5.1 Introduction

Chapter 2 through to Chapter 4 highlights the theory behind technology transfer. In order to compare the South African Aviation industry to the theory concerning technology transfer, research was undertaken in the industry. Chapter 5 forms part of the research that was done based on the theory in the preceding chapters. Chapter 5 will cover the research methodology, results of the research and a discussion on the results of the research.

The main aim of the research is to investigate the technology transfer activities, with reference to the transfer mechanisms used in the South African aviation industry. The feeling is that not enough emphasis is placed on technology, and the role technology can play in creating a competitive advantage in the market. The research will therefore also aim to focus the attention of role-players in the South African aviation industry on technology. In order to obtain the most appropriate technology it must be transferred and the focus of the research will be on transfer of technology from an originator to a user of the technology. The research will further focus on technologies used in the aviation maintenance function.

The results of the research will also be used to test the following hypotheses:

1. Do South African companies transfer technology?

   Hypothesis: Yes, technology is being developed outside the companies and therefore appropriate technologies are being transferred to the companies.

2. How effective is the transfer process?

   Hypothesis: Not very effective, due to the years of isolation.

3. Is there a gap between the current technology used and the technology available?

   Hypothesis: Yes, due to the years of isolation and the lack of knowledge concerning the technology available to the companies.

4. Are there dedicated people and programmes looking into technology and the managing thereof?

   Hypothesis: No, technology is not seen as an important enough aspect to have dedicated people managing it. This may be due to the fact that the industry is not dependent on in-house technology development. It may also be because the industry is technology followers, or technology is not seen as a factor for competitiveness.

5. Do barriers influence the effective transfer of technology?

   Hypothesis: True, there are many barriers to the transfer process like cost, red tape, ignorance, etc.

6. Is current technology fully exploited by the organisations?

   Hypothesis: No, due to insufficient training and scepticism around the technology being used, etc.

5.2 Research Methodology

The main research was done by means of a questionnaire consisting of 24 questions. Role players in the South African Aviation industry were contacted and asked to participate in the research project. The questionnaire was completed during a short interview with the relevant persons. The questionnaire was designed so that people throughout the hierarchy, could participate in the research. The questionnaires were completed anonymously. The questionnaire consisted of five sections. The sections will now be discussed in more detail.

Section A

Section A consists of a short introduction explaining what is required of the participant and the approximate duration of the questionnaire.

Section B

Section B consists of definitions in order to define certain terms used in the questionnaire. The purpose of this section is to create a mutual framework of understanding for all participants and to minimise the chances of confusion.

Section C

Section C gathers biographical information of the participant. The purpose of this section is to determine the position of the participant in the hierarchy of the organisation. This is relevant to the fact that the transfer can occur from outside sources or from within, and the emphasis will vary at different levels in the organisation.

Section D

Section D's questions focus on the technology transfer from outside the company and concentrate on the higher levels in the hierarchy. This is essentially a 'top-down' view of technology transfer in the organisation.

Section E

Section E's questions focus on the internal technology transfer of the company. This will involve more levels in the organisation and may be seen as a 'bottom-up' view of the organisation.

The general methodology followed in both the external and internal part (Section D & Section E) of the questionnaire is first, to determine if transfer of technology takes place that is relevant to the participant. If the answer is 'yes' the likely sources of the technology are identified and also the effectiveness according to the participants perception. Following this, the likely mechanisms of transfer are identified and also the effectiveness of the mechanisms, again

according to the perception of the participant. The questionnaire then aims to identify possible barriers to transfer of technology and finally it determines the appropriateness of the technology transferred. A copy of the questionnaire can be seen in Appendix A.

5.3 Results and discussion

In this section the results of the research will be discussed. This includes both the results from the questionnaires as well as the results of the interviews. First the results of the questionnaire will be discussed under the headings: biographical information, internal technology transfer and external technology transfer. Thereafter a short discussion on the interviews will follow.

