and approval of technology transfers was also established by Degnan and Horton (1997 - see 4.3.2, p57 for the nature of the respondents).

Department type	Respondents reporting use (%)
Legal and regulatory	70
Research	60
Licensing	59
Technical and engineering	55
Sales and marketing	50
Finance and accounting	38
Manufacturing and production	29

Table 31. Departments involved in licensing process.
(Degnan and Horton, 1997: 92)

operating executive; or one or more regional executives who regularly employ licensing or a technical executive in charge of contractual obligations or anti-trust aspects.

Internally, a licensing department or function should have available or have access to (and this is the Head's responsibility):
(i) All required functional and licensing-technical skills such as negotiation, contract administration, agreement execution, legal and marketing skills. These can reside in permanent teams or *ad hoc* teams.
(ii) Regional differences should be managed, perhaps by assigning permanent staff to regions. The whole function can be decentralised on this basis or initial strategy and negotiation can be left to the field while administration, litigation and inward licensing are done by a corporate office.
(iii) Goldscheider points out that emphasis on the needs of product divisions may prompt the appointment of managers from product divisions to attend to licensing.

In late 1996 Boeing acquired the defence portion of Rockwell International Corporation, followed eight months later by Boeing's merger with McDonnel Douglas Corporation. The company was re-organised into three main operating groups: a Commercial Airplane Group (CAG), an Information, Space and Defence System Group (ISDS) and a Shared Services Group. The licensing activities of the new organisation with about 220 000 employees, up from 120 000, had to be integrated.

Extensive studies and benchmarking with 12 other Fortune 500 companies regarding especially the centralisation of licensing resulted in the insight that the centralisation issue included both an activity element and an authority element. The former concerned finding technology and partners and negotiations and contracting. The latter concerned technology release. The benchmarking study discovered that activity and approval could both be centralised, could both be decentralised or could be found decentralised or centralised - all possible combinations existed in practice and worked well.

Boeing decided on two separate licensing groups, one each for CAG and ISDS. (Sproule, 1998.)

Survey objectives. (Results are presented in 8.13.)

It was decided to establish the frequency of occurrence of a specialised licensing function, South African manufacturing companies' own view of their technology trading prowess, their like/dislike of licensing, methods used to identify potential licensees, departments or functions involved in the licensing process including evaluation, agreement negotiation, agreement compilation, contract administration and how licensees are approached.

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**				
		Organization by discipline	Project management	Product line organization	Matrix organization	Venture management
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.)

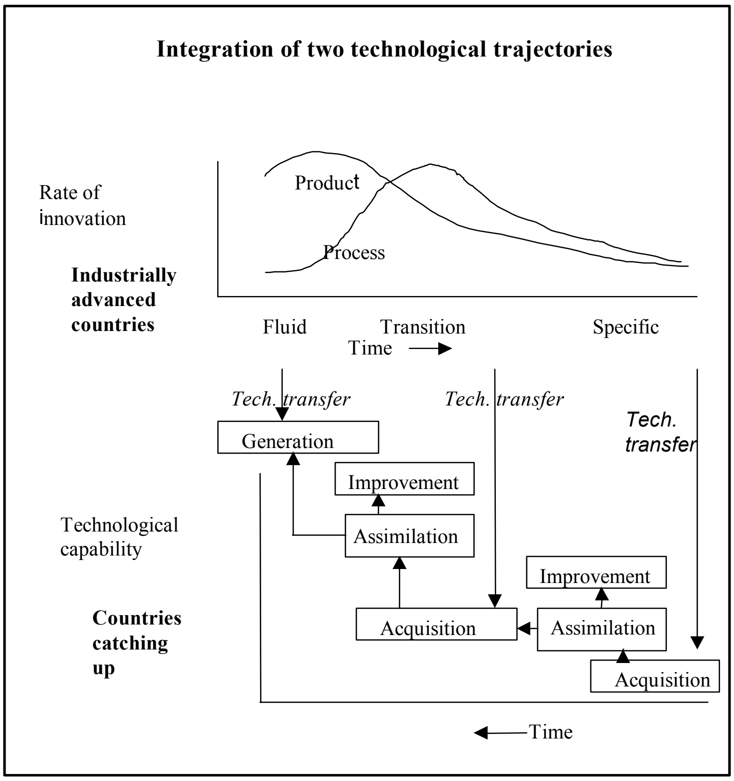


Figure 15. Countries catching up by working backwards up the S-curve.
(Kim,1997: 91)

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.

7. METHODOLOGY

7.1 Three objectives of this research

The multi-functional, multi-disciplinary licensing field *prima facie* appears convoluted. A simplified morphological perspective thereof is presented in Figure 16. The methodology including research design, execution and reporting was patterned upon the underlying paradigm.

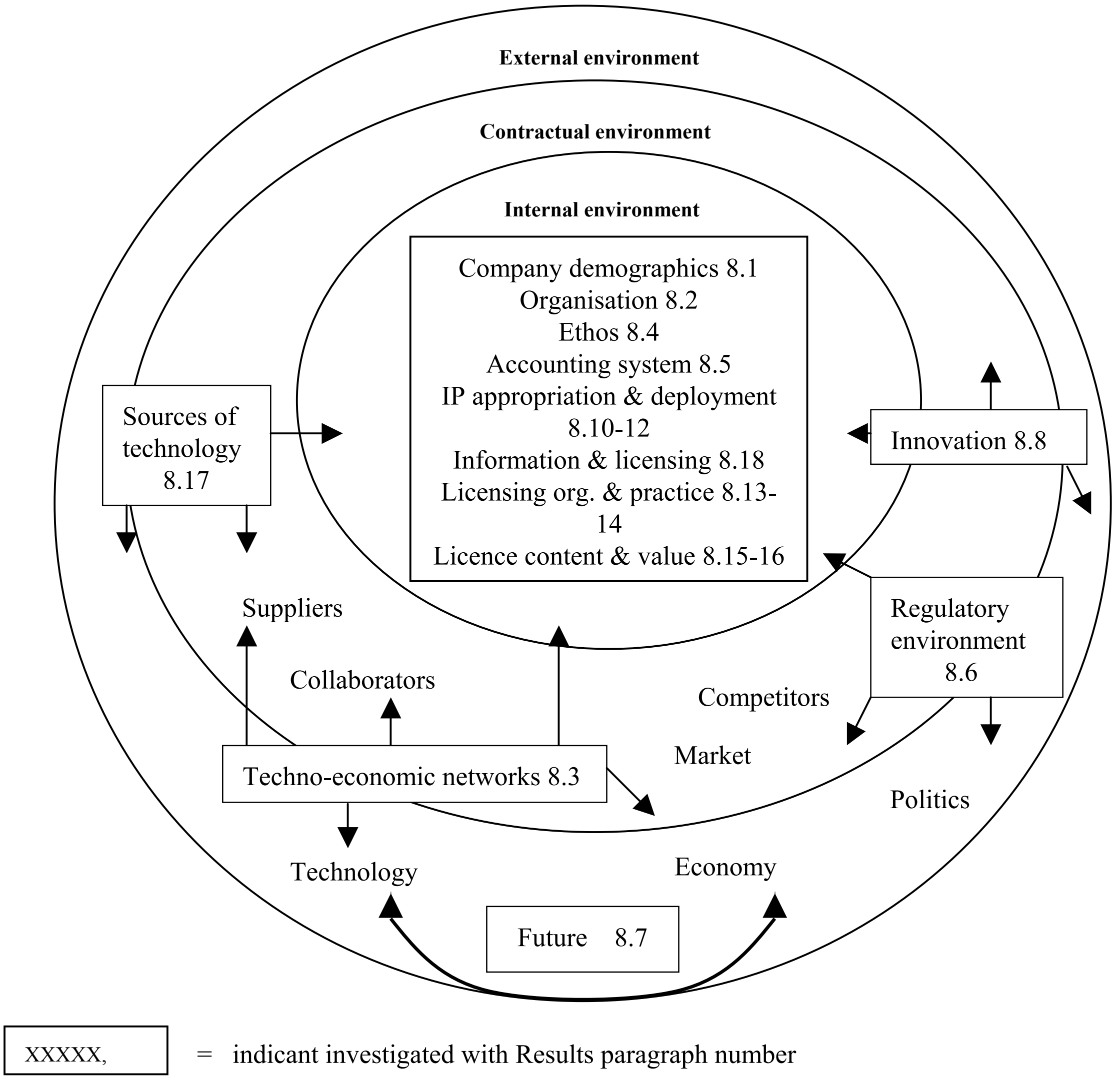


Figure 16. Simplified overview of morphology of licensing field.

7.1.1 The main objective of this research was to make progress towards empirically obtaining a profile of technology licensing practices of South African manufacturing companies and contrasting them where possible and useful with international practice. Four main morphological areas of analysis to enhance understanding of these were identified:

(i) Company characteristics.

(ii) Broader environment of company including its regulatory and enabling environment.

(iii) Company's technology management practices.

(iv) Company's licensing practices and preferences.

Indicants within these were clustered to investigate the following aspects, always in relation to technology licensing and the companies taking part in the survey and findings are presented in this order in Chapter 8:

Company and industry sector demographics.

Company physical and personnel organisation.

Techno-economic networks (TENs).

Company economic ethos.

Accounting systems.

Regulatory environment.

Sensitivity to the future.

Innovation levels.

Sensitivity to learning.

Appropriability.

IP portfolio.

Deployment of IP.

Licensing organisation.

Reasons for licensing or not.

Content of licences.

Valuation of licensed technology.

Sources of technology.

Use of information sources.

7.1.2 A second objective was to explore the notion that manufacturing companies can deliberately use some organisational characteristics to act as drivers to influence licensing activity. Detail again appear in chapter 8 and are interwoven with the profile reports. In overview the influence of the following determinant variables and latent variable constructs driven by postulated determinants was investigated:

(i) Techno-Economic Networks; and top management's attitude to licensing.

(ii) Orientation regarding risk taking and pioneering.

(iii) Forward planning.

(iv) Innovative activities.

(v) Intellectual property awareness and planning.

(vi) Licensing-directed research and development.

(vii) Technology management.

(viii) Use of information.

7.1.3 A third objective was to collate information in the multi-disciplinary multi-functional technology licensing field hitherto not available and present it, as well as where possible, indications for further research, to stimulate further scientific work in what could be considered a hitherto neglected academic field. This objective required working with and presenting varied collected information and synthesized constructs in order to maximise opportunities to identify, synthesize and extract areas and topics for further research.

7.1.4 Presenting the more detailed objectives, findings and recommendations together yet not overly compressed as topical clusters enhances readability by reducing cross referencing which would otherwise be much more complicated. The resulting quicker topical as well as inter-topical perspective will stimulate exploratory insights.

7.2 Type of research and questionnaire

The term "manufacturing companies" refers to manufacturing companies in South Africa known to have or to have had at least one licence agreement or patent or patent application or trademark. This requirement was introduced to attempt to ensure that the company possesses some relevant knowledge. Statutory bodies, science councils, universities, merchants, the retail trade, technology brokers and individuals such as inventors were specifically excluded. State owned for-profit companies were included. The research focus accentuated a company level approach rather than a sector or grouping or national level approach. Groups including industry sectors were however explored in some respects and results are reported. Responses were classified *post facto* and largely *ad hoc* into industry sectors according to basic function and to create reasonably sized groups for statistical purposes. An important additional

consideration, honouring an undertaking given to respondents, was to prevent recognition of individual respondents by readers. Licences involving only trademarks, trade names, copyright, franchising and distribution rights were excluded.
As part of the descriptive and exploratory research leaning towards a quantitative/positivistic rather than qualitative/ethnographic approach, the technology licensing and technology management literature was surveyed to identify characteristics and determinants of licensing practice and particularly those that could be considered the most important and actually or possibly qualifiable or quantifiable as the case may be. A number of surveys set internationally or in the developed world were found. No similar prior survey in South Africa was found. Characteristics were selected pragmatically, allowing for comparisons with other surveys and the synthesis of postulated determinant characteristics.

A cross section survey was then planned to gather relevant data. A questionnaire which appears as Annexure A was developed and used. Uninterrupted completion time was estimated at about one hour, which is considered to be rather long and taxing of respondents' patience and concentration. Because of the multi-disciplinary, multi-functional nature of the questionnaire and the research field and the need to obtain holistic views it was to be submitted to senior company staff preferably to be completed at that level. Questions which could be considered sensitive, involving matters such as exact sales figures, personnel numbers, specific royalty rates and identities of partners were avoided in the belief that this would encourage participation.

Where possible, use was made of rank ordering and scaling and agreement/disagreement methods of data collection. These independent response type items minimise confounding or the operation of unrecognised variables distorting the relationship between independent and dependent variables by reducing response set bias including the tendency of central response and normative measures offer the analytic advantages of correlation, also of groups of indicant or predictor variables reported. Questions addressing management style and philosophy were largely arranged in groups considered to follow general management thinking. This was part of an effort to minimise the mental exertion required of respondents to complete the lengthy questionnaire and contributed to preventing respondents to some extent from recognising the analytical purpose to which the predictor variables would be put in groups.

Respondents were oriented by providing the definitions of technology and innovation developed in respectively 2.1 and 2.4 above. They were assured that individual company confidentiality would be maintained and sensitive questions were avoided as stated above.

It was decided that targeted recipients of the questionnaire would be telephoned beforehand to explain the purpose and implications of receiving a questionnaire; and to send questionnaires only to those who agreed to participate. Prior agreement and dispatch of the questionnaire to a specific person would enhance the response rate. Companies and preferably names of individuals were therefore required. It proved impractical to identify qualifying recipients from a search through the records of the South African Patent Office. The main reasons were that patentees shown in the patent register are often not companies and even if so it was unclear whether they would meet the requirements. They would have had to be contacted to establish the facts and contact information is not readily available. Companies with licences are not recorded so the sample would be skew. A search through the U.S Patent Office records for South African patentees turned up very few and would skew the sample as well. A list of in-licensees could also not be obtained from the Department of Trade and Industry.

An attempt was made to have each of the 96 patent attorneys registered at the South African Institute of Intellectual Property Law on 31 May 2002 provide the name of 10 companies and the name of a person in each who had agreed to receive the questionnaire. They were requested to select companies from their clients across the size, industry sector, sophistication and geographic ranges. Disappointingly the response was mostly negative with about 60% of the practitioners confining themselves to trademark practice and confidentiality problems being claimed by most of the rest. Two of the bigger firms and several individual practitioners did contribute 18 names net after elimination of duplication and companies already identified in other ways.

The Design Institute of South Africa was requested to provide a list of contestants including the winners of the Technology 100 competition in 2001 and 2002 and from these 23 companies were identified as qualifying recipients of the questionnaire. It transpired that many contestants were individuals or non-manufacturing or start-ups.

Lists previously used by other students in and the Department of Technology Management of the University of Pretoria itself were scrutinised for likely recipients, and for the rest own knowledge and networking including *e.g.* perusing the Eezidex catalogue, talking to the publication Engineering News and contacting the National Advisory Council for small and medium enterprises, the Stainless Steel Development Association and the National Association of Components Manufacturers were used to compile a list of potential recipients. Throughout the process geographical, size and industry sector diversity was sought. A particular aim was to identify smaller companies alongside the bigger, more widely known companies.

All of the more than 300 potential recipient companies were telephoned according to plan and the personal agreement of a suitable individual to participate sought, free refusal being offered. Several proved not to have or have had a patent or a licence agreement, others felt they did not have sufficient knowledge to complete the questionnaire, several proved to be subsidiaries or affiliates or holding companies and were eliminated (see also 2nd paragraph of 7.3 following) and six claimed to be too busy or simply not interested.

In total 188 questionnaires expressing the hope of completion and return within one month were dispatched, the bulk during September 2002. Email addresses were unexpected but very useful information gathered during the telephone calls. These eased the mailing task and improved delivery certainty. Only one questionnaire had to be sent by ordinary mail and one was faxed. Returns were very tardy and more questionnaires were dispatched during the delay and the last towards October 2002. Many and repeated telephone calls to request return were necessary and resulted in some new recipients being suggested and requests to re-send the questionnaire. Most of the decisions not to return questionnaires were communicated during these calls, almost all recipients claiming that they or their companies were not suitable. In several cases repeated assurances were given that completion was in progress with imminent delivery and eventually the questionnaire was not actually returned. Three refused on confidentiality grounds, a somewhat unconvincing proposition. Four returned questionnaires reportedly went astray in the ordinary mail. The last repeat dispatch took place during January 2003. Eventually the end of February 2003 was set as closing date. In total 93 questionnaires or 49% were returned. One of these and one of the four reported lost arrived after the end of February and 10 others were discarded as too sketchy or clearly produced with less than proper attention.

7.3 Overview of validity and reliability

This study is a first of its kind and thus purely exploratory. An early pragmatic decision was to draw information only from those companies of which some knowledge of the issues could be assumed. Many companies were therefore not considered for inclusion in the study. This approach necessarily resulted in a non-probabilistic sample, for which the sampling plan was mostly informal. Thus there was less need for what may be termed "targeted sample sizes" and statistical hypothesis testing. Due to the nature of this study formal statistical hypothesis testing would not be warranted and statistical significance values could not be specified. Multivariate methods, like MANOVA and factor analysis were irrelevant, due to the limited number of sampled companies (only 81 altogether) and the limited number of variables considered (mainly number of licences). Follow-up studies should be more aware of careful sampling planning, formulation of hypotheses and specification of more advanced statistical techniques like multiple regression.

In total 81 questionnaires were statistically processed. In several cases respondents elected to complete only either the in-licensing or the out-licensing sections and in others only parts or even none of the questions concerning licensing specifically. Most completed the sections concerning broader company activities and strategies. Respondent numbers are reported with the detail results and where deemed necessary specific comments on validity and reliability are added.

During the telephonic discussions the question of whether a large corporation should complete the questionnaire for its whole or for a part or parts arose several times. The constant consensus was that it should be completed for a smaller part, even for a division as a presumed separate legal entity because the activities and aspirations of the group were too wide-ranging to enable meaningful answers to the questions.

The respondents were either chief executive officers, technology management heads, from the legal department or business development executives. Although specific enquiries were not made it would be close to true to say that the questionnaires were completed at the first or second level of management, which is very satisfactory from the point of view of information available to the respondent.

It should be borne in mind that companies that did not have and never had a patent or licence agreement were deliberately eliminated. In this respect the sample was skewed compared to all South African manufacturing companies because it comprises manufacturing companies with at least rudimentary experience and knowledge of intellectual property and licences. The implication is that patenting and licensing activitities of South African manufacturing companies as reported would be diluted should all manufacturing companies be considered.

An original objective to contrast industry sectors was abandoned when it became apparent that smaller groupings would jeopardise confidentiality.

It was clear from the questionnaires that not all questions were understood or understood in the same manner. Reasons include the fact that abstract ideas were involved in many cases, unclear phrasing by the researcher partly arising from space restraints and lack of knowledge on the part of the respondents. A good example is the question regarding the use of a 'gatekeeper'. Respondents were invited to offer no response if a question was not understood and only 66 of the 81 respondents (81%) responded to what was a straightforward question provided the concept of gatekeeper was known. This lack of understanding must have affected validity and particularly content validity deleteriously. It is however submitted that generally this cannot have distorted results seriously if validity is considered to be like integrity, character or quality, to be assessed relative to purposes and circumstances. (Brinberg *et al*, 1985: 13.) These authors argue that validity must be addressed separately within three domains of research, *viz.* the conceptual, the methodological and the substantive; and in each domain in three stages of research *viz.* a pre-study, a central and a follow-up stage. In stage 1 it would mean value or worth, in stage 2 correspondence or fit and in stage 3 robustness, generalisability. The current research belongs mostly in the conceptual domain and stage 1. Where constructs are designed using several posited indicants the process is deliberately exploratory. It is admitted that validity can be improved but it is submitted that this will be at the expense of breaking down used characteristics even more and this would have rendered the questionnaire with its current scope hopelessly unwieldy. Absolute validity could never be achieved because in most cases indicants and characteristics measured in the questionnaire are abstract ideas. If this argument holds it appears that generalisability at the intrinsic overview level of this research is widely possible.

Reliability over the sample population cannot have been affected by the unexpectedly extended time required to gather the inputs and if it were it would arguably have been improved because respondents were allowed more time to suit their own schedules. It is submitted that input-representative reliability across further respondents would be maintained at the population level of the total sample. Sensitivity is increased because some constructs and indicants are profiled in differing ways. It is possible that the length of the questionnaire may have induced a lackadaisical approach by respondents towards its end but the fact that questions begged discrete responses mitigates this. The comments above regarding construct validity are also relevant to reliability.

Great care is however required when groups are considered, especially 'industry sectors' created in this research, because the sample sizes are limited. χ^2 testing for differences between groups failed because of the sparse data per group (Kerlinger, 2000 : 229). Annexure B presents as an example the results of an inter-sector comparison of characteristics shown in Tables 44 and 45, p129. No statistically significant comparison using the χ^2 test between sectors, sales volumes, manpower levels and ownership was possible because of the few data available. In the case of sectors a maximum 81 observations have to be divided among eight sectors. Although further study of many of these and other equivalent data may be interesting their inter-group relationships are not generally of direct relevance to this research and further discussion is limited to some extracts presented later.

Use of Spearman's rank correlation testing to explore the influence of various attributes on licensing activity was preferred above Pearson correlation testing because the relationship between ranks is ordinal and cannot be assumed to be a constant ratio. (Wegner, 2001: 316.) Correlation of individual company attribute ratings with licensing activity for each attribute resulted in generally very low Spearman correlation coefficients (ρ) with the highest being 0,35 (Table 45, p130). These are shown in several Tables against listed attributes.

Data sparseness and variance proved problematic. Of the 81 questionnaires used, 35% (30) reported no licences at all, 15% (12) in- plus out-licences, 37% (30) in-licences only and 14%

(11) out-licences only as set out in Table 37, p122.

Statistics	In-licences	Out-licences
Minimum per company	0	0
Maximum per company	20	25
Mean	2,07	1,22
Median	1	0
Mode	0	0
Standard deviation	3,48	3,49
Shapiro-Wilk P value	<0,0001	<0,0001

Table 35. Licence variance.

Table 35 shows the variance and the low probability that the distributions are normal. (Shapiro-Wilk P value). This variance amongst sparse data deleteriously affects seeming correlation or non-correlation between strength of an attribute or construct and licensing activity intensity expressed as average number of licences per company in any one rank as discussed at various places herein and must be borne in mind. It must be stressed that correlation discussion should be seen as exploratory and not determinate or even an attempt to be determinate. Correlation coefficients for attribute totals are therefore not proposed even though in some cases the reported values appearing seem to suggest complete correlation. At best the seeming correlation shown by average number of licences per company regarding some attributes can be viewed as ranked-group averages correlating.

Aggregate scores were calculated for several sets of indicants posited to reflect theoretical constructs. Through item analysis, correlation among the items in a set was explored to test whether they were measuring the same construct while Cronbach's alpha was used as a measure of the internal consistency of these sets composed of Likert scale items. The resulting alphas as symbol α and the accompanying item-scale correlation coefficients as symbol C are presented in relevant Tables (Bohrnstedt and Knoke, 1988).

Where considered appropriate results are compared to those of the South African Innovation Survey 2001 (hereafter SAIS) (SAIS, 2003) to examine their representativity to some extent. This is difficult because of the different definitions of characteristics polled and the different compositions of the sample populations and care is required in interpretation. Generally, however, the two sets of results where compared can be said to reflect approximately the same phenomena, increasing confidence in the validity of the current results.

Briefly the SAIS polled all South African firms in manufacturing and services with 10 or more employees that conducted economic activities during 1998 – 2000 with very acceptable validity as the described methodology makes clear. Some 32% of respondents were from the services sector including financial and business services. This is an important difference between the SAIS population and that of this research, in addition to the skewing of that of this research compared to manufacturing companies in general.

8. RESULTS

Note 1: The reference at the end of each heading below refers to the paragraph above in which the objectives are developed and motivated.

Note 2: Numerical rounding results in many cases in a series of percentages not adding up to 100%.

Note 3: In several Tables below the presence of two companies with 20 in-licences and 25 out-licences respectively is indicated with A and B. This enables identification and consideration of the possible confounding caused by their appearance in the results.

Note 3: ρ = Spearman correlation coefficients.

Note 4: α = Cronbach's alpha, measure of the internal consistency of set.

Note 5: C = accompanying item-scale correlation coefficients.

8.1 Company and industry sector demographics - 6.1

Survey objectives were to profile technology licensing within South African manufacturing 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 and geographic spread of licences. Characteristics surveyed appear in questions 1 to 11, 22, 23, 116 to 120 and 227 to 229 in Annexure A.

Further objectives were to profile for South African manufacturing companies the broad nature of the technology transfer relationship where a licence is involved, size of the other party, extent of technology adaptation required, whether research and development cost is regarded as sunk, whether transfer cost is pertinently charged and whether their Boards are sufficiently knowledgeable in relevant technology. Characteristics surveyed appear in questions 445 to 451 in Annexure A.

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8.1.1 Formation of industry sectors

To explore possible similarities and differences between industry sectors suitable sectors had to be formed from 81 responses, preserving individual anonymity, capturing a reasonable number of responses per sector and creating a reasonably homogeneous sector. Direct use of recognized systems such as the Standard Industrial Classification system proved unworkable and sectors as shown in Table 36 were arbitrarily synthesized with the aim of creating generic groups. Within any one sector a variety of activities and products and substantial size differences exist. Further substantive description of any sector is not possible due to confidentiality requirements, except to confirm that the information, communication and telecommunication (ICT) sector does per definition not include producers of only software.

8.1.2 Licences per industry sector

Table 36 reflects by industry sector the number of respondents that reported licences and the number of licences that were reported by them. Table 37 reflects combinations of licensing activity reported by each sector. Compared to the overall 29% rate of out-licensing reported, 12% of firms in the SAIS survey reported transferring or selling technology. This difference probably arises because the SAIS survey included services including financial companies and because this survey eliminated non-licensors *a priori*.

