9. CONCLUSION

The topical sequence in this chapter is:

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9.5 Final remarks

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.)

Innovation

(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.