5.3.1 Biographical information

Ten people were interviewed and at this time a questionnaire was completed. Six people were interviewed from the civil industry and four from the military industry. Of the ten people interviewed, five were from middle management level and five were on a supervisor level or below. Eight people were in possession of a technical certificate or diploma, while one person had attended university up to a Bachelors – level and one up to Honours level. The age of the respondents varied between 20 and 49 years of age, with one respondent being older than 50.

5.3.2 External Technology Transfer

All the respondents replied 'yes' to the question whether their companies utilise opportunities to transfer technology from outside sources. The average rating for the effectiveness of these transfer projects were 80%. Under the main sources utilised, OEM's were quoted 8 times, tertiary institutions once, contracting firms once and business modelling experts once. The average weights (out of ten) depicting the importance of the sources to the company can be seen in graph 5.1.
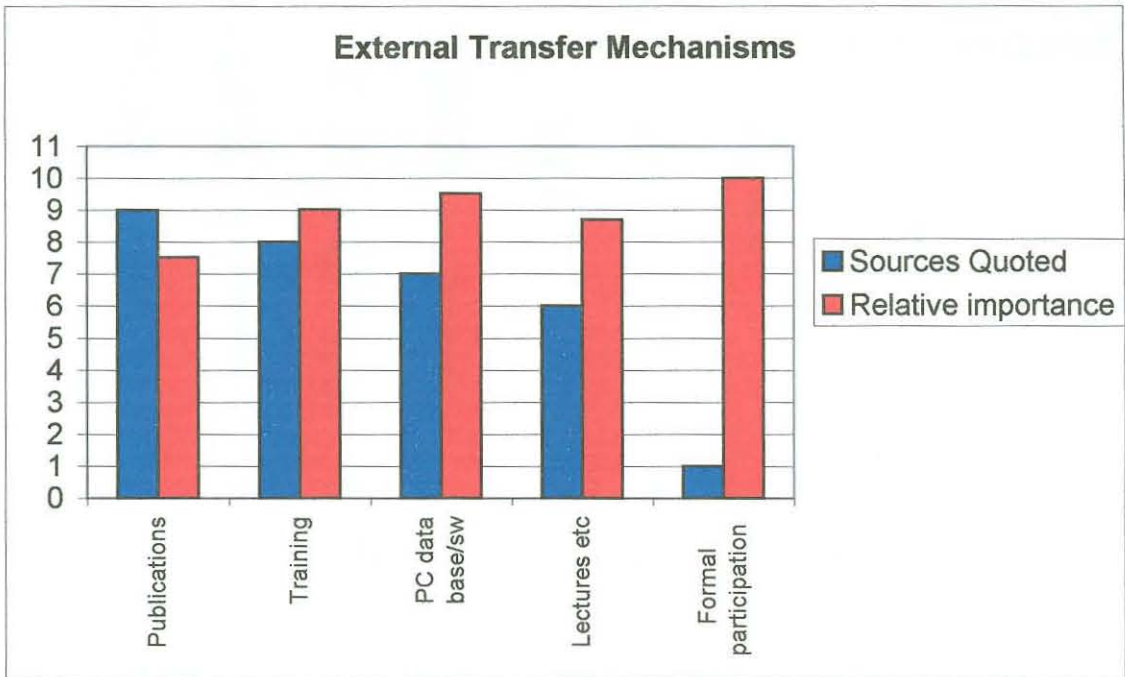
Sources of External Technology
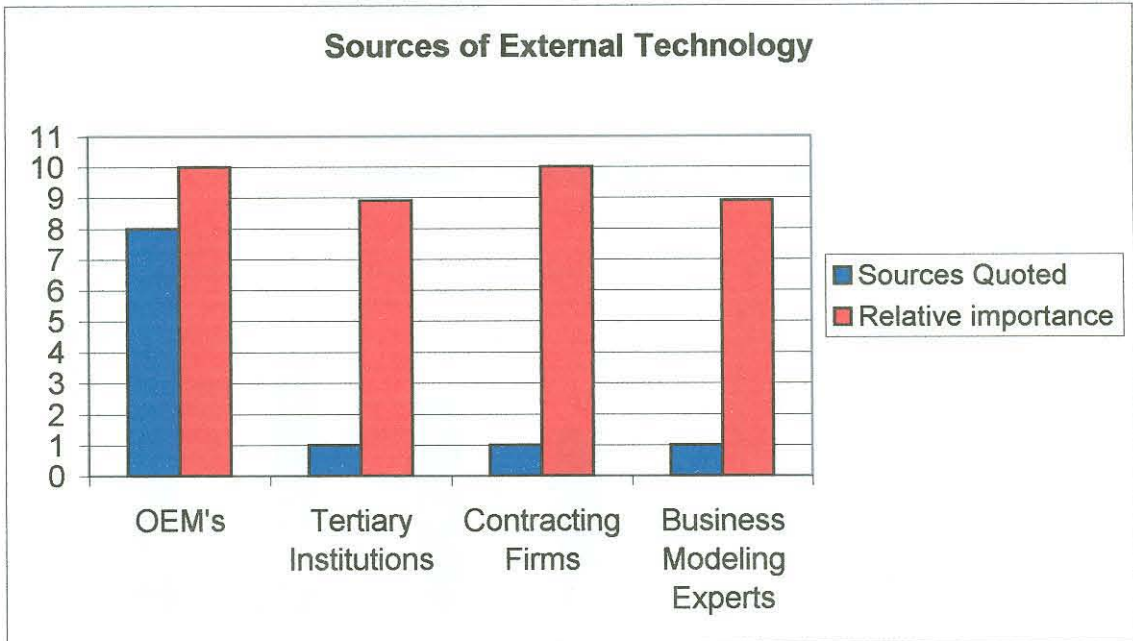
Graph 5.1: External Technology Sources