Licensing activity seems to be most intense in the chemicals including paper and textiles sector with an average 6,1 licences per respondent and 85% of respondents licensing. Building materials and components seemingly is second with a substantially lower average of four licences per respondent which are also concentrated on only three of seven respondents resulting in this sector having the most, 57%, non-licensing companies. Electrical, light shows lowest activity. From this sector came the comment that innovations are mostly incremental and are seldom considered to be economically or legally enforceably patentable.

Numbers of licences and their density per sector should be approached with care. For example, a company in the food and healthcare sector reported the maximum of 25 out-licences. It is exploiting its intellectual property through a system approximating joint venturing. If its 25 licences are removed the sector drops to second lowest overall and out-licensing activity level, while as reported it has the highest out-licensing level. Although it arguably has a skewing effect its reported position has to be accepted as a reported fact in this survey. This example also illustrates that a variety of licence types were included, a fact that should be borne in mind.

Even after removal of the 25 out-licences the food and healthcare sector still has more out-licences than in-licences, as does building materials and components mostly as a result of its activity in South Africa and Africa.

Industry sector	Respondents (N)				In-licences		Out-licences		Total licences	
	N	%	With licences	% of N	Number	No/N	Number	No/N	Number	No/N
Automotive components	10	*12*	8	*80*	29	2,9	0	0	29	2,9
Building materials & components	7	*9*	3	*43*	13	1,9	15	2,1	28	4,0
Chemicals including paper and textiles	13	*16*	11	*85*	51	3,9	28	2,2	79	6,1
Electrical, light	6	*7*	3	*50*	2	0,3	1	0,2	3	0,5
Heavy engineering	11	*14*	7	*64*	28	2,5	2	0,2	30	2,7
Food & healthcare	11	*14*	7	*64*	8	0,7	35	3,2	43	3,9
ICT & electronics	9	*11*	5	*55*	13	1,4	13	1,4	26	2,9
Metal products & machinery	14	*17*	9	*64*	24	1,7	5	0,4	29	2,1
Total	81	*100*	53	*65*	168	2,1	99	1,2	267	3,3
Ratio					1,7		1,0			
Maximum spread per company					0 to 20		0 to 25			

Table 36. Technology licences per industry sector.

Industry sector	Respondents	Respondents reporting licences						No licences	
		In only		Out only		Both			
		No	%	No	%	No	%	No	%
Automotive components	10	8	*80*	0	*0*	0	*0*	2	*20*
Building materials & components	7	1	*14*	0	*0*	2	*29*	4	*57*
Chemicals including paper and textiles	13	4	*31*	3	*23*	4	*31*	2	*15*
Electrical, light	6	2	*33*	1	*17*	0	*0*	3	*50*
Heavy engineering	11	6	*55*	0	*0*	1	*9*	4	*36*
Food & healthcare	11	1	*9*	4	*36*	2	*18*	4	*36*
ICT & electronics	9	2	*22*	1	*11*	2	*22*	4	*44*
Metal products & machinery	14	6	*43*	2	*14*	1	*7*	5	*36*

Total	81	30	*37*	11	*14*	12	*15*	28	*35*

Table 37. Combinations of licensing activity per industry sector.

It is noteworthy that 80% of all the respondent companies from the automotive components sector have licences; and in-licences only. This seems to be the case because several companies are subsidiaries of or controlled by developed world vehicle manufacturers including first tier components suppliers who are also important and prescriptive customers outsourcing their branded designs (Table 39) and confirms the scenario identified by Barnes and Kaplinsky (4.3.1 – p52).

The ratio of in- to out-licences of 1,7 may reflect South Africa's status as developing country when compared with the 1,0 of Japan (Table 8, p70) and the deduced 0,8 ratio of companies respectively so involved of the world-wide survey (Table 6, p57).

Table 38 shows the ratios of incidence of types of relationship when licences are present. Note that the results of Table 6 (p57) reflected in Table 38 represent responses when respondents were allowed to select multiple relationships, while the current survey allowed only one choice. Cross licensing occurs least and South African manufacturing companies are lagging the "world" when it comes to co-development and joint venturing. This is perhaps regrettable from the point of view of intrinsic advancement of South African manufacturing companies' technology. It should however be borne in mind that the "world" results include companies also from other industries and of other types including even research institutes. Even so the conclusion from these results and the ratio of in- to out-licences is clearly that South African manufacturing companies are fairly large net importers of technology. Against the background of the technology colonies postulated by De Wet (p4) the question arises whether the importers are aspiring to independence from their licensors and the results point to confirmation of De Wet's proposition. The remarks at 8.11, 8.12 and 8.14 on pp163, 168 and 173 regarding deployment of IP and use of licences are also relevant.

Nature of relationship	SA manufacturing companies		World-wide survey Table 6, p57
	In-licences	Out-licences	
Out-licence	-	17,00	2,20
In-licence	31,00	-	1,70
Co-development	7,50	6,33	1,53
Strategic alliance	-	-	1,45
Joint venture	10,50	9,11	1,35

Cross licence (Incidence arbitrarily set at 1.00)	1,00	1,00	1,00

Table 38. Ratio of incidence of types of licensing relationships.

8.1.3 Company ownership and licences

Table 39 shows that 65% of the respondent companies are in private hands while 35% have broader ownership; and that 69% are owned domestically, 16% by foreign owners and 15% have mixed ownership.

The ratio of in- to out-licences seems to increase when foreign ownership occurs. Against pure foreign ownership it is 3,0 which is notably higher than the average of 1,7. Much of this phenomenon can be ascribed to the automotive components sector for reasons advanced above. Against pure foreign ownership the lowest licensing activity also appears and this renders the ratio suspect due to the small numbers underlying its calculation. The seeming

Ownership		Private			Public			Domestic			Foreign			Domestic/ foreign		
Industry sector	N	Licences			Licences			Licences			Licences			Licences		
		In	Out	Co's	In	Out	Co's	In	Out	Co's	In	Out	Co's	In	Out	Co's
Automotive components	10	22		7	7		3	19		5	10		5			
Building materials & components	7	1		4	12	15	3	13	15	6			1			
Chemicals incl. paper & textiles	13	7	5	6	44 B	23	7	41 B	14	10				10	14	3
Electrical, light	6	1		4	1	1	2	1	1	4				1		2
Heavy engineering	11	27	2	10	1		1	20	2	7	5		3	3		1
Food & healthcare	11	2	30 A	6	6	5	5	2	31 A	6	0	3	3	6	1	2
ICT & electronics	9	8	4	6	5	9	3	13	11	7	0	2	1			1
Metal products & machinery	14	14	5	10	10		4	18	5	11				6		3
Total	81	82	46	53	86	53	28	127	79	56	15	5	13	26	15	12
Ratio in/out		1,78			1,62			1,61			3,00			1,73		

Licences/ company	In	Out	In	Out	In	Out	In	Out	In	Out
	1,55	0,86	3,07	1,89	2,26	1,41	1,15	0,38	2,17	1,25

Note: Company totals include companies with no licences.

Table 39. Company ownership and licences.

ratio of 1,78 for domestically owned companies is skewed by the one company with 25 out-licences and increases to 3,73 if only one out-licence is recognised for this company.

While the small sample may be subject to undue influence from this company it is worth reiterating that there is no reason to remove it or an arbitrary part of its licences. The density of out-licences across total companies responding is clearly lower than that of in-licences.

8.1.4 Company sales volume and portion derived from in-licences

Table 40 shows that respondents were reasonably representative across the sales volume range. Not surprisingly, the chemicals including paper and textiles sector is weighted towards greater volumes. None of the heavy engineering sector respondents has sales exceeding R500m per year. This may be partly because job shopping is prevalent and each is supplying just parts of big projects. No trend in licensing activity against sales size could be discerned.

Industry sector	Domestic sales (Rm/year) and % derived from in-licences						Export sales (Rm/year) and % derived from in-licences					
	<10	10-50	51-200	201-500	>500	%	<10	10-50	51-200	201-500	>500	%
	N						N					
Automotive components	2	0	2	3	3	11	1	5	2	1	1	10
Building materials & components	0	1	2	2	2	8	2	4	1	0	0	8
Chemicals including paper and textiles	2	2	1	1	7	15	2	1	4	3	3	15
Electrical, light	1	2	1	1	1	7	1	2	3	0	0	5
Heavy engineering	2	4	2	3	0	15	4	2	4	1	0	15
Food & healthcare	4	2	0	2	3	18	5	2	0	2	1	19
ICT & electronics	4	1	1	0	3	13	4	2	1	1	1	14

Metal products & machinery	2	5	2	1	4	13	7	2	2	2	1	14
Total	17	17	11	13	23	100	26	20	17	10	7	100

N = 81 N = 80

Table 40. Company sales size and portion derived from in-licences.

Food and healthcare shows the greatest proportion of sales derived from in-licences which seems to indicate, read with its second lowest density of in-licences that the few licences are of importance. This is consistent with the view that bigger volumes across fewer products may be sought. The next sectors, fairly closely behind are chemicals, heavy engineering, ICT and electronics and metal products and machinery. This finding seems intuitively correct except for the latter which is skewed by one company showing a very high proportion due to an extraordinary arrangement including a licence allowing South and Southern African exploitation of machinery.

The light electrical sector has the lowest proportion which is perhaps caused by its second lowest in-licensing intensity. Building material and components with relatively low in-licensing activity as well as the lowest proportion of companies licensing (43%, Table 36, p122) also ranks lowly.

Automotive components is third lowest and has about 60% of the highest proportion. It also shows the second highest in-licensing density. This may point to in-licences with low added value and raises questions about their technological content.

Table 41 suggests that patent holdings increase with company size as measured by domestic sales, even if the two companies which reported a combined holding of 632 patents and whose sales ratings correspond and are identified by X are removed. After such, strictly speaking, incorrect removal the distribution of average patents per company in the case of export sales retains the approximately normal distribution with no discernible trend.

Domestic	Sales (Rm/year)					Notes
	<10	10-50	51-200	201-500	>500	
Number of companies	14	17	11	11	18	71
Total patents	127	222	87	215	895 X	
Average patents per company	9	13	8	20	50	ρ=0,12
Export						

Number of companies	23	19	16	9	3	70
Total patents	289	124	1006 X	93	30	
Average patents per company	13	7	63	10	10	ρ=0,18

Table 41. Company sales size and extent of patent holding.

8.1.5 Geographic spread of in- plus out-licences

Table 42 shows the geographic spread of licences reported. Clearly international licensing is most intense to and from Europe with 35% of all licences reported. (The SAIS survey reported a high concentration of innovation partners in Europe.) This intensity exceeds even that within South Africa. North America is next at only 13% followed by Asia at 7%. These findings seem to confirm South Africa's past and continuing contact with Europe and perhaps builds on Kang's contention that the Europeans are most truly global (6.3, p90).

While the chemicals including paper and textiles sector also follows this trend it shows relatively intense activity within South Africa. Some distortion is introduced by one chemical company that has 20 in-licences from mostly other companies within the same group.

This sector with building materials and components and food and healthcare are the only three active in Africa. This may point to South Africa indeed seeking opportunities in Africa, perhaps especially in sectors where needs are high leading to local activity.

Industry sector	RSA	Africa	Europe	North America	South America	Asia	Middle East	Other
Automotive components	0	0	19	2	0	8	0	0
Building materials & components	17	4	5	0	1	0	0	1
Chemicals including paper and textiles	42	5	17	8	2	3	1	1
Electrical, light	1	0	1	1	0	0	0	0
Heavy engineering	1	0	13	9	5	0	0	2
Food & healthcare	5	8	15	5	2	5	2	1
ICT & electronics	9	0	11	3	0	2	0	1
Metal products & machinery	8	0	13	6	0	2	0	0
Total = 267	83	17	94	34	10	20	3	6
%	31	6	35	13	4	7	1	2

Table 42. Geographic spread of in- plus out-licences.

Table 43 accentuates the higher licensing activity within South Africa and between South Africa and Europe. An expected result is what appears to be net in-licensing by South Africa apart from with Africa, South America and the Middle East. The apparent in-licensing activity in South Africa is somewhat distorted by one company's 20 in-licences from mostly others within the same group. Perhaps in- and out-licensing within South Africa is actually more balanced. The question arises why the ratio of in- to out-licences is relatively higher in the case of Europe. This ratio declines for other countries and arguably the lower in-company to out-company ratios serve as an indication that South African manufacturing companies are searching for and getting out-licensing opportunities in other parts of the world, as seems to be the case for Africa.

Area	Number of licences		Max. number/company		Number of companies *	
	Inwards	Outwards	Inwards	Outwards	Inwards	Outwards
RSA	46	37	20	10	12	11
Africa	2	15	2	4	1	6
Europe	74	20	7	8	26	9
North America	25	9	5	2	14	7
South America	5	5	5	2	1	4
Asia	13	7	6	4	7	3
Middle East	0	3	0	2	0	2
Various	3	3	1	1	3	3
Total	168	99			64	45

* These totals are greater than those in Table 36 because companies here can be counted more than once if they have licences in more than one area.

Table 43. Prevalence of licences.

8.1.6 Relationship between various company characteristics and licence intensity

Table 44 shows that respondents generally consider their capital intensity above average with none rating themselves not at all capital intensive. In-licence density is highest among those rating themselves lowest at partly capital intense. The fact that five of the nine respondents from the ICT and electronics sector rated themselves thus and have several in-licences contributed to this. Out-licensing shows a decided peak in the case of extreme capital intensity. This coincides with the high out-licensing activity in the chemicals including paper and textiles and the food and healthcare sectors; and probably also underlies the possibly higher in-licensing shown.

Automation shows a balanced distribution while the licensing pattern resembles that of capital intensity with high in-licensing under “minor” and an out-licensing peak under “extreme”. In-licensing activity seems to increase with decreased automation except for the lowest automation level which includes job shops. Job shops show low activity which could be due to the one off nature of their activities. The overall trend could reflect increasing automation involving more turnkey equipment and jobbing shops doing things mostly once. Out-licensing increases with automation but not if the 25 out-licences of the single company are removed. The three companies rating themselves “extreme” are from the chemicals and food and healthcare sectors.

None of the Spearman correlation coefficients have statistically meaningful magnitude.

Attribute	Company view of attribute					Notes
Capital intensity	Extreme	Very	Average	Partly	Not at all	
Number of companies	10	31	27	12	0	80
%	13	39	34	15	0	100
No. of in-licences (N=80)	28	36	59	45 A	0	
Number per company	2,80	1,16	2,19	3,75	0	ρ=-0,13
No. of out-licences (N=80)	47 B	7	28	16	0	
Number per company	4,70	0,23	1,04	1,33	0	ρ=0,06
Automation	Extreme	Mostly	Mix	Minor	Job shop	
Number of companies	3	22	33	15	8	81
%	4	27	41	19	10	100
No. of in-licences (N=78)	0	40	75	46 A	7	
Number per company	0	1,82	2,27	3,07	0,88	ρ=-0,08
No. of out-licences (N=78)	10	37 B	30	15	7	
Number per company	3,33	1,68	0,91	1,00	0,88	ρ=-0,06

Table 44. Profile of perceived capital intensity and automation levels.

From Table 45 respondents having “excellent” research and development have the second lowest in-licence density after those with a “poor” rating. Those with a “none” rating have the second highest and is close to “adequate” when the 20 licences from a single company are removed from the latter and a deliberate policy not to do research could also contribute to this phenomenon. Out-licensing has a peak when research and development becomes “excellent”, assisted by the contribution of 25 licences by one company . This could indicate that an excellent function and perhaps the best and most complete technology do indeed deliver out-licences. The lower peak against “adequate” could be due to increased awareness of active out-licensing practitioners that yet more could be done. Research and development with intent to license (62% report poor and none) and technology licensing and selling (29% adequate, 54% poor and none) are respectively decidedly and seemingly considered below average. Considering that 84% thought out-licensing is profitable for the licensor and 12% very profitable (Table 47, p132) the question why arises. It could be that the lack of proper organisation for out-licensing contributes (Table 84, p170) but the reason for this lack could in turn be questioned. Perhaps respondents are simply not sufficiently acquainted with what may be termed the licensing discipline. It is certainly true that certain companies would be practising technology which may not be appropriable but it should be borne in mind that all respondents were chosen because of some involvement in patents or licences. While this question can regrettably not be answered from this research it offers useful directed further research opportunities. See also Table 81, p167 for a sectoral profile.

Capability	Company view of capability					Notes
	Excellent	Good	Adequate	Poor	None	
Research & development is						
Number of companies	17	30	19	10	4	80
%	21	38	24	13	5	100
No. of in-licences (N=80)	20	54	75 A	10	9	
Number per company	1,18	1,80	3,95	1,00	2,25	ρ=-0,11
No. of out-licences (N=80)	50 B	12	31	6	0	
Number per company	2,94	0,40	1,63	0,60	0	ρ=0,04
R&D with intent to license is						
Number of companies	5	11	15	23	26	80
%	6	14	19	29	33	100
No. of in-licences (N=80)	11	27	38	29	63 A	
Number per company	2,20	2,45	2,53	1,26	2,42	ρ=0,10
No. of out-licences (N=80)	36 B	15	27	9	12	
Number per company	7,20	1,36	1,80	0,39	0,46	ρ=0,23
Design is						
Number of companies	20	41	11	4	4	80
%	25	51	14	5	5	100
No. of in-licences (N= 80)	34	104 A	8	7	15	
Number per company	1,70	2,54	0,73	1,75	3,75	ρ=0,03
No. of out-licences (N=80)	40 B	48	1	6	4	
Number per company	2,00	1,17	0,09	1,50	1,00	ρ=0,05
Development is						
Number of companies	16	36	17	4	7	80
%	20	45	21	5	9	100
No. of in-licences (N=80)	19	80 A	46	0	23	
Number per company	1,19	2,22	2,71	0	3,29	ρ=-0,11
No. of out-licences (N=80)	42 B	29	19	4	5	
Number per company	2,63	0,81	1,12	1,00	0,71	ρ=0,03
Technology licensing and selling is						
Number of companies	3	10	23	18	24	78
%	4	13	29	23	31	100
No. of in-licences (N=78)	11	11	52	31	62 A	
Number per company	3,67	1,10	2,26	1,72	2,58	ρ=-0,01
No. of out-licences (N=78)	28 B	25	19	20	7	
Number per company	9,33	2,50	0,83	1,11	0,29	ρ=0,35

Table 45. Profile of perceived development and licensing capabilities.

Out-licensing activity increases impressively when research and development with the intention to license is rated “excellent” and remains highest after removal of the single company’s contribution of 25 licences. (This company rated itself “excellent” against all characteristics.) This phenomenon is accompanied by a weak Spearman correlation coefficient of 0,23 indicating positive correlation between research and development with intent to license and licensing activity and echoes the results for research and development.

Comparing licensing activity to design and development capability proves erratic. It is possible that companies from the chemicals and biotechnology sectors are confounding the overall results because these capabilities could best be associated with hardware.

No trend in in-licensing can be discerned as technology licensing and selling capability varies. It could be argued that the prompt in the questionnaire “Technology licensing and selling is Excellent … none” is illogical and caused confusion because of its implication that it concerns outward capability.

Out-licensing increases with capability to out-license and has a Spearman correlation coefficient of 0,35 which is still not statistically significant. When the capability peaks out-licensing increases strongly due to the contribution of the single company.

Note: The relationships between the first two attributes and the fifth attribute shown in Table 45 and patent portfolios are set out in Table 76, p161.

8.1.7 Inter-sector characteristics

Sectoral licensing and selling abilities are set out in Table 46. (For research and development with objective to license see Table 81, p167.

Technology licensing and selling is (%)	Excellent	Good	Adequate	Poor	None	N
Automotive components	0	10	20	10	60	10

Building materials and components	0	29	29	43	0	7
Chemicals including paper & textiles	0	8	25	33	33	12
Electrical, light	0	17	17	0	67	6
Heavy engineering	9	9	36	18	27	11
Food & healthcare	10	20	30	10	30	10
ICT & electronics	0	11	44	44	0	8
Metal products & machinery	8	8	31	23	31	13

Table 46. Sectoral technology licensing and selling ability.

The *caveat* raised in 8.1.6 above, that the question may have been confusing, applies to Table 46. The automotive components sector seems to acknowledge its one-sided in-licensing practice; as does the light electrical sector its scarcity of licences. Noteworthy is what may seem like a lack of self-confidence or may be realism reflected in the assessments of the others and especially by the relatively high activity chemicals and food, building and healthcare sectors.

8.1.8 Select other factors influencing licensing

Table 47 shows what may be expected, *viz.* that more in-licences come from bigger companies. It also shows somewhat surprisingly that more out-licences are concluded with smaller companies. This may mean that South African licensors avoid or fail to convince bigger international companies of the value of their technology and may be true even if the 37 out-licences to South Africa and the 15 to Africa, or 52%, are removed. Further research into this apparent phenomenon may yield interesting insights.

Usual size of other party (US$m/y)	<5	5 to 25	25+ to 50	50+ to 100	>100	Total
In-licence, companies	7	9	6	9	16	47
%	15	19	13	19	34	100
Out-licence, companies	10	12	7	1	4	34
%	29	35	21	3	12	100

Technology adaptation required	Extensively	Moderately	Not at all	
In-licence, companies	4	41	6	51
%	8	80	12	100
Out-licence, companies	5	23	9	37
%	14	62	24	100
Relevant technology knowledge of Board of Directors	Ample	Moderate	Not at all	
Companies	27	23	11	61
%	44	38	18	100
R&D cost is considered sunk	Yes	Sometimes	Never	
In-licence, companies	27	14	7	48

%	56	29	15	100
Out-licence, companies	19	14	3	36
%	53	39	8	100
Transfer cost is pertinently charged	Always	Usually	Never	
In-licence, companies	4	33	11	48
%	8	69	23	100
Out-licence, companies	4	22	10	
%	11	61	28	100
Respondent believes licensing is profitable for licensor	Very much	Yes	Worthless	
In-licence, companies	6	43	2	
%	12	84	4	100
Out-licence, companies	3	36	1	
%	8	90	3	100

Table 47. Other factors influencing licensing.

Moderate adaptation of licensed technology is mostly required.

The technology knowledge of Boards of directors is mostly sufficient, research and development cost is mostly regarded as sunk and transfer cost is mostly pertinently charged.

An overwhelming majority of respondents consider licensing to be profitable for the licensor. Useful further research establishing closer definitions of 'licensing' and analysing this finding against an arguably low licensing rate amongst South African manufacturing companies could provide valuable insights.

8.2 Companies' physical and personnel organisation - 6.5

Survey objectives: Profile South African manufacturing companies' organisation structure in terms of geographic 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 Here Syndrome. Characteristics surveyed appear in questions 21, 43 to 47, 49 to 51 and 130 in Annexure A.

For licensing organisation see 8.13 below.

Analyse prevalence of NIH syndrome.

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8.2.1 Physical location and organogram.

Table 48 provides an overview of respondents' physical locations and organograms regarding research and development. Not surprisingly, single unit operation predominates while research and development is unified even when companies operate several divisions and in several locations. This may mean that companies are to some extent alert to and avoiding the risk of imprisoned resources and bounded innovation warned against by Prahalad and Hamel (6.5.2, p98). Seven of the 80 respondents whose replies were useful reported no research and development function. Reasons are that technology is supplied from a parent company or a central source elsewhere in a group as well as small size rendering direct involvement of top and production management optimum. In the latter case research and development does take place albeit more informally.

Where no Head of research and development exists but research does take place the CEO generally is the *de facto* Head. Where a Head does exist the position reports to the CEO in 56% and to lesser functionaries in 43% of cases. Even in these the probability that this immediate superior reports to the CEO seems high and this means that companies are recognising the importance of the Chief Technical Officer as Foster urges. (6.5.2, p97).

Geographic location	Attribute					
	Geographic organisation		Operation of research and development		Research and development report node(s)	
	Companies reporting	%	Companies reporting	%	Companies reporting	%
One unit	34	42	49	61	49	70
Strategic business units	13	16	14	18	8	11
Divisions	10	12	9	11	11	16
Two or more locations	16	29				
One unit, divisions, two or more locations	1	1				
Strategic business units, divisions	1	1			1	1
Divisions, two or more locations	5	6				
Strategic business units, two or more locations	1	1				
One unit, divisions			1	1	1	1
No research and development			7	9		
Number of companies reporting	81	100	80	100	70	100
Head of research and development reports to (N = 81) ……						

CEO/ COO/ GM/ MD	Group Marketing Director	Technol./ Technical Director	Manufac-turing Director	Division Manager	Technol./ Technical Manager	Engineering Manager	New Business Manager	No Head
28	1	6	2	6	3	4	1	30
35%	1%	7%	2%	7%	4%	5%	1%	36%

Table 48. Companies' geographic organisation and organograms.

8.2.2 Management education and encouragement of innovative activities

Table 49 shows that respondents mostly deem management education very satisfactory. Only two of 80 respondents reported "uneven" education. It has to be recorded that the question may have been difficult to respond to because management was bundled together and perceptions of "good' will vary. As an example, a question raised by a respondent was: "All our top management have MBAs. Does this rate good or best?"

Out-licensing activity increases as management education improves but the Spearman correlation coefficient is weak at 0,19. This trend is maintained if the 25 out-licences contributed by a single company are removed. Arguably management education level measures sophistication of a company and increasing sophistication may require or result in increasing licensing activity. Again further research may be useful.

The question on manpower availability may have been too broad in not distinguishing between types and therefore responses should probably be read as tending to exclude blue collar workers. "Abundant" availability was selected by one company from the food and healthcare sector. "Can select" was not selected by any of the companies from the chemicals including paper and textiles, heavy engineering and ICT and electronics sectors, "scarcely" occurred mostly in the first two of these, indicating greater scarcity in these. Somewhat surprisingly no ICT and electronics company rated its situation "scarcely". This could perhaps be an effect of the slump in particularly this sector.

Attribute	Company view of attribute					Notes
Management education is	Best	Good	Average	Uneven	Weak	
Number of companies	15	49	15	2	0	81
%	19	60	19	2	0	100
No. of in-licences (N=81)	20	119 A	27	2	0	
Number per company	1,33	2,43	1,80	1,00	0	ρ=0,16
No. of out-licences (N=81)	42 B	51	6	0	0	

Number per company	2,80	1,04	0,40	0	0	ρ=0,19
Manpower availability	Scarcely	Can find	Fair	Can select	Abundant	
Number of companies	17	32	20	10	1	80
%	21	40	25	12	1	100

Table 49. Management education and manpower availability.

