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The impact of skills and social networks on the South African biotechnology sector.

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Abstract

South Africa may expand their biotechnology industry through increased foreign direct investment.

However, the main challenges facing South Africa are human capital development and social networking

The objective of this report was to gain a better understanding of the value that human capital development and social networks have on the biotechnology sector in South Africa. Used correctly, this understanding could enhance the success rate of foreign direct investment and provide a platform to increase South Africa's contribution as a serious global contender. The researcher's objectives were to answer research questions on skills and social networks.

Twenty eight respondents were interviewed via e-mail and face-to-face surveys, using a structured questionnaire for the skills survey. For the social networking survey, the same approach was adopted but only 8 responses were received.

Although the research only uncovered specific answers related to the research questions, delving into the various sources on information improved the current understanding of the role of skills and social networks in the biotechnology sector. These additional findings relate to the importance of clusters, female participation in the industry, collaboration efforts over geographically dispersed areas as well as which skills are important now and which will become important in the future.

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree of examination in any other University. I further declare that I have obtained the necessary authorization and consent to carry out this research.

Sabine Hellyer

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Table of Contents

List of Tables

List of Figures

1 Introduction to Research Problem

Internationally, biotechnology is seen as the next big economic wave following the climax in the IT sector during the last century. Time Magazine (2000) reported that "….the bioeconomy is the next one to be born, and of all economies past, present and future, it will exert an impact that will make the info-economy look like the runt of the litter". Freeman and Soete (1997) suggest that the same way steam power and the railway and more recently information and communication technologies have revolutionized society, biotechnology will change the way we live and think about living organisms and society.

Health, poverty and knowledge gaps between the developed and developing countries of the world are on the increase (Persaud, 2001 and Sachs, 2005). Modern biotechnology could provide the answers to addressing these challenges (Singer and Daar, 2001).

Globalisation has meant that South Africa, like other countries, has adopted a stance where both local and international ties are harnessed for the benefit of all. The strategic importance of attracting, retaining and benefiting from foreign investment is acknowledged by serious contenders in any industry.

"Foreign direct investment is generally considered a source of modern technology, in a broad sense, including product, process and distribution expertise, as well as management and marketing skills" (Blomstrom and Kokko, 1998, p 247). Driffield (2001) goes on to say that technology transfer may occur directly or through spillovers. Importing capital, advanced assets and proprietary technology from foreign firms may have a direct impact on the average productivity level of the host economy.

According to the OLI paradigm (Ownership, Location and Internalisation), a firm will become a multinational if it has an ownership advantage it wants to develop or exploit, if the host

State has a location advantage, and if it is more profitable to internalise the operation (integration advantage). These three factors determine the type of activity, i.e. which elements of the value chain will be located abroad, as well as the mode of entry (e.g. fully owned subsidiary, joint venture, strategic alliance, greenfield investment, or acquisition). Consequently, domestic firms can benefit from inward FDI (foreign direct investment), but a proactive policy on the part of the domestic firms and government is required to actually derive benefits from foreign MNEs (Multi National Enterprises) (Narula and Marin 2003).

Knowledge spillover from universities, the founder's connection with his/her university base, an entrepreneurial environment, the availability of scientific labour, the regulatory atmosphere, the presence of venture capitalists and large pharmaceutical companies are all important pre-conditions for success in biotechnology. (Hall and Bagchi-Sen, 2001).

Cloete, Nel and Theron (2006) state that their criteria are tax incentives, public funding and the ease of IP processing.

The following factors have emerged as being important for both FDI and biotechnology in Buckley, Devinney and Louviere's (2007) research:

1. Investment assistance (loans, grants, rebates etc.)
2. The fact that the country is elected in democratic and free elections
3. Political stability
4. Currency value
5. Cost of production
6. Return on investment
7. Access to new resources
8. Exploitation of existing assets
9. Pre-emption of competition
10. The existence of established relations in the market
11. Avoidance of trade barriers

12. Market size
13. Market growth
14. Asset protection
15. Being in the same line of business
16. English-speaking

Krizner (2004) adds that timing and patience should be considered when trying to develop a biotech cluster as the companies are research-intensive, but capital starved.

To enhance competitiveness, location and proximity are listed as being essential in high technology (Omas and Melecki, 2002). The tendency of firms to cluster in a region is observed in a variety of high tech sectors (e.g. Silicon Valley, Boston, Toronto, Oxfordshire and Banagalore). Bagchesen and Scully (2003) believe that cluster-to-cluster networks at national and international levels for the exchange of scientific knowledge and market intelligence are becoming an important component in the organisation of innovation and not only in biotechnology but in other high-tech industries as well. A common thread in the success of clusters is the presence of networks among the various stakeholders involved in the process of innovation. These networks facilitate information and knowledge exchange (Powell, Koput, Bowie and Smith-Doerr, 2002).