In the response to the question whether transferred technology enhanced the level of maintenance operations, eight respondents responded 'yes', while two responded 'no'.
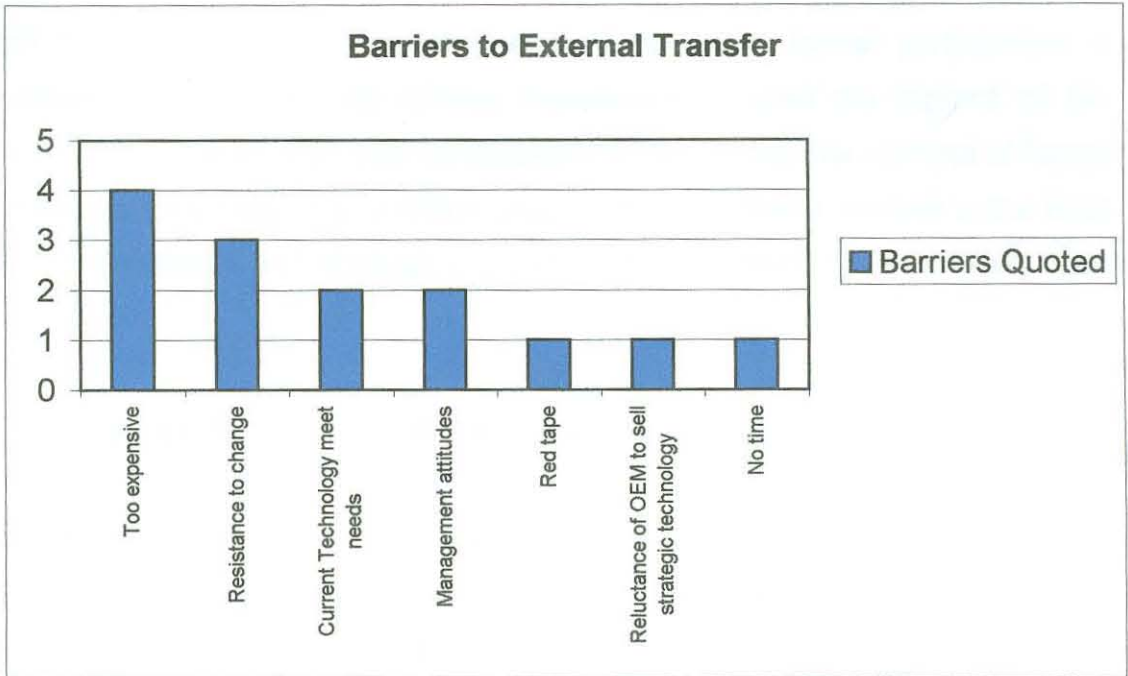
Six respondents felt that there is a gap between the technology utilised by their organisation and the technology that is available to the industry. Three respondents felt that there was no gap, while one respondent replied 'don't know'. The severity of the gap was indicated to be 5.9 out of ten with one indicating a severe gap and ten indicating an insignificant gap.