Table 50 shows good attention to the need to maximise technology capability among disciplines, functions and strategic business units. In the aggregate only 10 companies or 13% rated themselves under "not at all". This rating is encouraging, demonstrating respondents' awareness of the value of technology, while still leaving room for improvement.

It is not possible to suggest licensing activity trends against any of these attributes as the low Spearman coefficients of correlation also show. However, in out-licensing "sporadically" rated companies have least licensing activity for each attribute while out-licensing is highest for "continually" rated companies.

The aggregate is further discussed as part of Techno-economic networks in 8.3, p138.

Attribute	Company view of attribute				Notes
Alertness to the need to maximise, and actual deliberate maximisation of, technology capability.					
	Continually	Sporadically	Not at all	Not applicable	
Among disciplines					C=0,89
Number of companies	34	31	3	7	75
%	45	41	4	9	100
No. of in-licences (N=68)	85	73 A	2	2	
Number per company	2,50	2,35	0,67		ρ=0,06
No. of out-licences (N=68)	73 B	16	4	0	
Number per company	2,15	0,52	1,33		ρ=0,08
Among functions					C=0,92
Number of companies	31	35	3	6	75
%	41	47	4	8	100
No. of in-licences (N=69)	63	91 A	3	6	
Number per company	2,03	2,60	1,00		ρ=-0,07
No. of out-licences (N=69)	70 B	20	4	1	
Number per company	2,26	0,57	1,33		ρ=0,09
Among strategic business units					C=0,89
Number of companies	29	24	5	17	75
%	39	32	7	23	100
No. of in-licences (N=58)	87 A	32	8	34	
Number per company	3,00	1,33	1,60		ρ=0,13
No. of out-licences (N=58)	62 B	10	4	21	
Number per company	2,14	0,42	0,80		ρ=0,11

Aggregate *					
Number of reports (N)	28	33	10	4	75
%	37	44	13	5	100
No. of in-licences	66	74	21	1	
Number per company	2.36	2.24	2.10	0.25	
No. of out-licences	60	23	13	2	
Number per company	2.14	0.70	1.30	0.50	
Aggregate for correlation *					α=0,87
Number of reports (N)	33	36	2		71
%	46	51	3		100
No. of in-licences	78	82	1		
Number per company	2,36	2,28	0,50		ρ=0,05
No. of out-licences	74	18	4		
Number per company	2,24	0,50	2,00		ρ=0,10

Note: "Not applicable" ratings were ignored for correlation purposes.

Table 50. Management motivation.

* N here means companies that rated themselves against at least one of the three attributes. The aggregate rating was calculated by calculating an average for each company that rated itself against at least one attribute. Each such attribute average was rounded and the company placed in the rank thus indicated. Licences for each company so accounted for were added up and divided by the number of companies so qualifying to find the average number of licences per company.

What may seem anomalous – *e.g.* lower number of reports (= companies) and higher number of out-licences per company in the aggregate than in any of its constituent attributes – is correct because aggregation may place any company in a different rank and the companies therefore are not necessarily the same.

This approach applies to all other aggregates appearing henceforth.

8.2.3 Not Invented Here syndrome

From Table 51 the Not Invented Here (NIH) syndrome does not seem to be a general problem although only 23% of respondents reported its absence. The majority of cases seem to be "isolated" occurrence (59%). Only 4% of respondents reported "pervasive" presence. The "bothersome" ratings have relatively high licensing activity and it may be that such activity increases awareness of the syndrome.

Occurrence of Not Invented Here syndrome	Pervasive	Bothersome	Isolated	Absent	Notes
Number of companies	3	9	41	16	69
%	4	13	59	23	100
No. of in-licences (N=69)	13	21	70 A	47	
Number per company	1,42	2,33	1,71	2,94	ρ=0,06
No. of out-licences (N=69)	0	36 B	48	13	
Number per company	0	4,00	1,17	0,81	ρ=0,01

Table 51. Occurrence of Not Invented Here syndrome.

Table 52 indicates that the NIH syndrome is most felt in the food and healthcare sector followed by chemicals and ICT and electronics. As stated above this may reflect out-licensors that have come up against the syndrome amongst potential licencees and is an aspect that may be further researched.

Incidence of NIH syndrome (%)	Pervasive	Bothersome	Isolated	Absent	N
Automotive components	0	0	63	38	8
Building materials and components	0	17	83	0	6
Chemicals including paper & textiles	8	15	54	23	13
Electrical, light	0	0	60	40	5
Heavy engineering	13	0	63	25	8
Food & healthcare	11	22	56	11	9
ICT & electronics	0	22	56	22	9
Metal products & machinery	0	18	55	27	11

Table 52. Not Invented Here syndrome in sectors.

8.3 Techno-economic networks (TENs) - 2.3

Survey objectives: Profile characteristics 15 to 20 listed below for South African manfacturing companies. (For 49 to 51 see Table 50, p136.)

Notional postulate: A technology licensing and selling and acquisition TEN in a South African manufacturing company will manifest indirectly through the proposed indicants and will correlate positively with technology licensing and trading activities of the company.

Question in Annexure A	Characteristic or aggregate construct proposed as indicant of TEN activity	
15	Awareness of competitors' successes	
16	Awareness of competitors' failures	
17	Awareness of competitors' licensing activities	Aggregate
18	Top management's liking or disliking of licensing	
19	International experience	
20	Travel abroad	Aggregate
49	Maximisation of technology capabilities amongst disciplines	

50	Maximisation of technology capabilities amongst functions	Aggregate
51	Maximisation of technology capabilities amongst business units	

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Table 53 shows high awareness of competitors' successes and failures and somewhat less of their licensing activities which is understandable because these tend to be conducted in private. This attribute is the only one which contains a none rating by one company.

No trend in licensing activity against any of the attributes or the aggregate construct can be suggested although Cronbach's α = 0,76 and the item-scale correlation coefficients C are greater.

Attribute	Company view of attribute					Notes
	Awareness of competitors' - - -					
	Complete	Active	Average	Vague	None	
Successes						C=0,80
Number of companies	11	57	13	0	0	81
%	14	70	16	0	0	100
No. of in-licences N=81)	10	119 A	39	0	0	
Number per company	0,91	2,09	3,00	0	0	ρ=-0,19
No. of out-licences (N=81)	16	71 B	12	0	0	
Number per company	1,45	1,25	0,92	0	0	ρ=-0,01
Failures						C=0,87
Number of companies	7	54	15	5	0	81
%	9	67	19	6	0	100
No. of in-licences (N=81)	9	110 A	31	18	0	
Number per company	1,29	2,04	2,07	3,60	0	ρ=-0,11
No. of out-licences (N=81)	4	81 B	6	8	0	
Number per company	0,57	1,50	0,40	1,60	0	ρ=-0,04
Technology licensing activity						C=0,85
Number of companies	7	38	20	15	1	81
%	9	47	25	19	1	100
No. of in-licences (N=81)	29 A	75	34	30	0	
Number per company	4,14	1,97	1,70	2,00	0	ρ=0.08
No. of out-licences (N=81)	8	61 B	16	14	0	
Number per company	1,14	1,61	0,80	0,93	0	ρ=0,01
Aggregate awareness						α=0,76
Number of reports (N)	7	51	19	4	0	81
%	9	63	23	5	0	100
No. of in-licences	9	117	30	12	0	
Number per company	1,29	2,29	1,58	3,00	0	ρ=-0,02

No. of out-licences	4	80	7	8	0	
Number per company	0,57	1,57	0,37	2,00	0	ρ=0,06

Table 53. Awareness of competitive environment.

Table 54 shows that only 4% of management dislikes licensing with 44% accepting it and 52% liking it. International exposure seems very satisfactory with only 4% reporting only some or no international experience and 12% sporadic or no travel abroad.

It may be speculated that in-licensing activity, and out-licensing activity discounting the contribution of 25 licences from a single company, increase with liking. Increasing licensing activity with increasing international activities including for the aggregate construct may be possible. α = 0,80 with item-scale correlation coefficient C = 0,90 and 0,94 for the two constituent attributes.

Attribute	Company view of attribute					Notes
Top management's liking of licensing	Likes	Uses	Accepts	Ignores	Dislikes	
Number of companies	17	25	36	0	3	81
%	21	31	44	0	4	100
No. of in-licences (N=81)	45 A	62	60	0	1	
Number per company	2,65	2,48	1,67	0	0,33	ρ=0,10
No. of out-licences (N=81)	22	55 B	22	0	0	
Number per company	1,29	2,20	0,61	0	0	ρ=0,16
International experience	Excellent	Good	Fair	Some	None	C=0.90
Number of companies	23	44	10	2	1	80
%	29	55	13	3	1	100
No. of in-licences (N=80)	42	107 A	17	1	0	
Number per company	1,83	2,43	1,70	0,50	0	ρ=-0,01
No. of out-licences (N=80)	47 B	32	18	0	2	
Number per company	2,04	0,73	1,80	0	2,00	ρ=0,08
Travel abroad	Extensive	Often	Regular	Sporadic	None	C=0,94
Number of companies	26	28	16	9	1	80
%	33	35	20	11	1	100
No. of in-licences (N=80)	61	68 B	23	10	0	
Number per company	2,35	2,43	1,44	1,11	0	ρ=0,09
No. of out-licences (N=80)	65 A	22	5	5	0	
Number per company	2,50	0,79	0,31	0,56	0	ρ=0,17
Aggregate international experience and travel	Best				None	α=0,80
Number of reports (N)	16	38	21	4	2	81
%	20	47	26	5	2	100
No. of in-licences	27	103	35	3	0	
Number per company	1,69	2,71	1,67	0,75	0	ρ=0,07

No. of out-licences	47	29	20	1	2	
Number per company	2,94	0,76	0,95	0,25	1.00	ρ=0,09
Note: **Aggegate of maximisation amongst disciplines, functions and stategic business units : detail in Table 50 p136.**						

Table 54. Attitude to licensing and international exposure.

The aggregate construct from maximisation of technology capabilities detailed in Table 50, p136 may show increasing out-licensing activity with increasing attention to maximisation. $\alpha = 0,87$ with higher item-scale correlation coefficients C for the constituent attributes.

Table 55 reflects assessments of top managements' attitudes to licensing across sectors. Considering the relatively low portion of sales derived from licensing and the several licences the automotive sector's high assessment of two "likes", seven "uses" and one "accepts" may be subject to the qualification question: "To best effect for self?"

Assessment in the chemicals sector seems conservative considering its seemingly highest licensing activity and ICT & electronics and heavy engineering seem resigned considering their middling activity.

It would appear that focussed further research into managements' attitudes to licensing may yield interesting insights.

Top management and licensing (%)	Likes	Uses	Accepts	Ignores	Dislikes	N
Automotive components	20	70	10	0	0	10
Building materials and components	14	67	29	0	0	7
Chemicals including paper & textiles	31	15	54	0	0	13
Electrical, light	17	17	50	17	0	6
Heavy engineering	9	27	55	9	0	11
Food & healthcare	45	27	27	0	0	11
ICT & electronics	22	11	56	11	0	9
Metal products & machinery	7	29	64	0	0	14

Table 55. Sectoral top managements' attitude to licensing.

Generalising from Table 56 all sectors are keeping up their international experience with chemicals the seeming leader. One smallish company from the ICT & electronics sector is exploiting foreign technology yet insists that its international experience and travel (Table 54) are "none".

Incidence of international experience (%)	Excellent	Good	Fair	Some	None	N
Automotive components	11	89	0	0	0	9
Building materials and components	14	57	29	0	0	7
Chemicals including paper & textiles	31	69	0	0	0	13
Electrical, light	50	17	33	0	0	6
Heavy engineering	27	64	9	0	0	11
Food & healthcare	45	45	9	0	0	11
ICT & electronics	33	33	11	11	11	9
Metal products & machinery	21	50	21	7	0	14

Table 56. Incidence of sectoral international experience.

From Table 57 chemicals appear to be the leader also in international travel. Considering the small sample light electrical's "extensive" at 67% is probably misleading.

Incidence of international travel (%)	Extensive	Often	Regular	Sporadic	None	N
Automotive components	30	20	50	0	0	10
Building materials and components	0	43	43	14	0	7
Chemicals including paper & textiles	42	50	8	0	0	12
Electrical, light	67	0	17	17	0	6
Heavy engineering	27	36	18	18	0	11
Food & healthcare	27	45	18	9	0	11
ICT & electronics	56	11	0	22	11	9
Metal products & machinery	21	50	14	14	0	14

Table 57. Incidence of sectoral international travel.

For summary finding on notional postulate see 9.1.7, p198.

8.4 Approach to risk and pioneering - 6.2

Survey objectives: Profile South African manufacturing companies' perception of self regarding risk taking or conservatism, pioneering or following.

Notional postulate: Risk taking and pioneering will correlate positively and conservatism and followership negatively with in- and out-licensing activities.

Question in Annexure A	Proposed indicant surveyed
13	Risk taker or conservative
14	Pioneer or follower

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Table 58 shows no bias regarding orientation *vis-à-vis* risk taking or conservatism. Regarding pioneering 81% of respondents deemed themselves careful pioneers or pioneers. No trend in licensing activity can be suggested.

Attribute	Company view of attribute					Notes
Risk/conservatism	Risk taker	Tend to risk	Neutral	Careful	Conservative	
Number of companies	7	29	13	24	8	81
%	9	36	16	30	10	100
No. of in-licences (N=81)	15	38	53 A	34	28	
Number per company	2,14	1,31	4,08	1,42	3,50	ρ=-0,16
No. of out-licences N=81)	41 B	34	5	7	12	
Number per company	5,86	1,17	0,38	0,29	1,50	ρ=0,09
Pioneering	Pioneer	Careful	Neutral	Careful	Follower	
Number of companies	39	27	5	8	2	81
%	48	33	6	10	2	100
No. of in-licences (N=81)	61	49	35 A	22	1	
Number per company	1,56	1,81	7,00	2,75	0,50	ρ=-0,17
No. of out-licences (N=81)	79 B	16	4	0	0	
Number per company	2,03	0,59	0,80	0	0	ρ=0,25

Table 58. Profile of companies' economic orientation.

From Tables 58, 59 and 60 it seems that the respondents could be generalised as tending to pioneering but in conservative fashion.

Approach to risk (%)	Risk taker	Tend to risk	Neutral	Careful	Conservative	N
Automotive components	0	10	50	40	0	10
Building materials and components	0	71	29	0	0	7
Chemicals including paper & textiles	15	23	15	38	8	13
Electrical, light	0	50	0	33	17	6
Heavy engineering	0	18	18	55	0	11
Food & healthcare	9	55	0	9	27	11
ICT & electronics	22	44	11	22	0	9
Metal products & machinery	14	36	7	29	14	14

Table 59. Sectoral approach to risk taking.

Approach to pioneering (%)	Pioneer	Careful	Neutral	Careful	Follower	N
Automotive components	30	10	10	50	0	10
Building materials and components	43	57	0	0	0	7
Chemicals including paper & textiles	38	46	8	0	8	13
Electrical, light	50	33	17	0	0	6
Heavy engineering	36	55	0	9	0	11
Food & healthcare	73	18	9	0	0	11
ICT & electronics	56	33	11	0	0	9
Metal products & machinery	57	21	0	14	7	14

Table 60. Sectoral approach to pioneering.

For summary finding on notional postulate see 9.1.7, p198.

8.5 Accounting systems - 6.3

Survey objectives: Profile South African manufacturing companies' accounting systems in terms of divisionality, product line focus, short or long term, explicit encouragement of innovation, imposition by parent. Attempt to deduce impact on licensing. Refer question 25 in Annexure A.

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Table 61 indicates the frequency of occurrence of various orientations in accounting systems.

As expected several respondents reported the presence of more than one but only three list the combination of encouraging innovation and also recognising licensing income. Only 23% of respondents have a "short term" and 32% a "long term" view accounting system. For 45% time orientation seems to be irrelevant or "medium term". Clearly "detailed cost' systems are prevalent. This may well be inspired by several respondents being outsources because in-licences and not out-licences are most frequent when companies report this system.

A mere 5% indicated that licensing income from out-licences is recognised and only 5% has a system that encourages innovation. From the available data it does not appear that licensing activity is more intense at these.

The three companies reporting that licensing income is recognised and innovation is encouraged are from the building materials and components, chemicals and metal products and machinery sectors and respectively have in- and out-licences as follows: 2/0, 6/2, 5/13.

Accounting characteristic	Companies reporting (N=77)		Only companies having licences (%)					
	Number	%	In N	%	Out N	%	Either N	%
Divisional	29	38	13	17	11	14	19	25
Product line	24	31	14	18	5	6	16	21
Detailed cost	44	57	25	32	9	12	27	35
Short term view	18	23	10	13	8	10	15	19
Long term view	25	32	10	13	5	6	13	17
Encourages innovation	8	10	5	6	4	5	6	8
Imposed by parent company	18	23	9	12	4	5	11	14
Recognises licensing income	10	13	5	6	4	5	8	10
Total number of reports	176							
Encourages innovation and recognises licensing income	[3]							

Table 61. Overview of accounting systems.

8.6 Regulatory environment - 6.4

Survey objectives: Profile South African manufacturing companies' perception of patent, design and trade mark systems, licence agreement control systems, exchange control systems. Characteristics surveyed appear in questions 33 to 39 in Annexure A.

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From Table 62 respondents generally seem satisfied with regulatory systems with "unsound" ratings never exceeding 5%.

The two "perfect" assessments of agreement control abroad are suspect because it is doubtful that the particular two respondents have sufficient experience. Yet it has to be noted that other respondents also rated agreement control abroad relatively high. While the same ratings were requested for "agreement control" locally and abroad it would appear that the question which was intended to enquire about exchange control regulations impinging on payments pertaining to licences was framed and interpreted too broadly and the results have to be discarded.

Environmental attribute	Company view of attribute					Total
	Perfect	Good	Fair	Improve	Unsound	
RSA's patent system						
Number of companies	0	32	28	10	4	74
%	0	43	38	14	5	100
RSA's designs system						
Number of companies	0	26	30	8	3	67
%	0	39	45	12	4	100
RSA's trade marks system						
Number of companies	1	35	30	6	1	73
%	1	48	41	8	1	100
Agreement control – in RSA						
Number of companies	0	30	28	6	2	66
%	0	45	42	9	3	100
Agreement control – abroad						
Number of companies	2	33	22	5	1	63
%	3	52	35	8	2	100

Table 62. Regulatory environment.

8.7 Sensitivity to the future - 6.7

Survey objectives: Profile the characteristics listed below for South African manufacturing companies.

Notional postulate: The more a company chooses or is forced to plan ahead, the more licensing activity will intensify.

Question in Annexure A	Proposed indicant surveyed	
24	Environment friendly	
26	Market competition	
27	Technology competition	
121	Quality of unwritten knowledge	
122	Quality of complementary assets in heads	
123	Quality of technology portfolio	
	Quality of forward planning	
124	Scenario planning	
125	Awareness of S-curves	
126	Other	Aggregate

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Table 63 shows strong environmental friendliness ratings among respondents, yet only eight recorded ISO 14001 certification. The three companies (4%) who rated themselves “grudging” can be believed due to the nature of their operations which are relatively harmless. Possibly the effort to mount a dedicated environmental exercise is viewed as simply not worthwhile. High friendliness across sectors is confirmed by Table 65. No trends in licensing activity are discernible.

The respondents operate in a competitive environment while eight have each found a technology niche and report “minimal” competition and one may be considered to be protected by the entry barrier big volume.

Tacit knowledge is considered sufficient as is the quality of their technology portfolio while access to complementary assets seems to require more attention. The results regarding tacit knowledge, complementary assets and technology portfolios must be viewed with circumspection because it can be expected that respondents did not use the same and rigorous definition of each. An indication of this is that 11 did not respond to the question on complementary assets. The respondents reporting no technology portfolio are from the automotive component and heavy engineering sectors and could be viewed as assemblers using technology from customers and suppliers and not focusing on an own portfolio as an out-licensor would. Perhaps they have not yet thought systematically about the technology within the companies.

Market competition may stimulate in-licensing activity. As access to complementary assets improves out-licensing seemingly also improves. This may be related to a strong, vested technology base and consequent self-confidence. This possibility is reinforced by the seemingly increasing out-licensing as technology portfolios are rated stronger.

Attribute	Company view of attribute					Notes
Environmental friendliness	Extreme	Positive	Average	Grudging	Not at all	
Number of companies	11	49	17	3	0	80
%	14	61	21	4	0	100
No. of in-licences (N=80)	10	139 A	17	2	0	
Number per company	0,91	2,84	1,00	0,67	0	ρ=0,04
No. of out-licences (N=80)	28 B	40	31	0	0	
Number per company	2,55	0,82	1,82	0	0	ρ=-0,02
Market competition is	Fierce	Strong	Fair	Minimal	None	
Number of companies	23	42	14	2	0	81
%	28	52	17	2	0	100
No. of in-licences (N=81)	59 A	89	20	0	0	
Number per company	2,57	2,12	1,43	0	0	ρ=0,09
No. of out-licences (N=81)	38 B	50	11	0	0	
Number per company	1,65	1,10	0,79	0	0	ρ=0,05
Technology competition is	Fierce	Strong	Fair	Minimal	None	
Number of companies	16	39	17	8	1	81
%	20	48	21	10	1	100
No. of in-licences (N=81)	23	103 A	35	7	0	
Number per company	1,44	2,64	2,06	0,88	0	ρ=0,04
No. of out-licences (N= 81)	30 B	45	17	6	1	
Number per company	1,88	1,15	1,00	0,75	1,00	ρ=-0,08
Quality of tacit knowledge	Excellent	Good	Adequate	Poor	None	
Number of companies	21	41	12	4	1	79
%	27	52	15	5	1	100
No. of in-licences (N=79)	58 A	69	26	1	14	
Number per company	2,76	1,68	2,17	0,25	14,00	ρ=0,01
No. of out-licences (N=79)	25	57 B	15	2	0	
Number per company	1,19	1,39	1,25	0,50	0	ρ=-0,14
Access to complementary	Excellent	Good	Adequate	Poor	None	

assets						
Number of companies	8	24	27	5	6	70
%	11	34	39	7	9	100
No. of in-licences (N=70)	17	35	74 A	0	27	
Number per company	2,13	1,46	2,74	0	4,50	ρ=-0,06
No. of out-licences (N=70)	19	36 B	37	4	1	
Number per company	2,38	1,50	1,37	0,80	0,17	ρ=0,16
Quality of technology portfolio	Excellent	Good	Adequate	Poor	None	
Number of companies	2	47	19	8	2	78
%	3	60	24	10	3	100
No. of in-licences (N=78)	0	119 A	33	1	14	
Number per company	0	2,53	1,74	0,13	7,00	ρ=0,12
No. of out-licences (N=78)	10	62 B	22	4	0	
Number per company	5,00	1,32	1,16	0,50	0	ρ=0,07

Table 63. Some competitive attributes of companies and their environment.

As shown in Table 64 respondents seem to be generally forward looking but the relatively high rating of "other techniques" and scenario planning which could arguably be considered more philosophical or perhaps more well-known may point to a relative absence of more rigorous forward planning. Only two respondents reported no use of forward planning techniques at all. It could be that they were thinking of strictly technology forward planning in which case their responses are acceptable because one is employing specialised and new technology in a niche market and the other is in an 'old and settled' industry.

Out-licensing seemingly increases as S-curve usage increases. It could be very interesting to explore this relationship between licensing and what may arguably be viewed as a "technology indicator" further.

Attribute	Company view of attribute					Notes
	Excellent	Good	Adequate	Poor	None	
Quality of forward planning in terms of - - -						
Scenario planning						C=0,82
Number of companies	1	40	22	11	6	80
%	1	50	28	14	8	100
No. of in-licences (N=80)	1	79	61 A	20	7	
Number per company	1,00	1,97	2,77	1,82	1,17	ρ=0,04
No. of out-licences (N=80)	1	60 B	30	5	3	
Number per company	1,00	1,50	1,36	0,45	0,50	ρ=-0,00
S-curves awareness						C=0,86
Number of companies	5	22	24	12	11	74
%	7	30	32	16	15	100
No. of in-licences (N=74)	22	35	41	31 A	21	
Number per company	4,40	1,59	1,71	2,58	1,91	ρ=0,03
No. of out-licences (N=74)	12	41 B	20	20	4	
Number per company	2,40	1,86	0,83	1,67	0,36	ρ=0,12

Other techniques						C=0,85
Number of companies	4	25	36	9	4	78
%	5	32	46	12	5	100
No. of in-licences (N=78)	16	67	64 A	12	3	
Number per company	4,00	2,68	1,78	1,33	0,75	ρ=0,21
No. of out-licences (N=78)	5	63 B	21	5	2	
Number per company	1,25	2,52	0,58	0,56	0.,0	ρ=0,22
Aggregate of forward planning						α=0,81
Number of reports (N)	1	26	37	10	6	80
%	1	33	46	13	8	100
No. of in-licences	6	61	85	7	9	
Number per company	6.00	2.35	2.30	0.70	1.50	ρ=0,10
No. of out-licences	0	63	28	5	3	
Number per company	0	2.42	0.76	0.50	0.50	ρ=0,16

Table 64. Sensitivity to the future.

"Other" techniques suggest increases in licensing as quality of forward planning improves but a reversal for out-licensing when an "excellent" rating is reached, even if the 25 licences contributed by the single company are eliminated. Even though only four companies rated themselves in this rank, exploring why and what the other techniques are could well be worth further research.

A similar pattern for the aggregate can be noted where α = 0,81 and the item-scale correlation coefficients C are greater. The reversals are probably the consequence of respectively only four and one companies falling in the "excellent" rank which increases sensitivity to individual company characteristics.

Not surprisingly, environmental sensitivity from Table 65 is highest in the chemicals, food and healthcare and the heavy engineering sectors.

