

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.

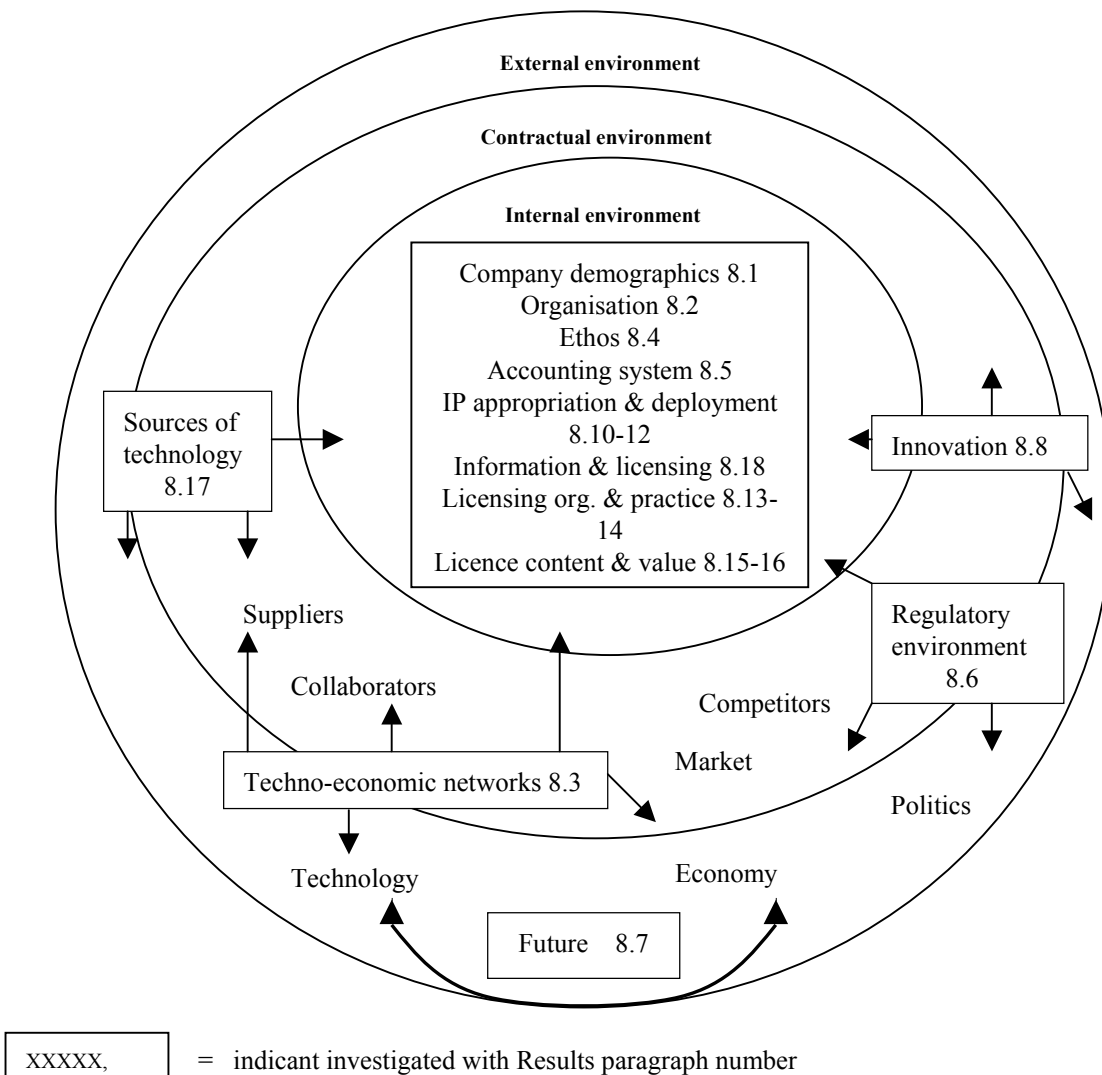


Figure 16. Simplified overview of morphology of licensing field.

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 activities 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 (Bohrstedt 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.