On the question whether there is a formal technology transfer programme present in the respective companies, seven respondents were not sure, while two respondents replied 'yes' and one responded 'no'.

Graph 5.2 indicates the mechanisms used in the transfer of technology. Graph 5.3 indicates the possible barriers to transfer as indicated by the respondents in the questionnaire.

External Transfer Mechanisms

Graph 5.2: Mechanisms of External Technology Transfer

Barriers to External Transfer

A bar chart titled "Barriers to External Transfer" with a legend "Barriers Quoted". The y-axis ranges from 0 to 5. The bars are: Too expensive (4), Resistance to change (3), Current Technology meet needs (2), Management attitudes (2), Red tape (1), Reluctance of OEM to sell strategic technology (1), No time (1).

Graph 5.3: Barriers to External Technology Transfer

Nine respondents felt that their companies invested in appropriate technology while one believed his/her company did not invest in the most appropriate technology.

Discussion on external technology transfer

Out of the research done it is clear that the main external source of technology is Original Equipment Manufacturers (OEMs). The needs of the aviation industry are therefore satisfied mainly by equipment supplied by OEMs. A certain level of skill and knowledge is needed in order to properly use the equipment and therefore all three aspects of technology are present. The research also indicates that there is a gap between the technology that is used in the industry and the technology that is available. The severity of the gap translates into being restrictive. There are therefore needs that cannot be satisfied by the current technology.

The mechanisms used to transfer the technology can be seen in graph 5.2. It is interesting to see that publications, mainly in the form of manuals, are the

most widely used, while their relative importance is rated as the lowest of the mechanisms used. On the other end of the scale, formal participation is utilised the least and its relative importance is rated the highest of the mechanisms used. This may be because of the fact that the concept of formal participation during an acquisition programme, is a newer concept to the local aviation industry and although it is seen to be important, it is not widely used yet.

The biggest barrier to external technology transfer is the cost of the technology. This point was also raised in the interviews. It seems that the individual companies just do not have enough money to buy the most appropriate technology. This may be the main reason for the gap between available and current technologies. A solution to this problem may lie in the nature of the relationship between the supplier of the technology and the user. It might be considered to enter into collaborative agreements, where the traditional supplier – user relation makes way for a more mutually beneficial agreement in which both parties gain, in terms of technology. In short, pay for technology with technology. This might be a very important point to consider. Another important aspect is that there are not dedicated personnel looking after technology transfer aspects in the respective companies. Most of the respondents were unsure if there were dedicated transfer policies or programmes in their companies. If a section identifies a need, they are responsible for transferring the appropriate technology. This can work but is not the most effective strategy. Personnel often do not have the appropriate skills to manage these types of projects. A dedicated team will have the appropriate skills and they will be exposed to various transfer projects, thereby gaining valuable experience in this field.

Most respondents felt that their companies do transfer appropriate technology. During the interviews however, people complained about the fact that not all the parties concerned are consulted when new technology is considered for the companies. Poor communication was cited as a major problem in this regard.

5.3.3 Internal Technology Transfer

Eight respondents indicated that their companies have training programs with the aim of transferring technology internally, while two respondents indicated that there are no such programmes.