Environmental friendliness (%)	Extreme	Positive	Average	Grudging	Not at all	N
Automotive components	0	70	30	0	0	10
Building materials and components	29	43	29	0	0	7
Chemicals including paper & textiles	23	62	8	8	0	13
Electrical, light	0	67	17	17	0	6
Heavy engineering	9	73	18	0	0	11
Food & healthcare	27	55	18	0	0	11
ICT & electronics	0	63	25	13	0	8
Metal products & machinery	14	57	29	0	0	14

Table 65. Sectoral approach to the environment.

Table 66 shows the aggregated result of the three forward planning attributes listed in Table 64 by sector as an indication of the attention respondents pay to future planning. Light electrical and metal products and machinery seem to be least concerned with forward planning. ICT and electronics companies can be said to be planning decently or not at all.

Future planning (%)	Excellent	Good	Adequate	Poor	None	N
Automotive components	0	20	60	20	0	10
Building materials and components	0	29	71	0	0	7
Chemicals including paper & textiles	0	46	54	0	0	13
Electrical, light	0	0	67	17	17	6
Heavy engineering	9	36	36	9	9	11
Food & healthcare	0	40	40	20	0	10
ICT & electronics	0	44	33	0	22	9
Metal products & machinery	0	29	29	29	14	14

Table 66. Sectoral forward planning – aggregate indicant.

For summary finding on notional postulate see 9.1.7, p198.

8.8 Innovation levels - 2.4

Survey objectives: Profile the characteristics listed below for South African manufacturing companies.

Notional postulate: Innovative activities in a South African manufacturing company will manifest indirectly through the characteristics surveyed and will correlate positively with technology licensing and trading activities

<table>
<tr><td>Question in Annexure A</td><td colspan="2">Characteristic surveyed</td><td></td></tr>
<tr><td>29</td><td colspan="2">Use of SPII funds</td><td rowspan="4">Aggregate</td></tr>
<tr><td>30</td><td colspan="2">Use of Innovation Fund of DTI</td></tr>
<tr><td>31</td><td colspan="2">Use of THRIPS funds</td></tr>
<tr><td>32</td><td colspan="2">Use of other innovation funding</td></tr>
<tr><td>40</td><td>International co-development</td><td rowspan="2">Aggregate</td><td rowspan="3">Aggregate</td></tr>
<tr><td>41</td><td>Offset/countertrade activities</td></tr>
<tr><td>42</td><td colspan="2">Aspiration to progress from OEM to own brand manufacturing</td></tr>
</table>

	Encouragement of innovative activity:	
52	In products and processes	
53	In production	
54	In logistics	
55	In management	Aggregate

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Table 67 shows in the aggregate that only 54% of respondents had tried to use or actually used public funding aimed at encouraging technology development. Underlying data show that seven (9%) did not know any funds and a further 14 (18%) admitted to not knowing what at least one of the available funds was. Qualifying criteria and scarcity of funds may have played a role in reducing usage or application rate but the ignorance rate among respondents which are all fairly to quite sophisticated is probably too high and could and should be reduced. (SAIS (p87) returned 7% used and 93% tried; and an equivalent European innovation survey returned 21% used and 79% tried.)

Attribute	Company view of attribute					Notes
	Maximally	Yes	Tried	No	What is it?	
Companies' use of National funding for innovation - - -						
SPII funds						C=0,83
Number of companies	4	18	8	33	16	79
%	5	23	10	42	20	100
No. of in-licences (N=63)	2	36	23	87 A		
Number per company	0,50	2,00	2,88	2,64		ρ=-0,11
No. of out-licences (N=63)	0	47 B	11	34		
Number per company	0	2,61	1,38	1,03		ρ=0,08
Innovation Fund of DTI						C=0,75
Number of companies	2	16	13	38	10	79
%	3	20	16	48	13	100
No. of in-licences (N=69)	1	34	20	100 A		
Number per company	0,50	2,13	1,54	2,63		ρ=-0,03
No. of out-licences (N=69)	2	33 B	8	51		
Number per company	1,00	2,06	0,62	1,34		ρ=-0,00
THRIPS funds						C=0,81
Number of companies	2	13	6	39	20	80
%	3	16	8	49	25	100
No. of in-licences (N=60)	5	35	8	101 A		
Number per company	2,50	2,69	1,33	2,59		ρ=0,05
No. of out-licences (N=60)	0	46 B	4	42		
Number per company	0	3,54	0,67	1,08		ρ=0,19
Other DTI/IDC/DACST funds						C=0,74
Number of companies	1	19	8	37	14	79
%	1	24	10	47	18	100

No. of in-licences (N=65)	5	42	25	87 A		
Number per company	5,00	2,21	3,13	2,35		ρ=0,10
No. of out-licences (N=65)	0	41 B	15	38		
Number per company	0	2,16	1,88	1,03		ρ=0,06
Aggregate of public funds usage						α=0,83
Number of reports (N)	1	11	27	33		72
%	1	15	38	46		100
No. of in-licences	1	25	59	79		
Number per company	1,00	2,27	2,19	2,39		ρ=-0,09
No. of out-licences	0	29	34	33		
Number per company	0	2,64	1,26	1,00		ρ=0,01

Note: Frequencies in the What is it? rank are ignored for correlation.

Table 67. Public funding usage.

DTI : Department of Trade and Industry.

SPII : Support Programme for Industrial Innovation of DTI.

THRIPS : Technology and Human Resources for Industry Programme of DTI.

The aggregate construct may point to increasing out-licensing with increasing use of public development funding; and increasing use of in-licensing with decreasing use of such funding with α = 0,83 and all item-scale correlation coefficients C except that for SPII funds lower. Interestingly, the pattern of the two companies with the most in and out-licences, A = consistently "not used" and B = consistently "yes, used" respectively, appearing below, seems to bear this out strikingly.

Table 68 indicates that chemicals including paper and textiles, light electrical, food and healthcare and ICT and electronics have had most success in winning financial support. Light electrical with lowest licensing intensity is a somewhat surprising finding but the expressed possibility that innovations may be marginal and not usefully protectable may play a role.

Building materials and components has tried hard but to no avail and only limited success is evident for automotive components.

Further study, unrelated to this research, to establish why knowledge of public development funds appears to be disappointing; and allocation criteria and their practical effect, perhaps also on exploitation may be useful.

Use of public technology development funds (%)	Maximally	Yes	Tried	No	N

Automotive components	0	20	70	10	10
Building materials and components	0	0	86	14	7
Chemicals including paper & textiles	0	54	38	8	13
Electrical, light	17	33	33	17	6
Heavy engineering	9	27	45	18	11
Food & healthcare	9	45	36	9	11
ICT & electronics	33	22	11	33	9
Metal products & machinery	23	8	54	15	13

Table 68. Sectoral use of public technology development funds – aggregate indicant.

In Table 69 respondents report that 27% are involved "intensively" or "frequently" in international co-development, 32% "often" and 40% "seldom" or "not at all". This should be read against the more than 70% rating international travel and experience "extensive/often" and "good/excellent" (Table 54, p140) and does not seem to give cause for concern because international co-development is a specialised activity. Both in- and out-licensing activity seemingly intensify as co-development increases although the small numbers actually involved in co-development signal caution in the interpretation.

More research to establish the exact nature of co-development will be useful; also with a view to establish the presence, or not, of cross-licensing and joint venturing.

Attribute	Company view of attribute					Notes
	Intensive	Frequent	Often	Seldom	Not at all	
International co-development						C=0,68
Number of companies	4	17	25	24	7	77
%	5	22	32	31	9	100
No. of in-licences (N=77)	16	45	55 A	44	7	
Number per company	4,00	2,65	2,20	1,83	1,00	ρ=0,20
No. of out-licences (N=77)	2	56 B	24	12	2	
Number per company	0,50	3,29	0,96	0,50	0,29	ρ=0,26
Offset/countertrade activities						C=0,68
Number of companies	5	8	5	28	31	77
%	6	10	6	36	40	100
No. of in-licences (N=77)	15	25	19	69 A	40	
Number per company	3,00	3,13	3,80	2,46	1,29	ρ=0,17
No. of out-licences (N=77)	2	10	5	64 B	14	
Number per company	0,40	1,25	1,00	2,29	0,45	ρ=0,12
Aspiration to progress from OEM to own brand manufacture	Already own brand manufacturer	Across the board	Most products	Some products	Not at all	C=0,67
Number of companies	37	8	7	18	9	79
%	47	10	9	23	11	100

No. of in-licences (N=79)	76	8	13	64 A	7	
Number per company	2,05	1,00	1,86	3,56	0,78	ρ =0,08
No. of out-licences (N=79)	54 B	3	15	15	2	
Number per company	1,46	0,38	2,14	0,83	0,22	ρ =0,05
Aggregate of all above attributes						α=0,49
Number of reports (N)	3	16	34	23	4	80
%	4	20	43	29	5	100
No. of in-licences	9	55	42	58	4	
Number per company	3,00	3,44	1,24	2,52	1,00	ρ =0,12
No. of out-licences	9	48	30	16	1	
Number per company	1,33	3,00	0,88	0,70	0,25	ρ =0,22
Aggregate of only first two of above attributes *						α =0,63
Number of reports (N)	0	10	18	29	21	78
%	0	13	23	37	27	100
No. of in-licences	0	0	29	53	60	
Number per company	0	2,90	2,94	2,07	1,24	ρ =0,20
No. of out-licences	0	3	7	57	24	
Number per company	0	0,70	3,17	0,83	0,38	ρ =0,20

* C = 0,82 and 0,87 respectively for the remaining two underlying indicants.

Table 69. International involvement and aspiration to own brand.

OEM : Original Equipment Manufacturer.

It is perhaps encouraging that 22% of respondents are involved “often” to “intensively” in offset/countertrade activities. This also confirms international awareness. It is encouraging that 47% are already own brand manufacturers (albeit that many are smallish) and that a further 19% are far advanced or striving strongly to own brand manufacture. Licensing may increase as international co-development and offset/countertrade activities increase while small numbers again underlie this outcome. No trend regarding OEM aspirations or status is discernible.

The aggregate of three indicants is clearly deleteriously affected by the inclusion of OEM aspirations and the aggregate without this attribute seems to support the trend comments above, with α = 0,63 and the item-scale correlation coefficients C = 0,82 and 0,87.

Table 70 shows that 78% (seven of 9) companies in the ICT & electronics sector reported manufacturing own brands. Automotive components has the lowest rating and seems not to desire any change. This is again a function of their being out-sources. Building materials seems to have the most aspirants towards OEM manufacturing, followed by chemicals including paper & textiles. Light electrical seems almost dichotomous with a 67% OEM rating but also 17% with no aspiration at all.

Aspiration to become an own brand manufacturer (%)	Already has own brand	Across the board	Most products	Some products	None	N
Automotive components	10	10	0	50	30	10
Building materials and components	29	0	43	29	0	7
Chemicals including paper & textiles	36	18	9	27	9	11
Electrical, light	67	17	0	0	17	6
Heavy engineering	36	18	18	18	9	11
Food & healthcare	45	9	9	27	0	11
ICT & electronics	78	0	0	11	11	9
Metal products & machinery	71	7	0	14	7	14

Table 70. Sectoral approach to original equipment manufacturing.

In Table 71 respondents report generally high continual attention to encouraging innovative activities. "Continual" encouragement of innovative activities in the aggregate is reported by 56% and "sporadic" encouragement by 43%. The perhaps non-obvious management activities are rated a good 60% and 35% respectively. Products and processes get most attention and logistics least. The "not applicable" rating is by an engineering contracting company with fewer than 50 employees. (Of the SAIS sample population 57% (p47) reported innovative products and 39% (p50) innovative processes created during the period 1998 - 2000.)

Attribute	Company view of attribute				Notes
	Continually	Sporadically	Not at all	Not applic.	
Encouragement of innovative activities regarding - - -					
Products and processes					C=0.71
Number of companies	61	19	0	1	81
%	75	23	0	1	100
No. of in-licences (N=81)	134 A	34	0	0	
Number per company (N=80)	2,20	1,79	0		ρ =-0.04
No. of out-licences (N=81)	89 B	10	0	0	
Number per company (N=80)	1,46	0,53	0		ρ =0.04
Production					C=0.77
Number of companies	55	21	4	1	81
%	68	26	5	1	100
No. of in-licences (N=81)	95	67 A	2	4	
Number per company (N=80)	1,73	3,19	0,50		ρ =-0.06
No. of out-licences (N=81)	81 B	16	2	0	
Number per company (N=80)	1,47	0,76	0,50		ρ =-0.08
Logistics					C=0.86
Number of companies	45	34	1	1	81
%	56	42	1	1	100
No. of in-licences (N=81)	102 A	62	0	4	
Number per company (N=1)	2,27	1,82	0		ρ =0.04
No. of out-licences (N=81)	41	56 B	2	0	

Number per company (N=80)	0,91	1,65	2,00		ρ=-0.07
Management					C=0.83
Number of companies	49	28	4	0	81
%	60	35	5	0	100
No. of in-licences (N=81)	117 A	45	6	0	
Number per company	2,39	1,61	1,50		ρ=0.09
No. of out-licences (N=81)	80 B	19	0	0	
Number per company	1,63	0,68	0		ρ=0.06
Aggregate encouragement					α=0.80
Number of reports (N)	45	35	1		81
%	56	43	1		100
No. of in-licences	111	57	0		
Number per company	2,47	1,63	0		ρ=0.04
No. of out-licences	78	19	2		
Number per company	1,73	0,54	2,00		ρ=-0.04

Table 71. Profile of innovative characteristics.

As encouragement of innovation in the listed items increases licensing activity seems to increase, with three exceptions. In-licensing seems independent of production innovation and out-licensing seems to decrease with greater attention to logistics. No trend in out-licensing can be discerned from the aggregate, possibly because of the effect of logistics. α = 0,80 and all item-scale correlation coefficients C are greater. In-licensing seems to increase with improving encouragement.

Table 72 confirms high attention to innovative activities by virtually all sectors.

Encouragement of innovative activities (%)	Continually	Sporadically	Not at all	N
Automotive components	90	10	0	10
Building materials and components	43	57	0	7
Chemicals including paper & textiles	77	23	0	13
Electrical, light	50	50	0	6
Heavy engineering	64	36	0	11
Food & healthcare	27	73	0	11
ICT & electronics	33	56	11	9
Metal products & machinery	50	50	0	14

Table 72. Sectoral approach to encouraging innovative activities – aggregate indicant.

From Table 73 automotive components, heavy engineering and building materials and components seem laggards in international aspirations while ICT and electronics leads.

International involvement (%)	Intensive	Frequent	Often	Seldom	Not at all	N
Automotive components	0	10	40	50	0	10

Building materials and components	0	14	43	43	0	7
Chemicals including paper & textiles	0	25	42	33	0	12
Electrical, light	0	0	83	0	17	6
Heavy engineering	0	27	27	36	9	11
Food & healthcare	0	45	18	27	9	11
ICT & electronics	33	11	44	0	11	9
Metal products & machinery	0	14	57	29	0	14

Table 73. Sectoral incidence of international co-development, offset/countertrade and aspiration to become OEM – aggregate indicant.

For summary finding on notional postulate see 9.1.7, p198.

8.9 Sensitivity to learning from in-licensing - 3.3

Survey objectives: Profile South African manufacturing companies' sensitivity to learning as licensees. Characteristics surveyed appear in questions 211 to 226 in Annexure A.

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Results shown in Table 74 reflect responses to the question "How is corporate learning managed when technology is licensed inwards?" and are congruent with the highest value rating assigned to know-how in licences (Table100, p180).

Attribute	Company view of attribute				Total
Planning horizon	Long term	Sporadic	Short	Immediate	
Number of companies	37	8	13	1	59
%	63	14	22	2	100
Strategic intent is communicated to all personnel	Fully	Reasonably	Sketchily	Not	
Number of companies	10	33	12	4	59
%	17	56	20	7	100
Priority of learning in venture is	Top	Planned	Also ran	Neglected	
Number of companies	4	33	13	5	55
%	7	60	24	9	100
Learning process is	Planned	Fair	Sketchy	Random	
Number of companies	11	38	5	5	59
%	19	64	8	8	100
Human Resources are involved	Fully	Fairly	In passing	Not at all	
Number of companies	10	24	16	7	57
%	18	42	28	12	100
Staffing assignments are	Thorough	Fair	To get by	Neglected	
Number of companies	8	42	7	1	58
%	14	72	12	2	100
Team members are	Top class	Fair	Can improve	Inadequate	
Number of companies	22	25	12	0	59
%	37	42	20	0	100
Control is	Taken over	Shared	Poor	Surrendered	
Number of companies	7	46	4	0	57

Attribute	Company view of attribute				Total
Planning horizon	Long term	Sporadic	Short	Immediate	
%	12	81	7	0	100
Learning depends on partner	Not at all	50:50	Largely	Completely	
Number of companies	11	32	13	1	57
%	19	56	23	2	100
Cross-cultural competence is	Excellent	Good	Average	Poor	
Number of companies	2	28	24	4	58
%	3	48	41	7	100
Cross-disciplinary competence is	Excellent	Good	Average	Poor	
Number of companies	2	39	16	2	59
%	3	66	27	3	100
Team career structure plan is	Clear	Framework	Vague	Not at all	
Number of companies	6	25	25	2	58
%	10	43	43	3	100
Responsibility for learning is	Clear	Good	Vague	Not clear	
Number of companies	9	35	12	2	58
%	16	60	21	3	100
Performance measures are	Long term	Medium term	Short term	Immediate	
Number of companies	6	32	20	1	59
%	10	54	34	2	100
Rewards for learning are	Excellent	Fair	Poor	Absent	
Number of companies	2	35	13	9	59
%	3	59	22	15	100
Tolerance of learning barriers is	High	Acceptable	Sketchy	Absent	
Number of companies	3	39	12	3	57
%	5	68	21	5	100

Table 74. Profile of companies' sensitivity to learning as licensees.

It indicates that the learning process is planned and mostly long term (63%), that the strategic intent is widely communicated, that learning priority is high and the process adjudged fair (64%) and planned (19%). Control of the process is shared in 81% and taken over in 12% of cases. Learning is considered to depend on both parties in 56% and not at all on the licensor in 19% of cases. Cross cultural competence is suspect with a 48% average to poor rating. In some cases the companies reporting poor or inadequate learning do not really need intensive learning due to the nature of their operations. Nevertheless the process can be improved at many of them.

8.10 Appropriability - 3.4

Survey objectives: Profile South African manufacturing companies' appropriability awareness in terms of the intensity and spread of use of appropriability instruments and their relevant organisation. Characteristics surveyed appear in questions 101 to 106 and 110 to 114 in

Annexure A. Analyse intellectual property (IP) holdings per group.

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8.10.1 Statutory intellectual property portfolios

Attribute	All companies surveyed					Total holding	
	Total	No report	Number reporting holding number incl. nil	Number with at least one holding	% with holding	Number	Maximum per company
South Africa :							
Patents plus applications	81	10	71	53	75	877	200
Designs plus applications	81	17	64	30	47	341	50
Trade marks plus applications	81	14	67	48	72	542	84
Elsewhere :							
Patents plus applications	81	14	67	33	49	669	200
Designs plus applications	81	17	64	13	20	128	50
Trade marks plus applications	81	17	64	28	44	317	50

Table 75. Profile of companies' intellectual property portfolios.

Several respondents did not respond to the simple yes or no questions regarding their statutory intellectual property holdings. These are listed under "no report" in Table 75. Respondents that did supply numbers of these holdings did so under the invitation to provide an approximate number (in the hope of increasing the response rate) and in some cases a clearly rounded number was discernible. All numbers should be considered with circumspection.

Only 75% of the respondents hold South African patents or applications and half avail themselves of registered designs in South Africa. Foreign holdings of all types of statutory intellectual property are considerably smaller against the background of all but one respondent reporting export sales activity.

Portfolios per company groupings are not analysed because the input information is considered too vague and unreliable.

The relationship between patents held and select attribute and aggregate ranking is set out in

Table 76. The presence of two companies with notably large domestic : foreign holdings of 200 : 200 and 132 : 100 patents respectively is indicated by the letters A and B. Patent holdings seemingly increase as ranking improves except for the construct aggregate international involvement. This tendency is weakly confirmed by the Spearman correlation coefficients. When A and B are removed from the aggregate international involvement construct the shown negative correlation is cancelled with average patents per company of 11 in the "poor" and "none" ranks.

This finding corresponds with several others reported, *viz.* that licensing activity increases with increasing ranking of various attributes. However, no relation between patent holdings and out-licences could be found. The Spearman correlation coefficient was a weak 0,20 while statistics for domestic and foreign patents reported returned a mean of 21,8, a standard deviation of 56,8, median of 5,0, minimum of 0 and maximum of 400,0.

Attribute	Company view of attribute					Notes
	Excellent	Good	Adequate	Poor	None	
Research & development is						
Number of companies	16	24	17	10	4	71
Patents total	326	913 A,B	278	28	1	
Patents average per company	20	38	16	3	-	ρ=0,34
R&D to license is						
Number of companies	4	9	13	21	24	71
Patents total	80	100	250	686 A	430 B	
Patents average per company	20	11	19	33	18	ρ=0,37
Technology licensing is						
Number of companies	3	7	20	16	23	71
Patents total	80	70	214	636 A	496 B	
Patents average per company	27	10	11	40	22	ρ=0,21
Technology portfolio is	Complete	Good	Adequate	Poor	None	
Number of companies	1	42	16	8	2	71
Patents total	29	1307 A, B	53	128	9	
Patents average per	29	31	3	16	5	ρ=0,29

company						
Aggregate use of national funds for innovation - 1	Maximally	Yes	Tried	No		
Number of companies		9	21	41		71
Patents total		496	577 a	473 B		
Patents average per company		55	27	12		ρ=0,42
Aggregate international involvement – 2	Intensive	Frequent	Often	Seldom	Not at all	
Number of companies	2	9	12	28	20	71
Patents total	4	73	294	709 A	466 B	
Patents average per company	2	8	25	25	23	ρ=-0,17
Aggregate encouragement of innovative activities - 3	Continually	Sporadically	Not at all			
Number of companies	39	31	1			71
Patents total	1194 A, B	348	4			
Patents average per company	31	11	1			ρ=0,12

Constituent characteristics 1 - in Table 67, p152: 2 – in Table 54, p139; 3 – in Table 71,p155.

Table 76. Patent holding against select attribute ranking.

8.10.2 IP management aspects

Table 77 shows that confidentiality agreements with employees are reported most frequently by 64 companies compared with about half as many with each of visitors and inventors. About 25% of respondents have agreements only with employees; and 19% with employees, visitors and inventors. A total of only 21% of companies do not have agreements with employees.

Respondents seem to be reasonably aware of the need for confidentiality agreements with inventors, 45% reporting that they have such agreements.

Awareness of South Africa's obligations under the Agreement on Trade Related Aspects of Intellectual Property is not high with 70% admitting this. This may point to weak general IP knowledge.

Confidentiality agreements with	Employees	Visitors	Inventors	N	%
	X			25	31
		X		4	5
			X	4	5

	X	X		7	9
	X		X	13	16
	X	X	X	19	23
		X	X	1	1
No information or none				8	10
Total occurrence	64	31	37		

Aware of RSA's TRIPS obligations	Well	Reasonably	Not really	Total
Number of companies	6	14	47	67
%	9	21	70	100

Lawyers on staff	General counsel	Patent counsel	Both	None	No respons e
Number of companies	19	7	4	54	5
Use of outside lawyers					
Number of companies	31	55	16	47	4

Patent systems used	EEC	ARIPO	Eurasian	OAPI	PCT
Number of companies	14	6	0	3	22
% usage	32	13	0	7	49

Table 77. Organisation of IP activities.

Results confirm that outside patent counsel is used when necessary, only seven companies having patent counsel in-house with four of these having general counsel colleagues as well. The 47 that reported no use of outside counsel probably did so considering intellectual property and licensing only.

Respondents seem to have taken to the Patent Cooperation Treaty with 49% reporting using it. Very little IP activity is reported in Africa and none in Eurasia.

8.11 IP portfolio's - 4.1

Survey objective: Profile frequency of occurrence of IP data bases and explore possible correlation between them and technology strategy activities. Characteristics surveyed appear below.

Notional postulate: Increased IP awareness will correlate positively with licensing activities.

Question in Annexure A	Characteristic surveyed	

108	Quality of IP data base	Aggregate
109	Quality of IP planning	
117	Research and development with objective to license	
127	Quality of technology strategy	Aggregate
128	Quality of technology/core competence audits - internally	
129	Quality of technology/core competence audits - externally	

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Table 78 suggests increasing licensing activity as IP data bases get better organised and that some IP planning lead to more licensing activity. The aggregate indicant indicates that intellectual property planning is not afforded the attention it deserves, with 51% indicating "not good" planning and 30% no planning. Further research to establish reasons for this phenomenon may be useful. It also points to increased licensing activity, especially out-licensing, as aggregate IP planning improves. α = 0,77 with the item-scale correlation coefficients 0,90 and 0,91.

Attribute	Company view of attribute			Notes
IP data base is	Organised	So-so	None	C=0,90
Number of companies	31	36	13	80
%	39	45	16	100
No. of in-licences (N=80)	86 A	72	10	
Number per company	2,77	2,00	0,77	ρ=0,04
No. of out-licences (N=80)	57 B	40	2	
Number per company	1,84	1,11	0,15	ρ=0,14
IP planning is done	Regularly	Sporadically	Never	C=0.91
Number of companies	20	34	24	78
%	26	44	31	100
No. of in-licences (N=78)	38	108 A	21	
Number per company	1,90	3,18	0,88	ρ=0,12
No. of out-licences (N=78)	49 B	41	9	
Number per company	2,45	1,21	0,38	ρ=0,21
Aggregate IP planning quality	Well run	Not good	Never	α=0,77

Number of reports (N)	15	41	24	80
%	19	51	30	100
No. of in-licences	23	124	21	
Number per company	1,53	3,02	0,88	ρ=0,07
No. of out-licences	46	44	9	
Number per company	3,07	1,07	0,38	ρ=0,16

Note: The aggregate is further analysed across select company groupings in Table79.