The sources used for technology and their perceived effectiveness (measured on a scale out of ten) is summarised by graph 5.4.
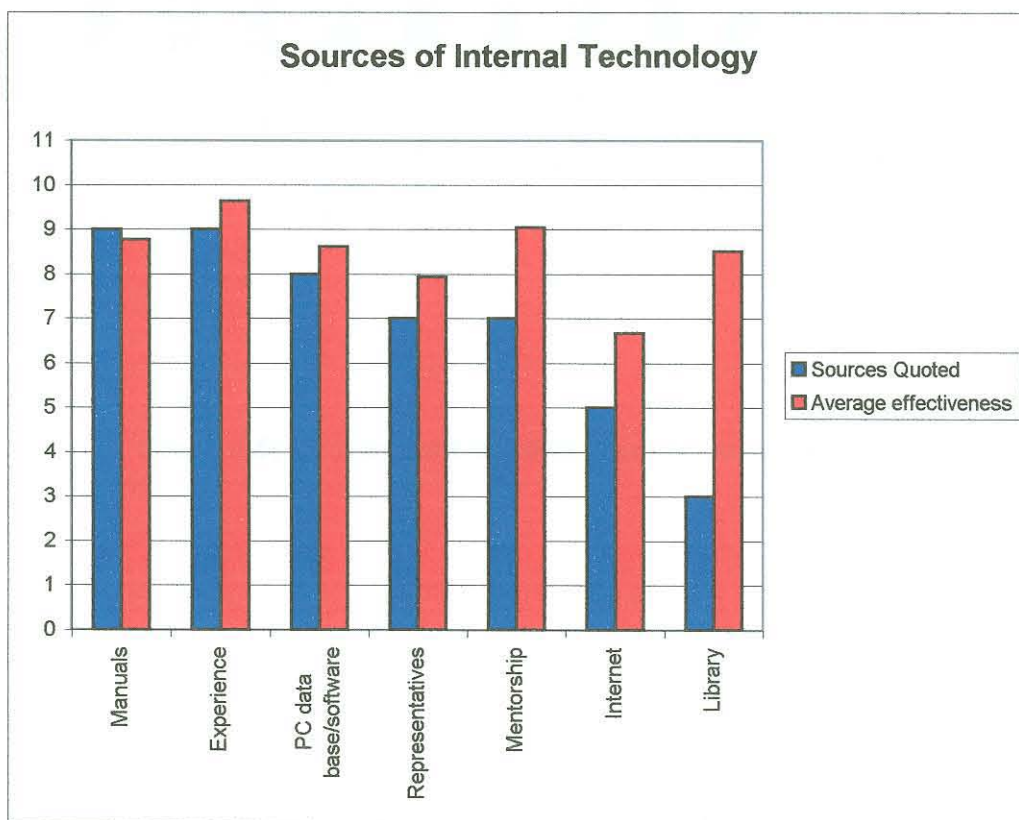

Graph 5.4: Sources of Internal Technology Utilised

Graph 5.5 indicates the mechanisms used to transfer technology internally. Seven respondents indicated that direct assistance is the most effective of the mechanisms used.

The barriers to internal transfer is illustrated in graph 5.6

Internal Transfer Mechanisms
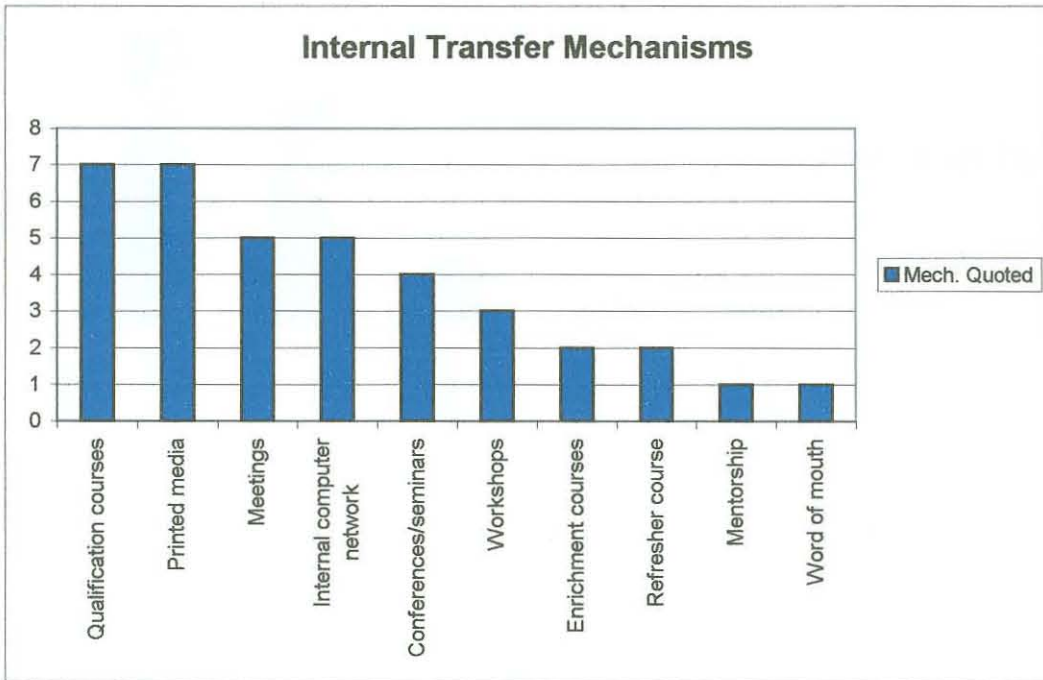
Graph 5.5: Mechanisms used in Internal Technology Transfer

Barriers to Internal Transfer
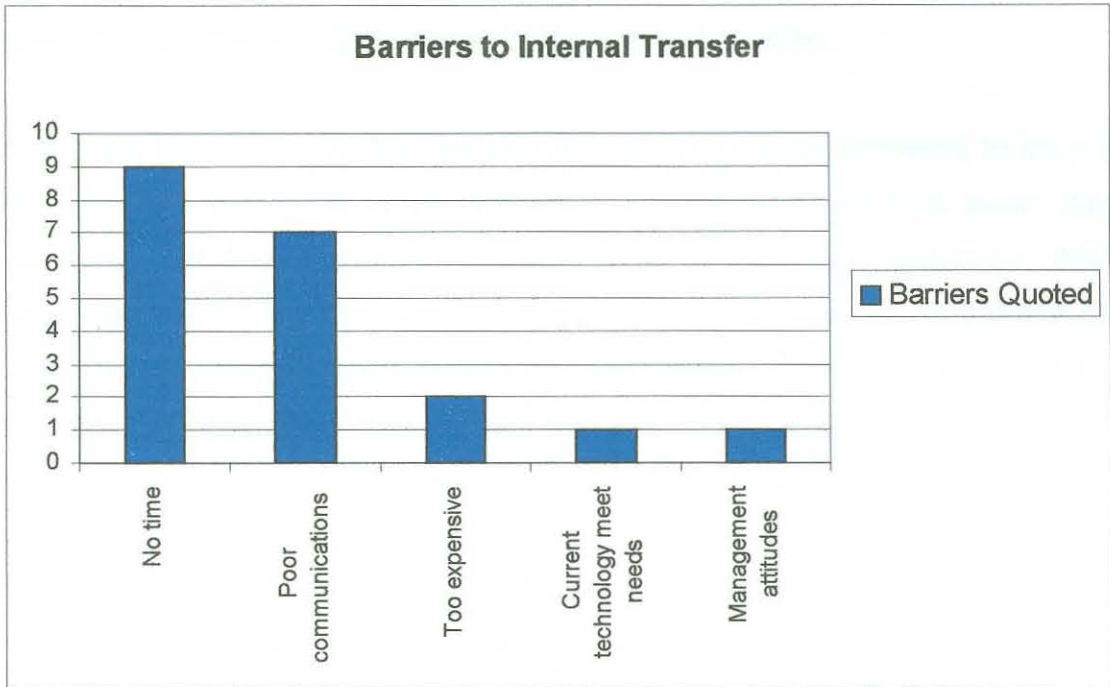
Graph 5.6: Barriers to Internal Technology Transfer

Only two respondents indicated that they believed that the technologies available in their companies are fully exploited and five indicated that the technologies utilised in the companies are appropriate.