Table 78. Profile of indicants of companies' awareness of IP management.

Sectorally, it can be seen from Table 79 that IP planning seems poorest in the heavy engineering and automotive sectors. These results can be reconciled to automotive only licensing in but hardly with heavy engineering showing middling licensing activity.

Food and healthcare seems the best planner, a finding which is not surprising because of healthcare's general involvement in patenting and trade marking.

Sectoral IP planning –aggregate (%)	Well run	Not good	Never	N
Automotive components	10	40	50	10
Building materials and components	0	100	0	7
Chemicals including paper & textiles	31	62	8	13
Electrical, light	0	67	33	6
Heavy engineering	0	45	55	11
Food & healthcare	50	30	20	10
ICT & electronics	11	56	33	9
Metal products & machinery	29	36	36	14

Table 79. Sectoral IP planning – aggregate indicant.

The aggregate indicant IP planning quality appearing in Table 80 is discussed at Table 78, p164.

From Table 80 respondents reporting "adequate" or better and those reporting "poor" or no research and development with the objective to license are about evenly split. Technology management strategy is likewise divided about evenly between "sporadically partial" and worse and "sporadically complete" and better. Technology auditing is not frequently practised with "sporadically complete" and better ranking for 49% internal and 25% external auditing.

Accepting the indications of the aggregate indicant only a disappointing 43% of respondents can arguably be said to pay reasonable and proper attention to technology strategy while 10%

admit no planning and 48% what could be dangerous and short-sighted practice.

As stated at table 78, p164, results for aggregate IP planning point to increased licensing activity, especially out-licensing, as aggregate IP planning improves. α = 0,77 with the item-scale correlation coefficients C greater. Licensing activity increases as research and development with the intention to license improves with out-licensing dramatically increasing when the "excellent" rating is reached and remains highest after removal of the single company's contribution of 25 licences. This phenomenon is accompanied by a weak Spearman correlation coefficient of 0,23 indicating positive correlation between research and development with intent to license and licensing activity.

Improved quality of technology strategy management (ρ = 0,12 for in- and 0,15 for out-licensing) as well as internal auditing activity (ρ = 0,22 and 0,07) seem to lead to increased licensing. No seeming trend is discernible regarding external technology auditing.

The aggregate also points to increased licensing activity with α = 0,85 and the item-scale correlation coefficients C = 0,89 except for external auditing where it is 0,78.

Annexure D lists respondents' rating of themselves under the two aggregate attributes and one simple attribute. Inspection of the frequency of occurrence of consistent or approximately consistent ratings of weak, middling or good for the three attributes by each respondent indicates that 53 of the 80 responses (66%) could be considered consistent. In other words, a company tends to be weak, middling or good in all attributes.

Attribute	Company view of attribute					Notes
Aggregate IP planning quality from Table 78, p164	Well run	Not good	Never			α=0,77
Number of reports	15	41	24			80
%	19	51	30			100
No. of in-licences	23	124	21			
Number per company	1,53	3,02	0,88			ρ=0,07
No. of out-licences	46	44	9			
Number per company	3,07	1,07	0,38			ρ=0,16
R&D with objective to license from Table 45, p130	Excellent	Good	Adequate	Poor	None	
Number of reports	5	11	15	23	26	80
%	6	14	19	29	33	100
No. of in-licences (N = 80)	11	27	38	29	63 A	
Number per company	2,20	2,45	2,53	1,26	2,42	ρ=0,10
No. of out-licences (N=80)	36 B	15	27	9	12	
Number per company	7,20	1,36	1,80	0,39	0,46	ρ=0,23

Quality of technology management ….	Regular and complete	Sporadic, complete	Sporadic, partial	Ad hoc	None	
Strategy						C=0,89
Number of companies	21	21	21	8	9	80
%	26	26	26	10	11	100
No. of in-licences (N=80)	57	38	51 A	14	8	
Number per company	2,71	1,81	2,43	1,75	0,89	ρ=0,12
No. of out-licences (N=80)	57 B	11	22	4	5	
Number per company	2,71	0,52	1,05	0,50	0,56	ρ=0,15
Internal audits						C=0,89
Number of companies	16	23	20	13	7	79
%	20	29	25	16	9	100
No. of in-licences (N=79)	28	72	54 A	7	6	
Number per company	1,75	3,13	2,70	0,54	0,86	ρ=0,22
No. of out-licences (N=79)	50 B	22	14	10	3	
Number per company	3,13	0,96	0,70	0,77	0,43	ρ=0,07
External audits						C=0,78
Number of companies	7	12	23	19	14	75
%	9	16	31	25	19	100
No. of in-licences (N=75)	6	32	58 A	30	32	
Number per company	0,86	2,67	2,52	1,58	2,29	ρ=0,07
No. Of out-licences (N=75)	3	46 B	23	19	6	
Number per company	0,43	3,83	1,00	1,00	0,43	ρ=0,06
Aggregate of strategy and audits						α=0,85
Number of reports	10	24	24	14	8	80
%	13	30	30	18	10	100
No. of in-licences	17	46	84	13	8	
Number per company	1,70	1,92	3,50	0,93	1,00	ρ=0,15
No. of out-licences	37	30	19	9	4	
Number per company	3,70	1,25	0,79	0,64	0,50	ρ=0,09

Table 80. Profile of technology and IP planning.

Compared to the approximately 78% of respondents who reported some technology strategy, in the case of the total SAIS sample 32% reported thus while for all sectors excluding financial at a high 96% the range reported was from 15 – 50% (p58).

Table 81 shows that research and development with objective to license is rated "poor" and "none" by more that half the companies in all sectors except food and healthcare. ICT and electronics seems to be more active.

Sectoral research and development with objective to license (%)	Excellent	Good	Adequate	Poor	None	N
Automotive components	0	20	0	20	60	10

Building materials and components	0	14	29	29	29	7
Chemicals including paper & textiles	8	8	15	38	31	13
Electrical, light	0	0	33	17	50	6
Heavy engineering	0	18	18	27	36	11
Food & healthcare	20	20	30	20	10	10
ICT & electronics	11	33	0	33	22	9
Metal products & machinery	7	0	29	36	29	14

Table 81. Sectoral research and development with objective to license.

From Table 82 it appears that the light electrical sector has a rather casual approach to technology management. Chemicals including paper and textiles fares best followed by food and healthcare and building materials. Considering ICT and electronics against research and development for licensing it may be signalling that it has recently turned to such research in an effort to bolster its technology management quality.

Quality of technology management (%)	Regular and complete	Sporadic, complete	Sporadic, partial	Ad hoc	None	N
Automotive components	10	20	50	10	10	10
Building materials and components	14	43	29	14	0	7
Chemicals including paper & textiles	15	54	23	8	0	13
Electrical, light	0	0	50	50	0	6
Heavy engineering	0	45	9	36	9	11
Food & healthcare	20	40	10	20	10	10
ICT & electronics	22	11	44	0	22	9
Metal products & machinery	14	14	36	14	21	14

Table 82. Sectoral technology management – aggregate indicant.

Further research into IP planning could yield interesting insights. Such research should be considered within the framework of IP deployment. See 8.12, p168.

For summary finding on notional postulate see 9.1.7, p198.

8.12 Deployment of IP - 4.2

Survey objective: Establish overarching goal to which South African manufacturing companies apply their intellectual property. Question 107 appearing in Annexure A was: "Broadly, for what purpose do you use your intellectual property?"

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Respondents were invited to mark one or more of the four objectives presented randomly. It is clear from Table 83 that manufacturing companies are mostly interested in exercising the exclusive rights they may obtain from their intellectual property through deterrence and monopolisation. This result could have been biased by some respondents perhaps not having borne in mind that intellectual property encompasses more than statutory intellectual property. Altogether 19% of respondents expressed interest in earning royalties. One company from the chemicals and food and one from the healthcare sector (3%) were exclusively interested in royalties.

Highest interest in earning royalties is also shown by these sectors with 36% and 33% respectively.

The findings correspond broadly with the 1994 Japanese survey results under "Future" in Table 3, p49 which show aspiration to monopolise and deter as highest priority.

Elements of the picket fence, smokescreen and bargaining chip patent strategies (4.2, p45) seem to be present. It would be interesting to explore further to what extent, if any, these strategies are deliberately being developed and used by South African companies. It may be possible that *e.g.* the toll gate and bargaining chip strategies if employed systematically and in a focussed manner, may open opportunities to cross-license. In parallel, the influence of company size may be investigated. Maybe South African companies are too small to be able to develop or afford sufficient numbers of patents. Also inviting further attention is the seeming defensive use of IP against the expressed high liking of licensing and the belief that it is profitable for the licensor.

Industry sector	Automotive components		Building materials & components		Chemicals incl. paper & textiles		Electrical, light		Heavy engineering		Food & healthcare		ICT & electronics		Metal products & machinery		All	
Purpose is to -	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Monopolise=1			2	29			2	33	2	22			3	33	3	21	12	16
Deter others=2	6	86	3	43	5	42	1	17	4	44	2	18	2	22	6	43	29	39
Earn royalties=3					1	8					1	9					2	3
Defend=4							1	17	1	11							2	3

1,2					2	17	1	17			5	45	2	22	3	21	13	17
1,3					1	8											1	1
1,4																		
2,3	1	14	1	14											1	7	3	4
2,4					1	8	1	17	1	11			1	11			4	5
3,4					2	17			1	11	1	9					4	5
1,2,3															1	7	1	1
1,2,4			1	14													1	1
1,3,4																		
2,3,4											1	9					1	1
1,2,3,4											1	9	1	11			2	3
Total reports	7	100	7	100	12	100	6	100	9	100	11	100	9	100	14	100	75	100
Co's in sector	10		7		13		6		11		11		9		14		81	
Companies showing an interest in -																		
Monopolies			3	43	3	25	3	50	2	22	6	55	6	67	7	50	30	40
Deterrence	7	100	5	71	8	67	3	50	5	56	9	82	6	67	11	79	54	72
Royalties	1	14	1	14	4	33			1	11	4	36	1	11	2	14	14	19
Defending			1	14	3	25	2	33	3	33	3	28	2	22			14	19

Table 83. Broad IP application objectives of manufacturing companies.

8.13 Licensing organisations - 5.5

Survey objectives: Establish frequency of occurrence of a specialised licensing function, South African industrial companies' own view of their technology trading prowess, methods used to identify potential licensees, departments or functions involved in the licensing process including evaluation, agreement negotiation, agreement compilation, contract administration and how licensees are approached. Characteristics surveyed appear in questions 47, 48, 120 and 420 to 441 in Annexure A.

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Table 84 shows that 31% of respondents report no licensing activity at all while 23% consider the functioning thereof as "poorly". This compares with 35%, not the same companies, that had no licences as such to report. (See also prior discussion of this attribute at Table 45, p130.) Licensing is not recognized within the accounting system in 45% of cases and only in 17% as profit centre. Of the 13 companies forming the 17% two had no licences at all at the time of the survey and three had only out-licences.

At 89% of respondents no specific Head of licensing exists. It appears to be general practice that this function is assigned to a functionary who has other main responsibilities, such as even the CEO. This practice probably is mainly a result of low licensing activity in general and the broad variety of specialist functions that get involved with licensing. (Table 86 below.)

Attribute	Company view of attribute					Total
Technology licensing and selling is run	Excellently	Well	Adequately	Poorly	Not	
Number of companies	3	10	23	18	24	78
%	4	13	29	23	31	100
Licensing is seen as a	Cost centre	Service centre	Profit centre	None		
Number of companies	22	7	13	35		77
%	29	9	17	45		100
Head of Licensing reports to (N = 81)	CEO/COO/ GM/MD	Technical/ Technology Director	Technical/ Technology Manager	Division Manager	R&D Manager	No Head
Number of companies	4	2	1	1	1	72
%	5	2	1	1	1	89

Table 84. Positioning of licensing function.

Table 85 shows responses to the request to rank on a scale between 0 and 9 the value assigned to some methods to identify possible licencees, offered at random in the questionnaire. Clearly respondents claim to know their industry and that most leads are identified along this route. The question can of course be raised whether the knowledge is indeed as strong as seemingly claimed, considering also the scarcity of licences to and from *e.g.* Eurasia. Using brokers seems not to be favoured and this aspect could be investigated to establish whether increased usage may not lead to more out-licensing by manufacturing companies.

Method/place	Companies' rating	Rating between 0 and 9	
		Minimum	Maximum
We know industry	5,55	0	9
Word of mouth	3,60	0	8
Shows/fairs	3,58	0	9
Desk search	2,65	0	9
Broker/agent	2,10	0	9
Total number of companies	40		

Table 85. Profile of methods used to identify possible licensees.

Table 86 shows the results of again requesting rating on the scale from 0 to 9 of randomly offered business functions and departments considered to be involved in licensing. Note that it would be advisable to bear in mind that the set of questions may well have appeared daunting to the respondents and that some may not have distinguished fittingly between in- and out-licensing.

Department or function	Evaluation of subject technology		Negotiation		Agreement (contract compilation)		Contract administration	
Licence direction	In	Out	In	Out	In	Out	In	Out
	Each column shows the rating on the left and the ranking on the right							
Legal	2,65 6	2,91 6	4,19 4	4,24 3	6,52 2	7,06 1	2,28 5	3,14 4
Research	5,57 4	6,15 3	3,29 5	3,45 5	2,56 7	2,83 7	1,58 8	1,04 9
Licensing	1,24 9	1,28 9	1,92 8	1,96 9	2,08 8	2,04 8	1,64 7	2,52 5
Accounting	1,77 7	1,61 8	2,76 6	2,03 7	4,19 4	3,39 5	6,83 1	5,59 1
Sales/marketing	5,65 3	4,64 4	5,31 2	4,63 2	4,26 3	4,00 3	3,22 3	3,52 3
Technical/engineering	7,67 1	6,34 2	5,02 3	4,10 4	4,12 5	3,65 4	2,38 4	2,44 6
Manufacturing	5,04 5	3,94 5	2,73 7	2,00 8	2,03 9	1,52 9	2,05 6	1,88 7
Top management	7,36 2	7,18 1	7,74 1	7,39 1	7,42 1	6,94 2	4,02 2	4,00 2
Outside counsel	1,61 8	1,65 7	1,77 9	2,07 6	3,27 6	3,38 6	1,29 9	1,19 8
Broker/agent	0,67 0	0,90 10	0,51 10	0,68 10	0,35 10	0,69 10	0,22 10	0,56 10

N varied between 25 and 47.

Table 86. Extent of involvement of various departments or functions in licensing process.

An outstanding feature is the involvement of top management throughout the process. This could be signifying the attendance of the 'decision maker' in most activities rather than a working involvement. It could also for the set of respondents be due to their smaller size and less intense licensing activity which renders a specialised licensing function uneconomic. (20% have fewer than 50 and 51% have fewer than 249 employees.)

The technological functions are duly involved during evaluation and negotiation and their seemingly much reduced involvement during contract administration could be because respondents were thinking of paper work rather than transfer of know-how when responding to the question. It appears that legal involvement may well be of the nature of writing up what had been agreed rather than making agreements which indicates that operational management is retaining the lead in the licensing process.

Table 87 shows a rough approximation of the relative involvement of the various departments or functions in licensing. These results were generated by adding the ranking numbers in Table 86 for each function or department across all four phases and expressing the totals relative to that of the top ranked one.

Department or function	SA manufacturing companies across all phases		Worldwide survey Table 31, p84
Licence direction	Both		Both
	Rating	Relative weight	Respondents reporting use %
Top management	1	100	Not available
Sales/marketing	2	52	50
Legal	3	44	70
Technical/engineering	4	41	55
Accounting	5	31	38
Research	6	25	60
Manufacturing	7	21	29
Outside counsel	8	20	Not available
Licensing	9	19	59
Broker/agent	10	15	Not available

Table 87. Comparison in principle of South African and worldwide use of functions.

The results can be compared to a limited extent with prior reported research which did not use the same functions. "Worldwide" results which came from generally larger respondents show relatively more use of the legal, research and technical/engineering functions; and a licensing function. This could be mostly a function of size.

Table 88 indicates that licencees are mostly approached in a personal manner and that they are studied beforehand. Selective mailshots are used to some extent. A mass approach is not favoured. These results are congruent with the claim 'we know industry' in Table 85, p171. Brokers are again least used.

Method of approach	In-licensing		Out-licensing	
	Rating	Rank	Rating	Rank
In person by visit	7,55	1	7,53	1
Target invited to visit licensor	4,69	2	5,23	2
Following study of target	4,49	3	4,12	3

Selective mail	1,04	4	1,39	5
Via broker	0,80	5	1,47	4
General mailshot	0,07	6	0,03	6
IP assigned to broker	0,05	7	0,03	6

N varied between 33 and 47.

Table 88. Methods of approaching potential licensees.

8.14 Reasons for licensing or not – 4.3

Survey objectives: Profile South African industrial companies' reasons for licensing and not licensing, inwards and outwards. Characteristics surveyed appear in questions 107, 230 to 245 and 401 to 407 in Annexure A.

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From Table 89 it can be concluded that in-licensing is driven by the need to obtain and hold market share through access to future and innovative technology. This focus seems satisfactory. Skills acquisition as such is not a priority but this does not mean that learning is precluded and the results are congruent with those reported in 8.9, p157 : Learning.

Out-licensing is driven by the need to secure and expand market share also through substituting direct sales. Arguably there is a tendency to attempt to do this through licensing spin-off technology rather than core technology. Given this situation it would have been interesting to have established also the ranking of licensing for royalty and the like income *per se* in contrast to substitution of sales. Setting of standards and complying with patent working requirements are not very important.

It may be interesting to attempt to research the degree to which these reasons are intertwined, if at all, with the deployment strategies. Refer 8.12, p168.

Reason	In-licensing		Out-licensing	
	Rating	Rank	Rating	Rank
Competitive advantage	6,72	1	5,68	3
Strategic reasons	6,70	2	6,64	1
Access to future technology	6,64	3	3,70	9
Market entry	6,09	4	5,78	2
More innovative technology	5,78	5		
Obtain cost advantage	5,17	6		
Reduce risk	5,06	7	4,05	7
Skills acquisition	4,91	8		
Diversification advantage	4,74	9		
Spin-off technology			4,53	4
Substitute direct sales			4,34	5

Regional differences			2,85	11
To set industry standards			3,58	10
To settle/prevent infringement	2,65	10	3,82	8
Response to competitors			4,15	6
Comply with patent working requirements			2,79	12

N varied between 38 and 49.

Table 89. Reasons for licensing inwards or outwards.

From Table 90 an inhibiting factor in licensing generally appears to be fear of revealing own know-how and losing control. This is perhaps overrated and the focus should maybe be on co-operation under controlled conditions – a constructive challenge. The phenomenon could be a function of relative smallness against what are perceived as or are multi-national giants.

The relatively high rating afforded the fear of revealing own know-how in out-licensing may raise questions regarding the perceived value of and enforceability of statutory protection; and a possibly fallacious overvaluation of local know-how.

The insights of Teece and Kim (3.2, p28) are pertinent. Kim's warning that technology transfer cannot be stopped and his paradigms of strategies for suppliers and recipients of technology should be heeded. A more systematic integration of these and market entry and retention strategies such as set out by Roberts and Berry (Fig. 11, p54) and factors affecting technology acquisition and disposition in perhaps the manner Ford suggests in Figures 9 and 10 (p52) may well lead to new insights for manufacturing companies and perhaps lead to the identification of opportunities for cooperation partly based on intellectual property being deployed as active assets.

There seems to be awareness that a licensee could be building a licensor's trademark to the licensee's detriment.

Objection	In-licensing		Out-licensing	
	Rating	Rank	Rating	Rank
Reveal own know-how	4,83	1	6,26	1
Dilute market			3,92	3
Lose close control	4,11	2	4,97	2
Debilitate or subjugate own R&D	3,80	3	3,56	4
Build licensor's trade mark	3,15	4		
Administrative burden	2,37	5	2,73	5
Excessive grant-back required	2,32	6		

N varied between 37 and 47.

Table 90. Objections to licensing inwards or outwards.

8.15 Content of and added value in licences - 5.2.2

Survey objectives: Establish technology or IP content of licences, bases on which royalties are calculated, royalty and payment types used, relative influence of licence terms and conditions on remuneration rates, desirability of restrictions, relative importance of some licence terms and conditions, impact of licences. Characteristics surveyed appear in questions 301 to 321, 328 to 336, 337 to 342, 343 to 348, 349 to 352, 408 to 416 and 417 to 419 in Annexure A.

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Table 91, again rating randomly presented aspects on a scale between 0 and 9, points to confirmation of the generally held view that purchased technology can be more advantageous to fast and cheaper market access than going it alone. In out-licensing the accent shifts somewhat to newness and patent strength pointing to the perceived out-licensing requirement to offer the latest and best. In both cases exclusivity is important as it is in the cases of the Japanese and USA surveys (Tables 16 and 17, p73).

Somewhat surprisingly trademarks and grant backs do not seem to play any significant role.

Note: The four transfer cost items which appear separated in Table 91 were presented in a bundle in the questionnaire.

Factor	In-licensing		Out-licensing	
	Rating	Rank	Rating	Rank
R&D expenditure	5,61	1	5,35	3
Age/maturity of technology	5,58	2	6,15	1
Exclusivity	5,45	3	6,12	2
Transfer cost – technical	5,19	4	4,69	8
Assistance offered	5,06	5	5,06	4
Industry norms	4,98	6	4,86	7
Licensee’s market size	4,73	7	4,91	6
Patent strength	4,32	8	4,94	5
Technical assistance fees	4,10	9	3,97	13
Cost of lost opportunity	4,02	10	3,42	16
Transfer cost – marketing	3,92	11	4,64	10

Patent life remaining	3,83	12	4,67	9
Risk	3,79	13	3,82	14
Trade mark	3,67	14	4,39	11
Transfer cost – training	3,43	15	4,09	12
Lump sums	3,20	16	3,16	18
Characteristics of licensee nation	3,07	17	3,45	15
Transfer cost – legal	2,52	18	3,38	17
Grant backs	2,02	19	2,31	19
Take what is available	1,77	20	1,93	20

N varied between 28 and 52.

Table 91. Some factors influencing the magnitude of royalties.

From Table 92 no significant differences exist between in- and out-licences regarding the frequency with which restrictions are sought. Territory and quality seem paramount.

Restriction	In-licensing		Out-licensing		39 USA firms 1977 (Table 18, p74)	
	Rating	Rank	Rating	Rank	%	Rank
Territorial	6,28	1	6,56	1	82,4	1
Quality control on finished goods	5,05	2	5,90	2	55,9	3
Quality controls on materials	4,48	3	4,77	4	29,4	4
Prohibition on handling competitors' products	3,79	4	4,84	3	23,5	5a
Export quantity	2,81	5	3,40	6	14,7	6
Export price	2,81	6	4,23	5	5,9	8
Tied supply	1,88	7	2,10	8	11,8	7
Export through designated agent	1,61	8	2,81	7	23,5	5b
Grant backs	1,03	9	1,52	9	70,6	2

N varied between 27 and 46.

Table 92. Frequency with which restrictions are sought.

The relatively high frequency of prohibiting the handling of competitors' products in the case of out-licensing is surprising. It seems that South African manufacturing companies as licensors are trying harder to coerce licensees to handle only their licensed products. Further research may yield interesting insights. The importance with which grant backs are viewed by the USA firms may indicate a greater awareness of and perhaps position of strength from which to capture relevant technology in order to strengthen the licensor's position even more. The less importance South African manufacturing companies place on this may be related to the relative absence of cross-licensing and cooperative development.

The result in Table 93 that sales and not net sales is the base on which royalties are calculated is surprising at first glance and could be alarming. Arguably this result could be because the respondents did not think clearly about the difference. If so, the results would correspond with the Japanese and world results. Yet sales is also frequently reported by the Japanese and world. As could be expected profit is much less used. Other methods reported refer to mixtures of the options offered.

Base	In-licensing		Out-licensing		Japan Table 10 5.2.2, p70	World Table 11 5.2.2, p71
	Rating	Rank	Rating	Rank	Weight %	% reports
Sales %	5,83	1	6,17	1	25,2	21
Per unit	4,22	2	4,46	2		26
Net sales %	3,00	3	4,18	3	69,4	39
Profit %	1,94	4	2,21	5	5,4	17
Period amounts	1,67	5	2,46	4		16
Other	0,18		0,61			

N varied between between 28 and 43.

Table 93. Base on which royalty is calculated.

Table 94 confirms that know-how is most important in a licence, by a considerable margin. It occurs most frequently. Trademarks seem to occur very seldom.

Content	In-licensing		Out-licensing	
	Rating	Rank	Rating	Rank
Know-how only	5,60	1	5,27	1
Know-how plus patent	3,76	2	4,07	2
Patent only	3,29	3	3,36	4
Know-how plus trade mark	2,13	4	3,45	3
Know-how plus patent plus trade mark	1,86	5	2,32	6
Patent plus trade mark	1,48	6	2,93	5

N varied between 28 and 47.

Table 94. IP content of licences.

Table 95 points clearly to running royalties as the preferred payment type, followed by the combination up front lump sum plus running royalties. Minimum royalties are gratifyingly scarce in in-licensing but rather more important in out-licensing. The moderation by the Department of Trade and Industry of in-licences may well have what can be seen as a beneficial influence (6.4.2, p92). Comparison with the prior studies requires care because definitions of categories vary with options offered to respondents. It can be speculated that South African manufacturing companies and Japanese companies seek reassurance through up front lump sums or minimum royalties in roughly the same proportion. The same applies to the world results if up front fees are seen as approximating lump sum payment.

Payment type	In-licensing		Out-licensing		Japan Table 12 5.2.2, p71	World Table 13 5.2.2, p71
	Rating	Rank	Rating	Rank	Weight %	% reports
Running royalty	6,59	1	5,90	1		28
Lump sum plus running royalty	3,63	2	3,79	2		
Up front lump sum	2,13	3	3,47	3	66,9	22
Minimum royalties or payments	1,98	4	3,21	4	32,4	25
Up front fees						32
Mixture of methods						41

N varied between 29 and 49.

Table 95. Frequency of occurrence of payment types.

Table 96 lists some contingent factors in licensing that are usually addressed in agreements. Ratings are rather flat across these. Nevertheless, as licensees South African manufacturing companies are clearly concerned about service to be provided by licensors, confidentiality and access to improvements, echoing their prior expressed need for access to know-how and fear of loss of information. As licensors these companies again stress confidentiality and improvements. A concern about enforcement of rights is also evident from the relative ranking of governing law, enforcement and termination. For the world, governing law seems important along with accounting (and reporting) and confidentiality. It would be prudent to point out here how easily understanding of these attributes can vary. The question in the questionnaire (Annexure A) was “What is the relative importance of the following factors to you in licensing?” Regarding accounting for instance, a high rating would be possible because of its pervading presence; or a low rating because it may be considered routine.

Contingent factor in licensing	In-licensing		Out-licensing		World Table 17 (Extract) 5.2.2, p73
	Rating	Rank	Rating	Rank	% reports
Provision of service	6,54	1	4,86	6	
Confidentiality	6,40	2	7,42	1	90
Provisions regarding improvements	6,04	3	5,86	2	75
Termination	6,00	4	5,29	5	
Infringement/enforcement	5,33	5	5,64	3	78

Governing law	5,16	6	5,40	4	93
Dispute resolution	4,78	7	4,56	7	84
Non-contest clause	4,02	8	4,42	8	20
Accounting	3,70	9	3,79	9	92

N varied between 31 and 47.

Table 96. Importance of contingent factors in licensing.

From Table 97 it transpires as expected that licensed technology mostly represents minor improvements and seldom revolutionary improvements.

Impact of licensed technology	In-licensing		Out-licensing	
	Rating	Rank	Rating	Rank
Minor improvement	5,61	1	4,00	1
Major improvement	4,88	2	5,41	2
Revolutionary	2,33	3	3,41	3

N varied between 29 and 44.

Table 97. Impact of licensed technology.

8.16 Valuation of licensed technology - 5.4

Survey objectives: Establish methods used to calculate royalties, maturity or obsolescence discounts and the relative values placed on patents, trade marks and know-how. Characteristics surveyed appear as questions 322 to 327, 353 to 356 and 442 to 444 in Annexure A.

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As Table 98 shows income based royalty calculation is most used by a wide margin. Calculations to determine current value from future values are not important, as Contractor also found (5.4, p80). The 25% rule is seldom used.

Method	In-licensing		Out-licensing	
	Rating	Rank	Rating	Rank
Income based	7,73	1	7,23	1
Mixture	1,78	2	2,54	2
Other	1,43	3	1,76	4
Discounted cash flow	1,29	4	2,07	3
25% rule	0,88	5	1,24	5
Asset based	0,80	6	1,18	6

N varied between 28 and 30.

Table 98. Methods used to calculate royalties.

According to Table 99 technology at the laboratory stage is virtually valueless in licensing compared to fully developed technology. The higher assessment of the latter is perhaps consistent with the search for know-how and the stress on proper technology transfer. "World" values from Table 22, p78 seem to decrease more gradually. This differential may be a pointer to technology colonies.

Technology maturity stage (maximum 9 arbitrarily set)	In-licensing		Out-licensing		World Table 22 5.3, p77
	Rating	Rank	Rating	Rank	Relative rate
Fully developed	9,00	1	9,00	1	10,0
Pilot/prototype	2,41	2	2,85	2	8,0
Detailed design	2,03	3	2,20	3	6,5
Laboratory stage	0,48	4	0,75	4	5,0

N varied between 20 and 29.

Table 99. Influence of stage of development of technology on royalty.

Table 100 confirms the highest value of know-how.

Type of intellectual property	In-licensing	Out-licensing
	Rating	Rating
Know-how	7,46	7,33
Patent	5,15	5,69
Trade mark	3,09	3,81

N varied between 36 and 48.

Table 100. Relative value of forms of intellectual property.

8.17 Sources of technology - 5.3

Survey objectives: Establish frequency of occurrence of sources of in-licensable technology (questions 201 to 210 in Annexure A) and of technology (question 115).

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8.17.1 Sources of in-licensable technology

Table 101 shows that respondents indicated that 60% of their in-licensable technology is sourced abroad. This ratio of 1,5 is approximately confirmed by the ratio of 1,4 reported in the SAIS survey. Although this may be expected because more is available abroad, it may well also be a symptom of technology colonies. Suppliers and other companies are the main equal sources. The prominent relative role of suppliers could be the result of South Africa being regarded as a developing economy in many respects and could confirm its dependence and its distribution rather than originating role. It is interesting that local and foreign researchers/laboratories serve equally as sources. Inventors abroad are a negligible source as opposed to domestically where inventors rank almost on a par with the marginally main sources suppliers and customers.

Some use of foreign patent literature is evident but this could be improved dramatically. Local patent literature plays almost no role and this could perhaps be taken as a sign that it is not highly regarded, perhaps because South Africa does not have official substantive examination.

Source of licensable technology	Domestic		Foreign		Total	
	Mean %	Rank	Mean %	Rank	Mean %	Rank
Customers	8,96	1	5,56	4	14,00	3
Suppliers	8,32	2	20,21	1	27,49	1
Inventors	7,60	3	1,36	6	8,64	5
Researchers/laboratories	6,51	4	6,17	3	12,22	4
Other companies	6,00	5	20,13	2	25,18	2
Government agencies/laboratories	1,66	6	0,42	9	2,00	8
Friends/acquaintances	1,13	7	1,17	7	2,22	7
Patent literature	0,32	8	3,98	5	4,15	6
Broker/agent assisted	0,02	9	0,47	8	0,47	9
Total of all above (%)	40,52		59,47		100	

N = 53

Table 101. Proportion of in-licensable technology obtained from indicated sources.

8.17.2 Sources of technology in general

Table 102 indicates that a somewhat surprising 29% of respondents use only single sources of technology. Internal research and development and own innovation occur most frequently at

13% and 10% of respondents with the first most used by metal products and machinery and the latter most used by heavy engineering. The latter could be viewed as consistent with the nature of jobbing shops.

Industry sector	Automotive components	Building materials & components	Chemicals incl. paper & textiles	Electrical, light	Heavy engineering	Food & healthcare	ICT & electronics	Metal products & machinery	All
Source					%				
Internal R&D=1	20				18	20	11	23	13
Contract out=2		17							1
License in=3	10	17	8		9			8	5
Own innovation=4	10	17	8		27		11	8	10
None				17					1
1, 2	10				9	10	11	8	6
1, 3		17	8						3
1, 4			23	50		20	11	23	16
2, 3	10								1
2, 4	10							8	3
3, 4					9	10			3
1, 2, 3	10								1
1, 2, 4	10			33	9	20	11	8	10
1, 3, 4	10	17	31			10	33	15	16
2, 3, 4					9				1
1, 2, 3, 4	10	17	23		9	10	11		10
Total reports	10	6	13	6	11	10	9	13	78
Companies in sector	10	7	13	6	11	11	9	14	81

Note: More detail in Annexure C.

Table 102. Company sources of technology.

Internal research and development plus own innovation and these two in conjunction with in-licensing are most used as combinations, by 15% of respondents. The two are most popular in electrical, light at 50% and the three in ICT & electronics at 33%.

Only 10% reported using all four sources. One reported no source. It is smallish and started operating fairly recently using what could almost be viewed as a turn-key package to produce its products. It has been deploying the manufacturing technology to closely allied but differently designed products and has probably not been confronted yet with a need to seek really new technology. It has certainly been innovating upon its existing technology and in this sense at least its rating of itself should be faulted.

As expected, contracting out is not viewed as a technology source.

Table 103 shows that internal research and development at 74% and innovation at 68% of respondents are most frequently reported. ICT and electronics and chemicals including paper are the leaders. Contracting out is least popular but heavily used by the automotive sector.

While two of the six electrical, light sector companies reported one in-licence each they do not report in-licensing as source at all and report relying on internal research and development and own innovation.

Industry sector	Automotive components	Building materials & components	Chemicals incl. paper & textiles	Electrical, light	Heavy engineering	Food & healthcare	ICT & electronics	Metal products & machinery	All
Companies per sector and total using any one source (% of N=78):									
Internal R&D	70	50	85	83	45	90	89	76	74
Contract out	60	33	23	33	36	30	33	23	35
License in	40	67	82	-	36	40	44	23	40
Own innovation	50	50	85	83	64	70	78	62	68
Total reports	10	6	13	6	11	10	9	13	78
Companies in sector	10	7	13	6	11	11	9	14	81

Note: Detail in Annexure C.

Table 103. Frequency of use of technology sources.

From Table 104 it can be argued that companies indicating in-licensing as source of technology do tend to in-license while own innovation play an important role in stimulating in-licensing activity.

Source reported	N	In-licences			
		Companies		Licences	
	Σ=78	N	%	N	N/co
3, 4	2	2	100	15	7,5
2, 3, 4	1	1	100	4	4,0
1, 2, 3	1	1	100	2	2,0
2, 3	1	1	100	1	1,0
1, 3, 4	12	11	92	65	5,9
License in = 3	4	3	75	15	5,0
1, 2, 3, 4	8	6	75	22	3,7
2, 4	2	1	59	1	1,0
Internal R&D = 1	10	5	50	16	3,2
1, 3	2	1	50	1	1,0
Contract out = 2	1				
Own innovation = 4	8	3	38	10	3,3
1, 2, 4	8	3	38	8	2,7
1, 2	5				
1, 4	12	4	33	8	2,0

Table 104. Technology source and in-licensing activity.

Table 105 may point to internal research and development and own innovation stimulating out-licensing.

From both Tables 104 and 105 it seems that use of more than one source of technology stimulates licensing activity among manufacturing companies.

Source reported	N	Out-licences	
		Companies	Licences

	Σ=78	N	%	N	N/co.
1, 2, 3, 4	8	4	50	29	7,3
3, 4	2	1	50	2	2,0
1, 3, 4	12	5	42	21	4,2
1, 2	5	2	40	3	1,5
1, 2, 4	8	3	38	29	9,7
License in = 3	4	1	25	2	2,0
Own innovation = 4	8	2	25	4	2,0
Internal R&D = 1	10	2	20	2	1,0
1, 4	12	2	17	6	3,0
2, 3	1				
1, 2, 3	1				
2, 3, 4	1				
2, 4	2				
1, 3	2				
Contract out = 2	1				

Table 105. Technology source and out-licensing activity.

8.18 Use of information and licensing - 6.6

Survey objectives: Establish intensity of use of information sources by South African manufacturing companies. Sources investigated appear in questions 131 to 148 in Annexure A.

Notional postulate: Increasing intensity of use of information sources will lead to increasing licensing activity.

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Table 106 indicates that journals, papers and professional literature are the major sources of information for the respondents. Customers, related companies, suppliers and visits to fairs and information seeking visits abroad are also fairly prominent. South African universities are not neglected.

Information source	Frequency of rating reported					Total	C
	Extensive	Often	Sporadic	Seldom	Never		
Use of one or more gatekeeper	3	25	18	8	12	66	0,64

%	5	38	27	12	18	100	
Use of journals/papers	12	36	19	8	4	79	0,63
%	15	46	24	10	5	100	
Use of professional literature	21	36	16	4	3	80	0,71
%	26	45	20	5	4	100	
Use of libraries	12	16	22	19	9	78	0,78
%	15	21	28	24	12	100	
Use of RSA patent specifications	3	14	22	23	17	79	0,68
%	4	18	28	29	22	100	
Use of foreign patent specifications	3	18	15	24	20	80	0,67
%	4	23	19	30	25	100	
Visits to RSA fairs, exhibitions	4	32	29	12	3	80	0,33
%	5	40	36	15	4	100	
Visits to foreign fairs, exhibitions	8	25	34	9	4	80	0,60
%	10	31	43	11	5	100	
Use of universities and research institutes							
In RSA	9	20	25	19	6	79	0,72
%	11	25	32	24	8	100	
In other countries	4	6	12	25	32	79	0,58
%	5	8	15	32	41	100	
Domestic information seeking visits	7	13	38	16	5	79	0,61
%	9	16	48	20	6	100	
Information seeking visits abroad	6	27	26	14	6	79	0,66
%	8	34	33	18	8	100	
Use of parent/daughter/sister company	11	22	12	10	22	77	0,33
%	14	29	16	13	29	100	
Polling customers for information	12	29	24	12	3	80	0,50
%	15	36	30	15	4	100	
Polling suppliers for information	10	26	22	14	7	79	0,58
%	13	33	28	18	9	100	
Use of new personnel	4	14	37	21	3	79	0,46
%	5	18	47	27	4	100	
Use of consultants	6	11	27	29	7	80	0,50
%	8	14	34	36	9	100	
Use of in-licences	10	12	15	24	18	79	0,34
%	13	15	19	30	23	100	
Aggregate use						α=0,87	
Number of reports	0	20	43	16	1	80	
%	0	25	54	20	1	100	
No. of in-licences	0	56	76	32	0		
Number/company	0	2,80	1,77	2,00	0	ρ=0,15	
No. of out-licences	0	25	67	7	0		
Number/company	0	1,25	1,56	0,44	0	ρ=0,16	

Table 106. Frequency of use of information sources.

Use of patent specifications seems rather low and respondents could make more use of them.

Aggregate use of information sources centres on “sporadic” at 54% with 20% “seldom” and 25% “often”.

For summary finding on notional postulate see 9.1.7, p198.

9. CONCLUSION

The topical sequence in this chapter is:

9.1 Salient findings

9.1.1 Demographic aspects

(From paragraph 8.1 above.)

(i) Against a sample population average of 3,3 licences per company the chemicals including paper and textiles sector as created in this research proved to be the most active in licensing with an average of 6,1 licences per company. Least active was electrical, light with an average of 0,5 licence per company (Table 36, p122).

(ii) The ratio of in-licences to out-licenses was found to be 1,7 against a reported ratio in developed countries of <1,0 (Table 36, p122).

(iii) The lowest in-licence density electrical, light sector reported 5% of sales as licence-derived. The second lowest in-licence density food and health sector reported the greatest percentage of sales as licence-derived, at 18% of domestic and 19% of export sales. The ICT and electronics sector with third lowest licence density reported about 13,5% of sales as licence-derived. This may point to high individual value of in-licences in the food and health sector.

Highest in-licence density sector chemicals including paper and textiles reported 15%. Second highest in-licence density automotive and components reported the third lowest proportion of about 10,5%. This may point to low added value of licences in the latter sector and further research into this phenomenon may be useful (Tables 36/40, pp 122/125).

(iv) In the automotive components sector 80% of companies had licences and notably, in-licences only. This phenomenon raises questions about this sector's appropriable innovative activities and its possibly bonded relationship with big foreign owners and customers (Table 36, p122).

Recommendations: Establish why 80% of the respondents in the automotive components sector have only in-licences.
Establish why the automotive components sector seemingly has low added value licences.

(v) The ratio of in-licensing to out-licensing possibly increases with foreign ownership. (Table 39, p124).
Recommendation: Establish whether the above indication is true; and if so, why.

(vi) Simple licences prevail with much less activity of the co-development, joint venturing and cross-licensing type present (Table 38, p123). Licensed access to improvements is not neglected (Table 96, p179). Further comment at 9.1.4 (iii), 9.1.5 (ix) (x).

(vii) South African licensors reported having mostly smaller licencees than licensors (Table 47, p132). This phenomenon also needs further research.
Recommendation: Establish factuality of the above situation.

(viii) Of all licences reported, 31% were within South Africa, 35% with Europe and 13% with North America. The leading position of Europe is congruent with Kangs's opinion (p90) that the Europeans are most global and confirms South Africa's past and continuing contact with Europe. Some activity, mostly out-licensing, in Africa in the building materials and components, chemicals including paper and textiles and food and healthcare sectors was reported. This may indicate that South Africa is indeed out-licensing where needs exist (Tables 42/43, pp127/128).

Recommendation: Establish patterns of out-licensing in individual sectors to determine which are most active abroad; and drivers of the process.

(ix) No trend is discernible, but when capital intensity and automation are reported as extreme out-licensing increases markedly. Out-licensing also seems to increase as research and development and research and development with objective to license get better. This may indicate that up-to-date and complete technology is indeed wanted and can be successfully licensed. Out-licensing also seems to increase as technology licensing and selling capability improves. It is unclear which aspect is the independent variable, if any.

Recommendation: Establish if independent variables can be extracted.

Research and development to license is reported as poor and non-existent by 62% of respondents, against fairly high 52% liking of licensing and the opinion by 98% of the 49% of the sample population that replied to the question that out-licensing is profitable (Tables 44/45/54, pp129/130/140).

Recommendation: Establish reasons for this seeming contradiction.

(x) Reasons reported by South African manufacturing companies to in-license include obtaining and holding market share. Reasons to out-license include securing and expanding market share, also through substituting direct sales (Table 89, p174).

The strategic objectives are clear and cannot be faulted. It is however unclear to what extent they are being attained compared to results reported in surveys of a more international nature. Satisfactory attainment may be hampered by economy of size and stage of development, or avoidably by lack of knowledge, experience or application. Recommendation: Establish level of attainment. See also 9.1.5 (x).

(xi) Patent portfolios may expand with increasing domestic sales (Table 41, p126).

(xii) Although licensing represents but one method of transferring technology and sectoral differences doubtlessly exist, several pointers to the scenario sketched by Barnes and Kaplinsky – a rigorous regime imposed by first tier, global automotive components suppliers – and the existence of technology colonies as posited by De Wet (p4) can arguably be found in the above phenomena. The scenarios are certainly not negated by the findings: In-licences (only) in the automotive industry, simple licences rather than co-development arrangements, the preponderance of in- over out-licences, lack of research and development with objective to license and South African manufacturing companies dealing with bigger licensors than licensees. Further elaboration at 9.1.5.

9.1.2 Economic orientation, overall and licensing organisation
(From paragraphs 8.4, 8.5, 8.2, 8.13 above.)

(i) The respondents could be generalised as pioneering in conservative fashion (Table 58, p143).

(ii) Of companies with out-licences 5% encourage innovation; at 6% licensing income is recognised and at three companies the accounting system does both (Table 61, p145).

No relation between accounting system and licensing activity could be found.

(iii) Indications are that consolidation of research and development in divisionalised or geographically spread companies enjoys some attention. Amongst companies having a Head of research and development the Head reports to the Chief Executive Officer at 56% of respondents. Satisfactorily, the Chief Technical Officer is probably mostly recognised as one of top management (Table 48, p134).

(iv) Management education is rated broadly satisfactory and there may be increasing licensing activity as it improves (Table 49, p135).

Recommendation: Refine insight into the possible relationship between management education which arguably is a determinant of sophistication and licensing activity.

(v) 13% of respondents reported that they do not at all maximise technology capability among disciplines, functions and strategic business units and 5% that such maximisation does not apply to them (Table 50, p136).
Recommendation: Establish reasons for the neglect apparent from the above.

(vi) At 31% of respondents no technology licensing and selling function exists and 23% report poor handling of it. At 89% there is no Head of licensing and the function is assigned to another functionary who also has other tasks. Licensing is not seen as a centre, be it cost, profit or service, at 45% of respondents (Table 84, p170).

(vi) A mere 4% of respondents reported the Not Invented Here syndrome as pervasive (Table 51, p137).

9.1.3 Regulatory environment
(From paragraph 8.6 above.)

South African manufacturing companies in general seem satisfied with domestic and foreign patent, design, trademark and agreement control systems (Table 62, p146).
Related recommendations at 9.1.4 (i) on innovation and 9.1.6 (ix) on moderation by government.

9.1.4 Directed future
(From paragraphs 8.8, 8.7, 8.9, 8.17 above.)

<u>Innovation</u>

(i) Increasing use of Support Programme for Industrial Innovation funding may lead to increased out-licensing activity; as may generally greater use of public funding. Knowledge of availability of public technology development funding is disappointing (Table 67, p152). Recommendation: Establish why this is so and improve dissemination of knowledge about support programmes.

(iii) International co-development is reported as intensive, frequent or often by 59% of respondents. This can be considered satisfactory to good for such a specialised activity. Detail regarding the exact nature of the co-development is vague (Table 69, p154). Refer also 9.1.5 (x). Recommendation: Establish also the role of licensing and especially cross-licensing.
(iv) Fairly high levels of continual encouragement of innovative activities regarding products and processes, production, logistics and management are reported (Table 71, p156).

Sensitivity to future

(v) Environment friendliness is generally considered high, although only eight respondents have ISO14001 certification. The chemical including paper and textiles, food and healthcare and heavy engineering sectors report the highest friendliness (Table 63, p148).

(vi) The majority of respondents describe their market and technology competition as strong (Table 63, p148).

vii) More attention to complementary assets seems necessary (Table 63, p148).
Recommendation: Intensify awareness of complementary assets in industry.

(viii) Forward planning seems to be practised generally with 8% reporting no and 13% poor planning (Table 64, p149).

Learning

(ix) Technology transfer is the application of technology to a new use, or to a new user (Gee, p31). The crux of the process of transfer alias diffusion of technology can simplistically be described as learning, which is a complex result of several underlying determinants. Learning in preparation for and during in-licensing seems not to be neglected but can probably be more focused and thus improved. Some doubt is expressed about cross cultural competence (Table 74, p158).
Recommendation: Complacency should be resisted resolutely. Aspects mentioned by Pucik (p34) could be incorporated. The determinants including what can be called preparatory determinants such as awareness of an innovation ethos and best-practice technology as put forward in South Africa's Innovation System (p5) should be identified and purposefully managed. Technology management education should propagate this recommended attitude.

Sources of information and technology

(x) Respondents source 60% of in-licensable technology abroad with suppliers and other companies main and equal. In the SAIS survey 59% of respondents reported foreign rather than domestic innovation partnerships (Table 101, p181).

(xi) Local and foreign researchers and laboratories are equal sources of in-licensable technology at a scant approximately 6% of total (Table 101, p181).

(xii) Patent literature as a source of in-licensable technology forms only about 4% of total.
Recommendation: Encourage greater use of patent literature as information source and to identify licensing opportunities.

(xiii) A disappointingly high 29% of respondents report using only one source of technology, be it internal research and development, contracting out, in-licensing or own innovation (Table 102, p182).
Recommendation: Establish industry's awareness of and insight into innovation.

(xiv) Internal research and development is used by 74% and own innovation by 68% of respondents as source of technology, whether solely or in combination with other sources (Table 103, p183).

(xv) Recommendation: To address all the above aspects and others evident from intellectual property administration and licensing, provision of practical innovation and licensing and intellectual property orientation and education to interested parties following suitable awareness campaigns should be investigated. For example, one possibility would be use of "easy one-stop" introductory centres, perhaps attached to the Innovation Hub and universities and in essence cost free to users. These would complement and not replace the functions of SARIMA (p6), patent attorneys and similar professionals. The accent should be on technology management and commercialisation rather than legal aspects.

9.1.5 Intellectual property

(From paragraphs 8.9, 8.11, 8.12 above.)

Appropriation

(i) Of the respondents 75% hold South African patents or applications and 47% designs or applications. Foreign holdings are smaller (Table 75, p159).

(ii) No relation between patents held and out-licences could be found (Table 76, p161).

(iii) Patent holdings may increase with improved research and development, research and development with intent to license, technology licensing, technology portfolio, use of public technology development funding and encouragement of innovative activities; and not with increased international involvement (aggregate of experience and travel) and possibly may decrease as the latter improves (Table 76, p161).

(iv) Confidentiality agreements with employees are used at 79% of respondents (Table 77, p162) and with inventors at 45%.

(v) TRIPS (Agreement on Trade Related Aspects of Intellectual Property) knowledge exists at only 30% of respondents (Table 77, p162).

(vi) The Patent Cooperation Treaty determinations are most used, and by 49% of respondents (Table 77, p162).

Intellectual property portfolios

(vii) Only 19% of respondents reported that their aggregate IP planning is well-run, 51% that it is not good and 30% that it is non-existent. This situation is *prima facie* disturbing (Table 78, p164).

Recommendation: Investigate the seeming lack of planning and management.

(viii) Quality of technology management strategy is considered by 10% to be *ad hoc* and by 11% to be non-existent; and the aggregate hereof and technology audits renders 18% and 10% respectively (Table 80, p166).

Recommendation: Investigate indications that technology management is considered weak.

(ix) Research as suggested above into IP planning and technology management strategy development should be done within the framework of IP deployment ((x) following) to accommodate appropriability considerations.

Deployment of intellectual property

(x) South African manufacturing companies are mainly interested in deploying their IP in deterrence and monopolisation roles and this cannot be faulted *per se* but active deployment seems to be lacking as *e.g.* altogether only 19% expressed interest in earning royalties (Table 83, p169).

It is not clear

- to what extent deliberate use is made of the described strategies (4.2, p45) and to what extent such use could lead to improved co-development and cross-licensing opportunities (refer also 9.1.1 (vi) and 9.1.4 (iii)) and

- why the apparent contradiction exists between the almost passive application of IP and the expressed high liking of licensing as well as the belief that it is profitable for the licensor (9.1.1 (ix)).

Recommendation: Investigate the aspects mentioned above.

9.1.6 Licences and licensing
(From paragraphs 8.14, 8.15, 8.16 above.)

Reasons to license or not

(i) In-licensing is driven by the need to obtain and hold market share through access to future and innovative technology. Out-licensing serves to secure and expand market share also through substituting direct sales (Table 89, p174).

Recommendation: Further research to place these reasons in perspective against the strategies mentioned in 9.1.1 and IP portfolio building may be interesting.

(ii) Fear of revealing own know-how seems to be a major inhibiting factor to out-licensing and raises questions regarding the perceived value of and enforceability of statutory protection as well as a possibly erroneous overvaluation of local know-how (Table 90, p175).

It would also be prudent to bear in mind the admonition of Teece and Kim (p28) that technology transfer cannot be stopped.

Recommendation: Clarify the seemingly disproportionate fear of revealing own know-how.

Content of and value added in licence agreements

(iii) The contents of licence agreements are broadly similar and similarly motivated to those in other countries (various Tables).