Discussion on internal technology transfer.

Graph 5.4 describes the sources of technology utilised in the companies. Manuals together with experience were identified as the most often used sources. The companies should therefore look at this source of knowledge and skills and make sure that the attributes these personnel possess, are fully exploited and that they are rewarded for their effort. Structures should also be in place to ensure that the skills and knowledge are transferred from the experienced personnel to the rest of the company's people.

The main mechanisms used to transfer technology, or part of it internally, are qualification courses, direct assistance and printed media. Direct assistance is used the most. This may be the result of experience being one of the main

sources of technology. Experienced people assist less experienced people and therefore it is one of the main mechanisms of transfer.

The main barriers to internal transfer of technology were identified to be not enough time and poor communications. Poor communications were also mentioned in the interviews as being one of the main obstacles. Also mentioned is the fact that personnel have work that must be completed on time and that they do not have time for anything else except their work. Again, people that look after the transfer process may be the answer. This is however, a bit difficult, because internal transfer has mostly to do with the broadening of the individuals knowledge and skills base. In order to realise this, individuals will have to attend courses, training sessions, etc. In the interviews it was indicated that there simply is not enough time to do this.

5.3.4 Discussion of Hypotheses

The research supports the first of the hypotheses. All the respondents acknowledged the fact that they do transfer technology and that most technology is developed outside their organisations.

The research didn't support the second hypothesis. The transfer process as used in the respective companies is perceived to be effective. It seems that the years of isolation did not have the negative impact that it was thought to have had. The effectiveness of the transfer projects may also be the result of the culture of 'we can make anything work', an attitude which is the result of the fact that the industry had to be self-sufficient.

The research supports the third hypothesis. The research indicates that there is a gap between the technologies used in the companies and the technologies available to the companies. The severity of the gap was indicated to be restricting. The gap may be the result of the barriers to the transfer of technology especially factors like cost.

The research supports the fourth hypothesis. There are no dedicated people concerned with managing technology and the transfer thereof. During the interviews there was great uncertainty as to whether there are formal strategies or programmes for the transfer of technology. The transfer projects are done in an informal way with the individual sections responsible for the transfer of the technology.

The research also supports the fifth hypothesis. The barriers to the transfer process are indicated in graphs 5.3 and 5.6. As can be seen in these graphs the barriers to transfer are not the same between the external and the internal transfer environments. This is due to the fact that these two environments are subjected to different difficulties, which eventually forms barriers to the smooth transfer of technology.

The final hypothesis was also supported by the research. The majority (80%) of the respondents indicated that the technologies used in their organisations, are not fully exploited. This may be due to the fact that the knowledge component in the transfer process is not sufficiently transferred. In short, workers may not be sufficiently trained in order to exploit the transferred technology fully.

5.4 Conclusion

During the research, most respondents indicated that their respective companies utilise the opportunity to transfer technology, if the need arises. Most respondents however, also indicated that their respective companies do not have formal technology transfer strategies or programmes in place. This means that there are not dedicated people looking after transfer projects. At this moment transfer projects are therefore overseen by 'non-specialists'. The section, to which the technology is transferred, is therefore also responsible for the management of the project. The positive side of this situation is that the people involved in the transfer process are very knowledgeable on the

technical aspects of the project, but are they competent in the management of the project? By having dedicated people specialising in the management of the project in the project team, the efficiency of the total project will be improved. Due to the fact that most respondents indicated that their respective companies do not have formal technology transfer strategies in place, a model is proposed to assist in establishing a formal strategy. The model also aims to introduce the basic aspects involved in a transfer project and show the difference in the activities associated with the transfer phase and the operating phase. Not only can the model be used in the early planning stages of a project, but it can also be used during the project as a guide to measure the progress and output of the project. The model will be discussed in Chapter 6.