(iv) Relative valuation of factors influencing royalty rates points to confirmation that purchased technology can be more advantageous to fast and cheaper access to technology and thus markets. Research and development expenditure, age and maturity of the technology, transfer cost and assistance offered are all highly valued (Table 91, p176).

Exclusivity is always important.

In out-licences the accent shifts somewhat to newness and patent strength.

(v) Trademarks are of less interest, as are grant backs. The lack of importance attached to the latter, also as compared to reported international practice, may be related to the relative scarcity of cross-licences (Tables 91/94, pp176/177).

Recommendation at 9.1.5 (x).

(vi) Restrictions regarding territory and quality seem most important (Table 92, p176).

Confidentiality is also required (Table 96, p179).

(vii) In out-licensing additional stress seems to be placed on restricting the handling of competitors' products (Table 92, p 176).

Recommendation: Establish the reasons for this phenomenon.

(viii) Respondents seem generally aware of the value of licensed access to improvements (Table 96, p179).

(ix) Running royalties are preferred, minimum royalties are scarce in in-licences and are sought more frequently in out-licences (Table 95, p178). The intercession of the Department of Trade and Industry on behalf of the Reserve Bank may well contribute to this profile, demonstrating the value of its policy which imposes what can be seen as mild requirements when in-licensing.
Recommendation: Maintain policy.

Valuation of licensed technology
(x) Know-how is the most important intellectual property by a considerable margin (Table 100, p 180).

(xi) Fully developed technology is most valuable by a considerable margin (Table 99, p180).

(xii) Royalties are mostly income-based (Table 98, p180).

9.1.7 Influence of notionally postulated determinants of licensing

No statistically meaningful correlation coefficients to support any of the notional postulates, all concerning correlation between attributes or clusters of attributes of individual respondents notionally acting as determinant variables upon licensing activity could be found.

However, in a different approach Table 107 provides an overview of the summed results for attributes and clusters notionally postulated to affect licensing activity positively or negatively. These require statistical circumspection but nevertheless offer interesting perspectives regarding possible influences of determinants on industry. In general all are neutral to positive. Only use of public innovation funding shows negative correlation and this is with in-licensing which arguably seems intuitively acceptable. Awareness of intellectual property is consistently neutral to in-licensing and consistently correlates positively with out-licensing. Sensitivity to the future perhaps has the greatest effect on encouraging licensing activity both outwards and inwards. While Techno-economic Networks appear to have a positive effect on in-licensing they are essentially neutral to out-licensing.

Although tenuous, these preliminary results suggest that several of the listed determinants as well as others reported on in Chapter 8, and yet others not identified or singled out, do have an effect on licensing activity. Although their effect cannot on the available statistical evidence be assigned to individual companies they can be seen as influencing companies on average, from which can be deduced that some will be influenced. Such determinants can thus be put to use by management to attempt to attain specific goals; and education within industry at large would arguably enhance licensing on average. Speculatively, depending on individual company circumstances, objectives could be to influence in-licensing positively, by increasing management liking thereof, international exposure, maximisation of technology capability, and so forth. Out-licensing would be similarly positively influenced by increasing management liking but not by international exposure and maximisation of technology capability.

It is noteworthy that increasing international exposure, maximisation of technology capability and innovative activities were counter-intuitively found positive to in-licensing but neutral to out-licensing. An explanation of this phenomenon could be that the activities underlying these determinant variables intensify as a result of a search for a solution to a problem a local company

Determinant	Possible correlation		Detail in table ---
	In-licensing	Out-licensing	
1. Techno-economic networks			53,54,50
Awareness of competitors' successes and failures	o	o	
Top management's liking of licensing	+	+	
International exposure	+	o	
Maximization of technology capability	+	o	
2. Economic ethos of company			58
Risk taker	o	+	
Conservative	+	o	
Pioneer	o	+	
Follower	o	o	
3. Sensitivity to the future			63,64
Environmental friendliness	o	o	
Market competition	+	+	
Technology competition	+	+	
Tacit knowledge	o	+	
Access to complementary assets	o	+	
Technology portfolio	+	+	

Forward planning	+	+	
4. Encouragement of innovative activities			67,69,71
Use of public innovation funds	-	+	
International involvement	+	+	
Innovative activities	+	o	
5. Awareness of intellectual property			
R&D with objective to license	o	+	78,80
IP planning	o	+	
Technology planning	o	+	
6. Information source use	o	o	106

Table 107. Summary of possible effect of attributes and clusters on licensing activity

may be experiencing and therefore tend to lead to technology acquisition. While attention to these activities is commendable they disappointingly seem one-sided. What is perhaps lacking is the simple realisation that a solution to an own problem may well be sought after by possible licencees.

On what may be termed company culture level, an ethos of risk taking and pioneering may stimulate out-licensing and conservatism may stimulate in-licensing, perhaps confirming the influence of ethos on innovation as postulated by Tidd *et al* (p88) and Prahalad and Hamel (p89).

Recommendation: It is recommended that further directed research be undertaken. This may yield valuable further insights into the possible effects of the notional and further drivers; and may lead to the clearer identification of factors that could be employed to improve South African and possibly other countries' industries' technology licensing practices; whether it be directly or indirectly and to contributing to possible mechanisms to emancipate South Africa from any technology colony status.

9.2 Compendium of recommendations

9.2.1 Demographic aspects.

(i) Establish why 80% of respondents in the automotive components sector have in-licences and only in-licences.

(ii) Establish why the automotive sector seemingly has low added value licences.
(iii) Establish whether the ratio of in- to out-licences indeed increases with increasing foreign ownership of companies; and if so, why.
(iv) Establish why foreign licencees are smaller than foreign licensors.
(v) Establish patterns of out-licensing in individual sectors to determine which are most active in licensing technology abroad; and attempt to identify drivers of the process.
(vi) Establish why licensing is described as profitable and liked but research and development with objective to license is weak.
(vii) Establish to what extent strategic reasons advanced for licensing are being attained.

9.2.2 General and licensing organisation, techno-economic networks, economic orientation.

(i) Organisation for technology management seems reasonable. Organising for licensing seems to be held back by lack of volume. Establish factuality of both indications.
(ii) Refine insight into possible relationship between management education and licensing intensity.
(iii) Establish why respondents do not fully maximise technology capability among disciplines, functions and strategic business units.

9.2.3 Regulatory environment.

General satisfaction with the South African and other patent, design, trademark and agreement control systems was found. Related recommendations appear at 9.2.4 (ii) on innovation funding and at 9.2.6 (v) on moderation by government.

9.2.4 Innovation, future awareness, learning, sources of technology, information use.

(i) Intensify awareness in industry of complementary assets and forward planning.
(ii) Improve dissemination of information about public technology development support and funding programmes.
(iii) While international co-development can be considered satisfactory further investigation into the exact nature thereof may be fruitful; also to establish the role of licensing and especially cross-licensing. (See also 9.2.5 (iii) and 9.2.6 (iv).)

(iv) Learning in preparation for and during licensing seems not neglected but can probably be more focused and thus improved. Complacency should be resisted resolutely. Aspects mentioned by Pucik (p34) could be incorporated. The determinants including what can be called preparatory determinants such as awareness of an innovation ethos and best-practice technology as put forward in South Africa's Innovation System (p5) should be identified and purposefully managed. Technology management education should propagate this recommended attitude.

(v) Encourage greater use of patent literature as information source and to identify licensing opportunities.

(vi) With 29% of respondents reporting use of only one source of technology the question whether they are optimally sensitive to innovation should be investigated.

(vii) Consideration should be given to the provision of "easy one-stop" centres to provide practical licensing orientation and education to persons interested following suitable awareness campaigns. These could be attached to the Innovation Hub and universities and should in essence be cost free to users, being of an introductory nature. They would complement and not replace the functions of SARIMA (p6), patent attorneys and similar professionals. The accent should be on technology management and commercialisation rather than legal aspects.

9.2.5 Intellectual property.

(i) Investigate neglect of IP planning and management.

(ii) Investigate indications that technology management strategy is considered weak.

(iii) Respondents' tendency to limit IP deployment to deterrence and monopolisation roles as opposed to active exploitation should be investigated

- to determine whether more active use would increase co-development and use of cross-licensing and
- to resolve the apparent contradiction between expressed high liking of licensing and the belief that it is profitable against the almost passive application.

9.2.6 Licences and licensing.

(i) Exploration of reasons advanced for licensing against available exploitation strategies

(p45) and IP portfolio building could be informative.
(ii) Clarify the seeming disproportionate fear of revealing own know-how in out-licensing.
(iii) Investigate the additional stress, which may be related to the fear of revealing know-how, placed in out-licensing on restricting licencees' use of competitors' products.
(iv) Investigate the seeming lack of importance attached to grant-backs in out-licensing, when compared to international practice, and which may be related to insufficient cross-licensing and co-development awareness.
(v) Continue the policy of moderation of in-licences by the Department of Trade and Industry.

9.2.7 Determinants or drivers of licensing.

Undertake further directed research to expand insights into the possible effects of the notional and further drivers; and thus possible identification of factors that could be employed to improve South African and possibly other countries' industries' technology licensing practices.

9.3 Perspectives

9.3.1 Signs of a technology colony

South African manufacturing companies are net importers of technology and as a group in this respect manifests as a technology colony.

Of the sample population of South African manufacturing companies 37% had only in-licences, 14% only out-licences, 12% both types and 35% had no licences (Table 37, p122). A world-wide sample, based mostly in developed countries and including 3% of respondents from each of Japan and Australia; probably discounting companies with no licences; and including all and not only manufacturing companies, in 1997 returned respectively 5%, 24%, 71% and nil (4.3.2, p57). In- to out-licensing company ratios are therefore approximately (37+12) : (14+12) and probably (5+71) : (24+71) or 1,9 for South Africa and 0,8 for the "world". Local and foreign researchers and laboratories are equal sources of in-licensable technology at a scant approximately 6% of total (Table 101, p181). Original, external technology thus is introduced sparsely. 40% of in-licensable technology is sourced from foreign suppliers and companies.

In- to out-licences ratios are 1,7 and 1,0 for respectively South Africa and Japan (Table 36, p122 and Table 8, p70).

South Africa pays several times what it earns in royalties, and in 1994 Japan and the UK were about neutral while Germany and France were paying about twice their earnings (Table 1, p28).

South Africa as a whole clearly is a net importer of technology. It uses little licensed research and development – a characteristic posited for technology colonies. Sectoral differences will doubtless exist and some sectors may even have been emancipated.

While comparative statistics quoted above include licensing activities of research laboratories and governmental institutions as opposed to those for South Africa, the effect can probably be discounted considering the low 6% laboratories form of in-licensable technology sources.

9.3.2 Signs of independence

South African manufacturing companies are probably not largely dependent on foreign technology or markets and as a group appears to have progressed towards a state that abates the negative impacts of being a technology colony and leaves them more independent.

Licence based domestic and export sales are reported in ranges respectively between 7% - 18% and 5% - 19% of total, with the highest percentage in both cases reported by the food and the arguably specialised healthcare sector (Table 40, p125). Respondents further reported that only 60% of their in-licensable technology is sourced abroad (Table 101, p181). This ratio was also found in the SAIS survey, regarding the geographical spread of "innovation partners" (8.17.1, p181). This leaves more than 80% of turnover based on in-house technology and only about 8% based on foreign technology.

In parallel, broadly confirming the above scenario, sources of general technology, used uniquely or in combination, were internal research and development reported by 74%, own innovation by 68% and licensing by 40% of South African manufacturing companies, with the latter most diluted by the simultaneous use of other sources (Table 102, p182).

These findings seem to point away from technology colonies by appearing to re-assure regarding dependence on foreign technology sources and markets. The possibility that the foreign-sourced licensed content may be small but crucial to market success can however not be eliminated. The finding in the SAIS survey that South African companies tend to innovate by imitation rather than by invention may be relevant; and the SAIS policy recommendation that the proved ability of South African firms to improve products and processes using foreign technology should be encouraged, is supported for manufacturing companies.

9.3.3 Immature companies with sub-critical licensing mass?

South African manufacturing companies may show signs of immaturity and sub-critical mass as licensors.

International exposure as aggregate of international experience and travel abroad is reported by respondents as sporadic or none by only 7% of respondents (Table 54, p140). A seemingly high 60% of respondents report international co-development as often or better (Table 69, p154). Management reports liking of or use of licensing at 52%, accepting it at 44% and disliking it at 4% (Table 54, p140) and about 97% considers it profitable for licensors (Table 54, p140 and Table 47, p132).

But research and development to license is reported as poor and non-existent by 62% of respondents (Table 45, p130). Respondents' licencees are smaller than their licensors (Table 47, p132). Cross licensing, joint venturing and co-development occur markedly less than simple licensing, be it in- or out-licensing; and also compared to reported international practice (Table 38, p123). Intellectual property (Table 78, p164) and technology strategy planning including technology audits (Table 80, p166) show considerable room for improvement with respectively 51% not good and 30% never; and 28% poor or none ratings. Intellectual property is mostly applied in deterrence and monopolisation roles with little evidence of sophisticated use (Table 83, p169). About 66% of all licences are confined to South Africa (31%) or Europe (35%), leaving 34% for all other countries. (Table 42, p127.)

The contradictions above are accompanied by apparently weak specific organisation for licensing and the absence of recognition of licensing as an accounting centre. Is management guilty of wishful thinking, or perhaps merely subject to economy of scale constraints? Is management deluding themselves under the influence of a reasonable knowledge of European conditions and in-licensing from there?

Perhaps a critical level is required before out-licensing reaches meaningful volumes, as suggested by the phenomena that out-licensing shows marked increases when capital intensity is rated extreme (Table 44, p129) and when research and development and also research and development with intent to license are rated excellent (Table 45, p130) and seems to increase with increasing automation (Table 44, p129).

9.3.4 Lip service to licensing; licensing impacts uncontrolled and lost?

It can be argued that immaturity in out-licensing is closely related to immaturity in in-licensing or stated differently, to licensing in general. The phenomena mentioned in 9.3.1 and 9.3.3 can be interpreted as outlining an erratically licensing South African manufacturing industry. Without deliberate cognisance of and organisation for licensing (King; Ford & Ryan, p14) credible licensing results must be doubtful. Aimlessness may leave companies vulnerable to possibly iniquitous designs of licensors. Purposeful and informed action will create access to the contributions licensing could make to the health of manufacturing companies. These include cross-licensing to protect against becoming specialised islands at risk of being by-passed, collaboration as described by Tidd *et al,* (Fig. 12, p55) nurturing innovation through *e.g.* establishing supportive cultures to fend against colonisation, TENs (p19) organising available and searching for new technology and operating at the nexus of competing technologies, IP planning and even less of deliberately deploying IP strategically (Glazier, p.45) to enter new business (Kim, p29; Roberts and Berry, p54), or of nurturing complementary assets (Teece, p37).

9.3.5 Towards best practice

Better or poorer licensing practice ought to and will be a function of objectives and circumstances. Schafer's insight bears repeating (p62):

> …. Traditionally, companies have given a low priority to out-licensing. There are a number of reasons for this. The business imperative … is to introduce new products. Outlicensing is seen to divert resources. It gets the lowest priority in legal departments when other deals are being done. It can be seen as failure by R&D departments trying to develop products for the company. And company executives may be concerned they might give away rights the company will need later. (Schafer, 1993: 119.)

Conducive ambiences can however be created for in- and out-licensing. Towards this end several recommendations that can be grouped as involving national policies, companies and the research community appear in 9.2 above.

Regarding national policies it appears that public technology development funding may encourage out-licensing and discourage in-licensing. The assistance currently offered is however not well-known among the sample companies. Maintaining such support and promoting it better may well bring desirable results. Moderation of royalties through the Department of Trade and Industry (DTI) also appears to be salutary. Possibly some education through the DTI or the Companies and Intellectual Property Registration Office (CIPRO) or Innovation Hub(s) could be made available or funded.

Clearly CIPRO should function properly and South Africa's IP registration system should be user friendly and in tune with international practice. Imposition of patent working requirements and withholding taxes on royalties have proved controversial and not necessarily salutary.

Companies could be guided through activation and education. Schafer points to circumstances and objectives militating against out-licensing. Misconception and time constraints seem to be paramount. It may be that smaller companies, which are the majority in South Africa, should be targeted. These, because of a lack of time and management breadth may be less aware of licensing and its intricacies – and may even be unaware that they need to know more. Such action which could be funded as part of national policy would also be congruent with the national Innovation Policy (p.5).

Misconception and time restraints do not only restrict licensing activities. They probably prevent the development of proper awareness amongst company personnel and what may be seen as a pernicious circle causing lack of action results. Directed study is desirable and deliberate consideration of licensing options and actions is necessary. Its multi-disciplinary and multi-functional nature should be admitted and managed. Findings in this study indicate that awareness of IP planning and management including application should be improved, organising for licensing should be considered and the advantages of and mechanisms to arrange cross-licensing and grant-backs should be propagated.

Interesting preliminary pointers to drivers of licensing were also identified. Companies should consider activation of these.

The research and teaching community should pay systematic attention to licensing. Further research on several aspects including regarding the effect of postulated drivers is suggested. Awareness of these and their possible effects will thus be raised and should be propagated. Likewise attention should be drawn in technology management education to obviating misconceptions such as those mentioned above. Importantly, learning even before and during in-licensing, arguably the most important diffusion mechanism, should be addressed. The profile of patent literature as information source should be raised.

9.3.6 Extendability to other developing countries of results and recommendations

The findings reported regarding demographic aspects and the regulatory environment reflect conditions amongst the respondent companies, *i.e.* a selection of South African manufacturing companies that had or had had at the time of the survey at least one licence agreement or patent. These findings cannot be projected onto other countries.

Very circumspectly, some other results can be projected to varying degrees to other countries' manufacturing companies approximating those herein defined. Although licences *per se* can largely be classified generically in several taxonomies, neither licensing practices within, nor the impact thereof upon all including developing countries can be expected to be the same. This is because individual licences will be designed and operated for different purposes and to do so within the differing milieus of country economic status in the broadest sense and governmental policies.

Governmental policies including policies relating to statutory intellectual property, application of and restrictions regarding intellectual property, protectionism in general, incentive schemes and innovation can be expected to vary and will influence licensing practices to at least some extent. As examples, royalties payable to foreign licensors could be limited to some extent as the South African government does, patent working requirements may be in force (4.3.3, (v) and (vii), p60) or encompassing development policies may influence sectors or countries.

Likewise the country's and its industries' stage of evolvement, their available skills and raw materials, culture and corporate system of governance (p88), the possible presence of local monopolies and even their colonial parentage may introduce variances among countries and sectors of their industries. As an example, available skills can be selected as crucial to in-licensing. Considering that licensing is mostly a learning process recipients have to be ready to assimilate new technologies. Skills development by Korea and Japan has been intense and appears to have played a role to advance both countries relatively faster than previously comparable developing countries. South Africa has shown its prowess to innovate by imitation and its ability to improve products and processes using foreign technology. It has originated and widely commercialised interesting inventions. Arguably Korea, for one, also went through and is now beyond such a stage.

Policies and economic status are also intertwined and have separate and combined influences on economic activity and by extension on licensing. The differences between (say) Taiwan on the one hand and on the other hand mainland China and newly emancipated countries from the former Soviet Union highlight some of the effects. These can be seen in their banking sectors, marketing ethos and international connections. Perhaps South Africa can be viewed as occupying an intermediate position. Its lack of skills amongst the broader population and perhaps a prevailing incorrect attitude can be seen as underlying the suggestions by De Wet (p5) that engineering education should be reoriented, the functions of scientific institutions adapted and National Systems of Innovation focussed. At the same time it represents an advanced open economic society.

Specifically regarding licensing the possibility of indifferent policies and minimal or immature development exists and this could within countries or sectors lead to unimaginative licensing and perhaps lock a country into technology colony mode and supplying markets identified and dictated by licensors. Automotive components manufacturers in various developing countries including South Africa may possibly be in a position approximating this condition and be largely powerless to change it. Furthermore, for various sectors, the respondents in this study reported between 5% and 19% of sales as licence based. Arguably this part of sales can be removed with relatively mild consequences whereas for instance a deliberate or haphazard 50% dependence would present a completely different picture. Such dependence may, as stated, be deliberate and not necessarily undesirable as a planned precursor of emancipation, representing the OEM stage just before the ODM or OBM stages. Judicious in-licensing, preferably as part of a more encompassing development policy and for example taking regard of Ford's approach to identify acquisition reasons (p52) as well as using acquisition techniques as pointed to by, amongst others, Kim with reference to Korea, may bring technological as well as market success and emanicipation as achieved by Korea and Japan.

It is clear from the foregoing that the impact of licensing will also vary, being for example influenced by restrictive or encouraging policies and assimilation, application and adaptation skills.

Some of the findings reported herein certainly support the notion that practices in South Africa are not too different from those in countries, mostly developed countries, in which prior surveys were done. This correspondence encourages circumspect projection of some findings. These include the impact of notional drivers of licensing as described herein and similar characteristics; content of licences, valuation of licensed technology and reasons for licensing. Recommendations of a more generic nature may be similarly projectable.

9.4 General recommendations on research

(i) Further work to refine the findings of this research may consider defining the determinants and rating scales better and the scales finer to obtain more data points. It may also be useful to limit a survey to only companies with active licences to eliminate possibly confounding input coming from a more varied selection. This will contribute to reducing variance, as will increasing the sample size. The latter may be problematic. The number of licences per company in the sample of this research ranged from 0 to 20 in-licences and 0 to 25 outlicences.

This type of variance will *prima facie* necessitate large sample sizes in future research to increase statistical certainty accompanying many findings. To achieve satisfactorily large samples will be a challenge considering South Africa's and South African companies' size and the fairly low response rates that can be expected. Involving sectors other than the manufacturing industry may ease the number problem but may mask differences between the sectors.

Further study of the influence of drivers of the licensing process ought to contribute substantially to developing an answer to the question 'What do I do to achieve <effect> regarding licensing?'

(ii) Insights into South Africa's status - and perhaps changing status - as technology colony or not may be gained by exploring practices again after a number of years.

9.5 Final remarks

The hope is expressed that this research will contribute to the understanding of South African industry's licensing practices and views and ultimately to policy making and further similar research .

Not least it is hoped that interest in and pragmatic use of technology licensing will be stimulated.

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FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

Department of Engineering and Technology Management

TECHNOLOGY LICENSING IN SOUTH AFRICA SURVEY

This is the first cross section survey of the views and activities of South African manufacturing companies regarding technology licensing. The results will be collated and analysed as part of a doctoral study on the subject, extracts from the collated results will be published and will be shared with respondents wishing to do so. The thesis itself will contain collated results and will be open to the public.

Individual confidentiality will be respected and maintained.

Your kind co-operation in completing and returning this questionnaire shall be greatly appreciated by both the student and the Department of Engineering and Technology Management of the University of Pretoria. About 50 minutes will be required. We trust you will also find some of the questions stimulating!

Please return the completed questionnaire as follows:

To fvanvuuren@ifc.org or to University of Pretoria
Department of Engineering and Technology Management
Lynnwood Road
Pretoria
0002 Attention Mr F J J van Vuuren

Fax number 012-362-5307

Should any questions arise, please do not hesitate to take them up with

(Student) Francois J J van Vuuren at cell phone number 083-399-9801
or at fvanvuuren@ifc.org .

Please attempt to return the questionnaire as soon as possible – during October?.

Please take a minute to read the brief instructions appearing overleaf …..

Orientation and instructions.

Please bear the following definitions in mind:

- **Technology** is the knowledge, concretely or abstractly embodied, underlying machinery, equipment and processes severally and jointly and by means of which productive systems, products or services are constructed, operated, manufactured and supplied, as well as used, for economic benefit.

Fruits of the mind or intellect such as works of fine art, music, poems and the like are excluded because of their aesthetic rather than industrial character.
Fine arts such as music, literature and paintwork are excluded except in so far as they may be employed for commercial purposes such as image building and advertising other goods or services.

- **Innovation** is the ongoing as well as recently completed rearrangement in novel ways of technical and scientific as well as organizational elements for economic benefit.

- ***In*-licensing** refers to your company being the licensee and ***out*-licensing** to your company being the licensor.

- **Please disregard all response numbering signs. These appear in the following forms: *italic 1, 2 … 10, 1….10. …***

- **Do not write on any shaded area.**

- **Special request: It is difficult to convey some concepts in a word or two. Therefore, if a question is unclear, please draw a line through it rather than guess at its meaning, perhaps providing a misleading response.**

………………………………………………………….

F J J van Vuuren Pr. Eng.

It is hereby confirmed that the questionnaire is being returned with the concurrence of the Chief Executive Officer, under the conditions and for the purposes set out on the front page:

Name	
Position	
Signature	
Date	

1. COMPANY. Questionnaire number

Company name *1*						
Physical address	....					
Industry – describe *2*						
Respondent's name			Telephone:			
Respondent's function/ title						
No of employees *3*	*1* <50	*2* 50 – 249	*3* 250 – 500	*4* >500		
Major product/service *4*	…………………………………………………………………………					
Ownership (✔ one or more) *5*	Private	Public	Domestic	Foreign	Domestic/foreign	
	1	2	3	4	5	
Owns other companies *6*	In RSA:	*1* Yes	*3* No			
7	Elsewhere:	*2* Yes	*4* No			
Domestic sales (Rm/year) *8/9*	<10	10-50	51-200	201-500	>500	% involving in-licences: %
	1	2	3	4	5	6
Export sales (Rm/year) *10/11*	<10	10-50	51-200	201-500	>500	% involving in-licenses: %
	1	2	3	4	5	6
Tick ISO certification obtained *12*	9001/2000	9001/1994	9002/1994	9003/1994	140001	
	1	2	3	4	5	

2. HOW DO YOU PERCEIVE THE COMPANY'S GOVERNANCE MILIEU?

In each row mark block containing the closest description.

	1	2	3	4	5
Is the company's usual style that of a risk taker or is it conservative? *13*	Risk taker	Tend to risk	Neutral	Careful	Conser-vative
Is it a pioneer or a follower? *14*	Pioneer	Careful	Neutral	Careful	Follower
Its awareness of competitor's successes is *15*	Complete	Active	Average	Vague	None
Its awareness of competitors' failures is *16*	Complete	Active	Average	Vague	None
Its awareness of competitors' technology licensing activities is *17*	Complete	Active	Average	Vague	None
Top management's attitude to licensing? *18*	Likes	Uses	Accepts	Ignores	Dislikes
Overseas experience is *19*	Excellent	Good	Fair	Some	None
Travel abroad is *20*	Extensive	Often	Regular	Sporadic	None
Management education is *21*	Best	Good	Average	Uneven	Weak
Are operations capital intensive? *22*	Extreme	Very	Average	Partly	Not at all
Is production automated? *23*	Extreme	Mostly	Mix	Minor	Job shop
Company's environment-friendliness is *24*	Extreme	Positive	Average	Grudging	Not at all

Which of the attributes following characterize your accounting system? (Mark one or more.) 25							
Divisional	Product line	Detailed cost	Short term view	Long term view	Encourages innovation	Imposed by parent	Recognises licensing income
1	2	3	4	5	6	7	8

3. PLEASE CHARACTERISE THE COMPANY'S SENSE OF ITS ENVIRONMENT.

Mark one descriptive block in each row.

	1	2	3	4	5
Market competition is 26	Fierce	Strong	Fair	Minimal	None
Technology competition is 27	Fierce	Strong	Fair	Minimal	None
Manpower is available 28	Scarcely	Can find	Fair	Can select	Abundant
Has the company made use of or is it making use of National funding for innovation?					
SPII funds 29	Maximally	Yes	Tried	No	What is it?
Innovation fund of DTI 30	Maximally	Yes	Tried	No	What is it?
THRIPs funds 31	Maximally	Yes	Tried	No	What is it?
Other DTI/IDC/DACST funds 32	Maximally	Yes	Tried	No	What is it?
What is the company's impression of the following legal and control systems?:					
RSA's patent system 33	Perfect	Good	Fair	Improve	Unsound
RSA's designs system 34	Perfect	Good	Fair	Improve	Unsound
RSA's trade marks system 35	Perfect	Good	Fair	Improve	Unsound
Agreement control – in RSA 36	Perfect	Good	Fair	Improve	Unsound
- abroad 37	Perfect	Good	Fair	Improve	Unsound
Exchange control – in RSA 38	Perfect	Good	Fair	Improve	Unsound
- abroad 39	Perfect	Good	Fair	Improve	Unsound
Co's international co-development 40	Intensive	Frequent	Often	Seldom	Not at all
Co. involved in offset/countertrade? 41	Intensive	Frequent	Often	Seldom	Not at all
Is the company striving to progress from original equipment to own design to own brand manufacture? 42	Already own brand manufacturer	Across the board	Most products	Some products	Not at all

4. PLEASE DESCRIBE SOME ASPECTS OF THE COMPANY'S ORGANISATION.

Mark **at least one** descriptive block in each row offering alternatives.

	1	2	3	4
How is the company organised and spread geographically in the RSA? 43	One unit	Strategic Business Units	Divisions	Two or more locations
Research & development is operated within 44	One unit	Strategic Business Units	Divisions	No R&D
R&D reports to 45	One unit	Strategic Business Units	Divisions	
To whom does the Head of R&D report, if R&D function exists? 46	Position title:			
Licensing is seen as a 47	Cost centre	Service centre	Profit centre	None
To whom does the Head of Licensing report, if licensing function exists? 48	Position title:			
Is the organisation alert to the need to; and deliberately maximising technology capability among :				
Disciplines? 49	Continually	Sporadically	Not at all	Not applic.
Functions? 50	Continually	Sporadically	Not at all	Not applic.
Strategic Business Units? 51	Continually	Sporadically	Not at all	Not applic.

Does the organisation encourage personnel to innovate regarding:				
Products and processes? *52*	Continually	Sporadically	Not at all	Not applic.
Production? *53*	Continually	Sporadically	Not at all	Not applic.
Logistics? *54*	Continually	Sporadically	Not at all	Not applic.
Management? *55*	Continually	Sporadically	Not at all	Not applic.

5. INTELLECTUAL PROPERTY

Mark at least one descriptive block in each row.

	1	2	3	4
	RSA		Elsewhere	
Any patents or applications? *101*	Yes	No	Yes	No
Total number (approx.) *102*				
Any designs or applications? *103*	Yes	No	Yes	No
Total number (approx.) *104*				
Any trade marks or applications? *105*	Yes	No	Yes	No
Total number (approx.) *106*				
Broadly, for what purpose do you use your intellectual property? (✓ one or more) *107*	To mono-polise	To deter others	To earn royalties	To defend if sued
Our intellectual property data base is *108*	Organised	So-so	None	
Intellectual property planning is done *109*	Regularly	Sporadically	Never	
We have confidentiality agreements with *110*	Employees	Visitors	Inventors	
Aware of RSA's TRIPS obligations? *111*	Well	Reasonably	Not really	

Which lawyers do you use for licensing?		2	3
Lawyer on staff (✓ none, one, or more) *112*	General counsel	Patent counsel	None
Outside lawyer (✓ none, one, or more) *113*	General counsel	Patent counsel	None

	1	2	3	4	
Mark other patent systems you use (✓) *114*	EEC	ARIPO	Eurasian	OAPI	PCT
Which technology sources do you use? (✓ one or more) *115*	Internal R&D	Contract out	License in	Own in-novation	None

6. HOW DO YOU PERCEIVE THE COMPANY'S CAPABILITIES?

Mark one block in each row.

	1	2	3	4	
R & D is *116*	Excellent	Good	Adequate	Poor	None
R&D with intent to license is *117*	Excellent	Good	Adequate	Poor	None
Technology design is *118*	Excellent	Good	Adequate	Poor	None
Technology development is *119*	Excellent	Good	Adequate	Poor	None
Technology licensing and selling is *120*	Excellent	Good	Adequate	Poor	None
Unwritten (tacit) knowledge is *121*	Excellent	Good	Adequate	Poor	None
Access to complementary assets is *122*	Excellent	Good	Adequate	Poor	None
Our technology portfolio is *123*	Complete	Good	Adequate	Poor	None
Our forward planning techniques include the following in which our capabilities are as described:					
Scenario planning ability is *124*	Excellent	Good	Adequate	Poor	None
S-curves awareness is *125*	Excellent	Good	Adequate	Poor	None
Other techniques are *126*	Excellent	Good	Adequate	Poor	None
Our technology strategy planning is 127	Regular and complete	Sporadical, complete	Sporadical, partial	Ad hoc	None
Our internal technology/core competence auditing is *128*	Regular and complete	Sporadical,complete	Sporadical, partial	Ad hoc	None

Our <u>external</u> technology/core competence auditing is *129*	Regular and complete	Sporadical,complete	Sporadical, partial	Ad hoc	None
The occurrence of the Not Invented Here or NIH syndrome is *130*	Pervasive	Bothersome	Isolated	Absent	

7. WHICH SOURCES OF INFORMATION DO YOU USE AND HOW?

Mark one descriptive block in each row.

		1	2	3	4	
Use of one or more gate keeper is	*131*	Extensive	Often	Sporadic	Seldom	Never
Use of journals/papers is	*132*	Extensive	Often	Sporadic	Seldom	Never
Use of professional literature is	*133*	Extensive	Often	Sporadic	Seldom	Never
Library use is	*134*	Extensive	Often	Sporadic	Seldom	Never
Use of RSA patent specifications is	*135*	Extensive	Often	Sporadic	Seldom	Never
Use of foreign patent specifications is	*136*	Extensive	Often	Sporadic	Seldom	Never
Visits to RSA fairs, exhibitions are	*137*	Extensive	Often	Sporadic	Seldom	Never
Visits to foreign fairs, exhibitions are	*138*	Extensive	Often	Sporadic	Seldom	Never
Use of universities/research institutes						
in RSA is	*139*	Extensive	Often	Sporadic	Seldom	Never
in other countries is	*140*	Extensive	Often	Sporadic	Seldom	Never
Local information seeking visits are	*141*	Extensive	Often	Sporadic	Seldom	Never
Information seeking visits abroad are	*142*	Extensive	Often	Sporadic	Seldom	Never
Use of parent/daughter/sister company is	*143*	Extensive	Often	Sporadic	Seldom	Never
Polling of customers for information is	*144*	Extensive	Often	Sporadic	Seldom	Never
Polling of suppliers for information is	*145*	Extensive	Often	Sporadic	Seldom	Never
Use of new personnel is	*146*	Extensive	Often	Sporadic	Seldom	Never
Use of consultants is	*147*	Extensive	Often	Sporadic	Seldom	Never
Use of in-licences is	148	Extensive	Often	Sporadic	Seldom	Never

8. WHERE DO YOU SOURCE YOUR <u>IN-LICENSABLE</u> TECHNOLOGY?

(Numbers in brackets are provided as examples – please overwrite.)

Please weigh the sources of your in-licensed technology according to perceived incoming volume plus quality – not sales. Please enter % such that total is 100%.

Source of technology		1	2	3
		Geographic source		
		Domestic	Foreign	**Total**
Suppliers	*201*		*(5)*	*(5)*
Customers	*202*		*(5)*	*(5)*
Other companies	203	*(40)*		*(40)*
Researchers/laboratories	204			
Government agencies/laboratories	205			
Inventors	*206*	*(40)*		*(40)*
Patent literature	*207*			
Friends/acquaintances	*208*	*(10)*		*(10)*
Broker/agent assisted	209			
Total of all above	*210*	***(90)***	***(10)***	**100**

9. HOW IS CORPORATE LEARNING MANAGED WHEN TECHNOLOGY IS LICENSED INWARDS?

Mark one block in each row.

	1	2	3	4
Planning horizon is *211*	Long term	Sporadic	Short	Immediate
Strategic intent is communicated to all personnel *212*	Fully	Reasonably	Sketchy	Not
Priority of learning in venture is *213*	Top	Planned	Also ran	Neglected
Learning process is *214*	Planned	Fair	Sketchy	Random
Human Resources are involved *215*	Fully	Fair	In passing	Not at all
Staffing assignments are *216*	Thorough	Fair	To get by	Neglected
Team members are *217*	Top class	Fair	Can improve	Inadequate
Control is *218*	Taken over	Shared	Poor	Surrendered
Learning depends on partner *219*	Not at all	50:50	Largely	Completely
Cross-cultural competence is *220*	Excellent	Good	Average	Poor
Cross-disciplinary competence is *221*	Excellent	Good	Average	Poor
Team career structure plan is *222*	Clear	Framework	Vague	Not at all
Responsibility for learning is *223*	Clear	Good	Vague	Not clear
Performance measures are *224*	Long term	Medium term	Short term	Immediate
Rewards for learning are *225*	Excellent	Fair	Poor	Absent
Tolerance of learning barriers is *226*	High	Acceptable	Sketchy	Absent

10. CURRENT LICENCES – TO AND FROM WHICH COUNTRIES?

Please **exclude** pure trade mark, copyright and distribution-only licences. Leave blank if nil.

	1		3	4	5		7		9
	RSA	Africa	Europe	North Amer.	South Amer.	Asia	Middle East	Vari-ous	Total
Number of in-licences *227*									
Number of out-licences *228*									
Years experience *229*									

11. AS HOW SERIOUS DO YOU REGARD THE FOLLOWING REASONS TO LICENSE IN OR OUT?

Rank **each** reason on a scale between 0 (no relevance) and 9 (most important). Rank for both **in-** and **out-**licensing, please. Do not write in shaded boxes.

Reason for licensing	1 In	2 Out	Reason for licensing ctnd	1 In	2 Out
Cost advantage *230*			Market entry *238*		
Risk reduction *231*			Substitute direct sales *239*		
Access to future technology *232*			Regional differences *240*		
Skills acquisition *233*			To set industry standards *241*		
Competitive advantage *234*			Settle/prevent infringement *242*		
Diversification advantage *235*			More innovative technology *243*		
Spin-off technology *236*			Response to competitors *244*		
Strategic reasons *237*			Comply with patent working requirements *245*		

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12. WHAT FACTORS INFLUENCE THE MAGNITUDE OF THE ROYALTY AND OTHER REMUNERATION FOR BOTH IN- AND OUT-LICENCES?

Rank **each** factor on a scale between 0 (no relevance) and 9 (most important). Rank for both **in-** and **out-**licensing, please.

Factor		*1* In	*2* Out
Industry norms	*301*		
R&D expenditure	*302*		
Licensee's market size	*303*		
Cost of lost opportunity	*304*		
Transfer cost	*305*		
Technical	*306*		
Legal	*307*		
Marketing	*308*		
Training	*309*		
Assistance offered	*310*		
Technical assistance fees	*311*		

Factor continued		*1* In	*2* Out
Age/maturity of technology	*312*		
Patent life remaining	*313*		
Patent strength	*314*		
Characteristics of licensee nation	*315*		
Lump sums	*316*		
Grantbacks	*317*		
Risk	*318*		
Exclusivity	*319*		
Trade mark	*320*		
Take what's available	*321*		

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13. WHICH METHOD IS USED TO DETERMINE THE ROYALTY RATE?

14. HOW FREQUENTLY/STRONGLY ARE THE FOLLOWING RESTRICTIONS SOUGHT?

Rank **each** method and **each** restriction on a scale between 0 (method not used and restriction not sought) and 9 (most important). Rank for both **in-** and **out**-licensing, please.

Calculation method		*1* In	*2* Out
Income based	*322*		
25% rule	*323*		
Discounted cash flow	*324*		
Asset based	*325*		
Mixture	*326*		
Other (please mention immediately below)	*327*		

Restriction		*1* In	*2* Out
Territorial	*328*		
Export quantity	*329*		
Export price	*330*		
Grantbacks	*331*		
Tied supply	*332*		
Export through designated agent	333		
Prohibition on handling competitors' products	*334*		
Quality controls on materials	*335*		
Quality controls on finished products	*336*		

15. HOW FREQUENTLY IS THE FOLLOWING USED AS A BASE TO CALCULATE ROYALTY?

16. HOW FREQUENTLY DO THE LICENCE AGREEMENTS INCLUDE THE FOLLOWING LICENSED INTELLECTUAL PROPERTY?

Rank **each** base and each content type on a scale between 0 (never) and 9 (most frequent occurrence). Rank for both **in-** and **out-**licensing, please.

Base on which royalty is calculated		*1* In	*2* Out
Sales %	*337*		
Net sales %	*338*		
Profit %	*339*		
Per unit	*340*		
Period amounts	*341*		
Other (please describe)	*342*		

Content of licences		*1* In	*2* Out
Know-how only	*343*		
plus trade mark	*344*		
Patent only	*345*		
plus trade mark	*346*		
Know-how plus patent	*347*		
plus trade mark	*348*		

17. PAYMENT TYPE

Assign number to indicate frequency of occurrence out of maximum 9.		
Payment type	1 In	2 Out
Up front lump *349*		
Running royalty *350*		
Lump sum + running royalty *351*		
Minimum royalties/payments *352*		

18. TECHNOLOGY MATURITY PREMIUM

What royalty will apply if fully developed technology earns 9%?		
Maturity stage	1 In	2 Out
Fully developed 353	9	9
Pilot/prototype *354*		
Detailed design *355*		
Laboratory stage *356*		

19. AS HOW SERIOUS DO YOU REGARD THE FOLLOWING OBJECTIONS TO LICENSING?

20. WHAT IS THE RELATIVE IMPORTANCE OF THE FOLLOWING FACTORS TO YOU IN LICENSING?

Rank **each** objection and factor on a scale between 0 (no relevance) and 9 (most serious and important). Rank for both **in**- and **out**-licensing, please. Do not write in shaded boxes.

Objection	1 In	2 Out
Reveal own know-how *401*		
Dilute market *402*		
Lose close control *403*		
Debilitate or subjugate own R&D *404*		
Administrative burden *405*		
Build licensor's trade mark *406*		
Excessive grantback required *407*		

Factor	1 In	2 Out
Governing law *408*		
Accounting *409*		
Confidentiality *410*		
Provisions regarding improvements *411*		
Dispute resolution *412*		
Infringement/enforcement *413*		
Non-contest clause *414*		
Provision of service *415*		
Termination *416*		

21. HOW FREQUENTLY DOES TECHNOLOGY WITH THE IMPACT INDICATED OCCUR IN YOUR LICENCES?

22. HOW FREQUENTLY ARE THE FOLLOWING METHODS USED TO IDENTIFY POSSIBLE LICENSEES?

Rank **each** reason and each method on a scale between 0 (never) and 9 (most frequent). Rank for both **in-** and **out-**licensing, please.

Impact	1 In	2 Out
Revolutionary *417*		
Major improvement *418*		
Minor improvement *419*		

Method/place	Out
Shows/fairs *420*	
Desk search *421*	
Broker/agent *422*	
Word of mouth *423*	
We know industry *424*	

23. HOW INTENSELY/FREQUENTLY ARE THE FOLLOWING DEPARTMENTS/FUNCTIONS INVOLVED IN THE LICENSING PROCESS?

Rank **each** department on a scale between 0 (never) and 9 (most frequently). Rank for both **in-** and **out-**licensing, please.

	Evaluation of subject technology		Negotiation		Agreement (contract) compilation		Contract administration	
Department or function	*1*	*2*	*3*		*5*	*6*	*7*	*8*
	In	Out	In	Out	In	Out	In	Out
Legal *425*								
Research *426*								
Licensing *427*								
Accounting *428*								
Sales/marketing *429*								
Technical/engineering *430*								
Manufacturing *431*								
Top management *432*								
Outside counsel *433*								
Broker/agent *434*								

24. HOW ARE POTENTIAL LICENSEES APPROACHED?

Assign number to indicate frequency of occurrence between 0 and maximum 9 for both in- and out-licensing.

Approach	*1*	*2*
	In	Out
General mailshot *435*		
Selective mail *436*		
In person by visit *437*		
Following study of target *438*		
Target invited to visit licensor *439*		
Via broker *440*		
IP assigned to broker *441*		

25.RELATIVE VALUE OF VARIOUS FORMS OF INTELLECTUAL PROPERTY.

Assign number to indicate value between 0 and maximum 9 for both in- and out-licensing

Licensed technology	*1*	*2*
	In	Out
Patent *442*		
Know-how *443*		
Trade mark *444*		

26. VARIOUS

Mark a block in each in- **and** out-license row.

		1	2	3	4	5
Usual size of other party (US$million/yr sales) (R10 = US$1) *445*	In	<5	5 to 25	25+ to 50	50+ to 100	>100
	Out	<5	5 to 25	25+ to 50	50+ to 100	>100
To what extent does technology have to be adapted? *446*	In	Extensively	Moderately	Not at all		
	Out	Extensively	Moderately	Not at all		
Does your Board of Directors have sufficient relevant technology know-how? *447*		Amply	Moderately	Not at all		
Is R&D cost taken as sunk? *448*		Yes	Sometimes	Never		
	Out	Yes	Sometimes	Never		
Do you believe that licensing is profitable for the licensor? *449*	In	Very much	Yes	Worthless		
	Out	Very much	Yes	Worthless		
Is transfer cost pertinently charged? *450*	In	Always	Usually	Never		
	Out	Always	Usually	Never		
		1	2	3	4	
Type of relationship involving licence (✔) *451*	In	Licence	Cross-licence	Co-development	Joint venture	
	Out	Licence	Cross-licence	Co-development	Joint venture	

27. PROBLEMS FROM AGREEMENTS

We shall appreciate it if you would mention licensing problems you may have experienced and which you consider to be out of the ordinary:

Sector/group & characteristic	Companies reporting capability or characteristic (%)					N
Capital intensity	Extreme	Very	Average	Partly	Not at all	
Automotive components	0	50	30	20	0	10
Building materials and components	14	29	57	0	0	7
Chemicals including paper & textiles	23	31	38	8	0	13
Electrical, light	0	67	17	17	0	6
Heavy engineering	18	45	27	9	0	11
Food & healthcare	40	30	30	0	0	10
ICT & electronics	0	11	33	56	0	9
Metal products & machinery	0	50	36	14	0	14
Automation	Extreme	Mostly	Mix	Minor	Job shop	
Automotive components	0	20	50	30	0	10
Building materials and components	0	43	43	14	0	7
Chemicals including paper & textiles	15	15	38	31	0	13
Electrical, light	0	50	33	0	17	6
Heavy engineering	0	9	55	27	9	11
Food & healthcare	9	55	27	9	0	11
ICT & electronics	0	11	44	11	33	9
Metal products & machinery	0	29	36	14	21	14
Research & development is	Excellent	Good	Adequate	Poor	None	
Automotive components	0	20	50	20	10	10
Building materials and components	0	43	57	0	0	7
Chemicals including paper & textiles	23	46	23	0	8	13
Electrical, light	67	17	17	0	0	6
Heavy engineering	0	55	0	18	18	11
Food & healthcare	30	30	20	20	0	10
ICT & electronics	67	22	0	11	0	9
Metal products & machinery	7	50	21	21	0	14
R&D with intent to license is						
Automotive components	0	20	0	20	60	10
Building materials and components	0	14	29	29	29	7
Chemicals including paper & textiles	20	8	15	38	31	13
Electrical, light	0	0	33	17	50	6
Heavy engineering	0	18	18	27	36	11
Food & healthcare	20	20	30	20	10	10
ICT & electronics	11	33	0	33	22	9
Metal products & machinery	7	0	29	35	29	14
Design is						
Automotive components	10	70	10	0	10	10
Building materials and components	14	14	57	14	0	7
Chemicals including paper & textiles	23	69	8	0	0	13

Electrical, light	33	50	17	0	0	6
Heavy engineering	27	55	0	9	9	11
Food & healthcare	10	70	0	10	10	10
ICT & electronics	56	33	0	11	0	9
Metal products & machinery	29	36	29	0	7	14
Development is						
Automotive components	0	70	20	0	10	10
Building materials and components	14	14	71	0	0	7
Chemicals including paper & textiles	23	54	23	0	0	13
Electrical, light	17	67	0	0	17	6
Heavy engineering	18	27	18	9	27	11
Food & healthcare	10	70	0	10	10	10
ICT & electronics	56	33	0	11	0	9
Metal products & machinery	21	29	36	7	7	14
Technology licensing & selling is						
Automotive components	0	10	20	10	60	10
Building materials and components	0	29	29	43	0	7
Chemicals including paper & textiles	0	8	25	33	33	12
Electrical, light	0	17	17	0	67	6
Heavy engineering	9	9	36	18	27	11
Food & healthcare	10	20	30	10	30	10
ICT & electronics	0	11	44	44	0	9
Metal products & machinery	8	8	31	23	31	13

Industry sector	Automotive components		Building aterials & components		Chemicals incl. paper & textiles		Electrical, light		Heavy engineering		Food & healthcare		ICT & electronics		Metal products & machinery		All	
Source	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Internal R&D=1	2	20							2	18	2	20	1	11	3	23	10	13
Contract out=2			1	17													1	1
License in=3		10	1	17	1	8			1	9					1	8	4	5
Own innovation=4	1	10	1	17	1	8			3	27			1	11	1	8	8	10
None							1	17									1	1
1, 2	1	10							1	9	1	10	1	11	1	8	5	6
1, 3			1	17	1	8											2	3
1, 4					3	23	3	50			2	20	1	11	3	23	12	16
2, 3	1	10															1	1
2, 4	1	10													1	8	2	3
3, 4									1	9	1	10					2	3
1, 2, 3	1	10															1	1
1, 2, 4	1	10					2	33	1	9	2	20	1	11	1	8	8	10
1, 3, 4	1	10	1	17	4	31					1	10	3	33	2	15	12	16
2, 3, 4									1	9							1	1
1, 2, 3, 4	1	10	1	17	3	23			1	9	1	10	1	11			8	10
Total reports	10	100	6	100	13	100	6	100	11	100	10	100	9	100	13	100	77	100
Companies in sector	10		7		13		6		11		11		9		14		81	
Companies using any one source:																		
Internal R&D=1	7	70	3	50	11	85	5	83	5	45	9	82	8	89	10	71	58	75
Contract out=2	6	60	2	33	3	27	2	33	4	36	4	36	3	33	3	21	27	35
License in=3	4	40	4	67	9	82	0	-	4	36	3	43	4	44	3	21	31	40
Own innovation=4	5	50	3	33	11	85	5	83	7	64	7	64	7	78	8	57	53	69

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09:13 Friday, June 13, 2003

The FREQ Procedure

AGRV98_V99	V123	AGRV133_V135	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	1	1	1	1.25	1	1.25
1	1	2	1	1.25	2	2.50
1	1	3	1	7 1.25	3	3.75
1	2	2	2	2.50	5	6.25
1	3	1	2	2.50	7	8.75
1	3	4	1	1.25	8	10.00
1	3	5	1	1.25	9	11.25
1	4	2	1	1.25	10	12.50
1	4	3	2	2.50	12	15.00
1	5	3	2	2.50	14	17.50
1	5	4	1	1.25	15	18.75
2	1	1	2	2.50	17	21.25
2	2	1	3	3.75	20	25.00
2	2	2	3	3.75	23	28.75
2	2	3	1	1.25	24	30.00
2	3	2	3	30 3.75	27	33.75
2	3	3	5	6.25	32	40.00
2	3	4	2	2.50	34	42.50
2	4	2	7	8.75	41	51.25
2	4	3	4	5.00	45	56.25
2	4	4	1	1.25	46	57.50
2	5	1	1	1.25	47	58.75
2	5	2	4	5.00	51	63.75
2	5	3	3	3.75	54	67.50
2	5	4	2	2.50	56	70.00
3	2	3	2	2.50	58	72.50
3	3	1	1	1.25	59	73.75
3	4	2	1	1.25	60	75.00
3	4	3	3	3.75	63	78.75
3	4	4	1	1.25	64	80.00
3	4	5	3	3.75	67	83.75
3	5	2	2	2.50	69	86.25
3	5	3	1	17 1.25	70	87.50
3	5	4	6	7.50	76	95.00
3	5	5	4	5.00	80	100.00

Frequency Missing = 1

IP planning aggregate

R&D with objective to license

Quality of technology management aggregate

Approximately consistent ratings across attributes