1.1 Motivation for the research

The aim of this research was to explore what curriculum is important for skilled personnel to emerge from South Africa's tertiary education facilities and to establish what impact social networks have on foreign direct investment decisions in the South African biotechnology industry.

1.2 Value of the project

The study provided insight into the strengths and weaknesses of the biotechnology industry in South Africa, the different role players involved and the international leadership potential of the sector. Information from this survey may be used by various organisations for economic or market analysis, to study industry performance, to assist policy formation, and, by the academic community, for research purposes.

2 Literature Review

2.1 Introduction and Background

2.1.1 What is biotechnology?

The OECD (2001) defines biotechnology as the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services. In addition, biotechnology can be divided into the following generations:

1st Generation biotechnology: involves the use of wild type or natural biological organisms to produce a product, for example the use of yeast to make beer or wine.

2nd Generation biotechnology: refers to the production of specific products using a pure cell or tissue culture of organisms that have been specifically selected, through random cross-breeding or similar techniques, for their superior production or expression abilities without introducing foreign DNA.

3RD Generation biotechnology: involves manipulation of the genetic make-up of organisms by introducing selected foreign (across the species barrier) DNA, through recombinant DNA technology, to make them produce small molecules, compounds or proteins.

2.1.2 *Biotechnology Internationally*

Burrill and Company (2008) report that the biotechnology industry was 30 years old in 2006 and generated over $75 billion in revenue globally. There are 5000 companies worldwide and 600 public organisations included in the sector. A strong pipeline exists with 350 biotech drugs in late stage clinical trials. Over 100 products are in the market which exceeds $1 billion. Cures and preventions fall under the healthcare umbrella which could benefit society, especially in the developing world, with the development of vaccines for critical illnesses e.g.Hepatitis B, HIV, TB and Malaria. Agro biotech products are now grown on 200 million acres throughout the world. Industrial applications are largely driven by biofuels.

2.1.3 *About South Africa*

In 2007, a population of 47.9 million was recorded in South Africa (BioSA 2008). According to the Global Competitiveness Report 2007 (WEF) South Africa ranked 46 out of 128 countries and is also the most socially, economically and infrastructurally developed country on the African continent. An abundant supply of resources, well-developed financial, legal, communications and transport sectors and the fact that it is the continent's largest energy producer and consumer, all contribute to a GDP of $587.5 billion (18th), or $13,300 per capita (56th). The South African rand (ZAR) is the world's most actively-traded emerging market currency and was the best-performing currency against the United States dollar between 2002 and 2005. The Johannesburg Stock Exchange ranks among the top twenty in the world (BioSA 2008). Of interest is that South Africa has more than 20,000 different plants and 10% of all the known species on earth. After Brazil and Indonesia, South Africa is the most biodiverse country in the world (BioSA 2008).

2.1.4 *Biotechnology in South Africa*

South Africa has recognised the magnitude of the biotechnology industry and since the turn of the century has received considerable focus and investment from government. Biotechnology is seen as an area that can contribute to profitable economic growth that in turn can give rise to small, medium and micro-enterprises (SMMEs). This can create opportunities for employment at various levels of expertise thereby alleviating poverty. Young scholars can be encouraged to enter the field of science and technology and enhance their skills through international partnering for skills transfer. This could result in export opportunities and increased foreign direct investment. Food security can be improved through the development of genetically engineered crops and healthcare enhanced through progress on vaccines and diagnostic treatments for threatening infectious diseases such as tuberculosis, malaria and HIV/AIDS. In addition, bioremediation or waste usage processes could reduce the impact on the environment *(*Cloete, Nel and Theron*,* 2006*).*

In 2001 the South African government adopted the National Biotechnology Strategy. The objectives of the strategy are to develop companies, goods and services which address South Africa's needs, to improve the quality of life, boost economic growth and create the necessary infrastructure to allow biotechnology development. (The National Biotechnology Strategy of the Republic of South Africa, 2001). It "addresses human resource development, funding, regulatory and legal issues and also endeavours to close the gap between research activities and commercialization. To this end, private-public partnerships between domestic and international stakeholders are being encouraged" (ibid).

Furthermore, the government initiated and supported the creation of biotechnology regional innovation centres (BRICs) to act as nuclei for the development of biotechnology and biotechnology platforms. From these, a range of businesses offering new products and

services can be developed. This initiative involves the strategic development of several 'bioclusters', rather that encouraging clusters to grow under their own impetus (Cloete *et al,* 2006*).*

The BRICs are located in different geographical areas within South Africa (Western Cape, Gauteng and Kwa Zulu Natal i.e. Cape Biotech, BioPAD, LIFElab and PlantBio) and are responsible for Human & Animal Health, Industrial and Plant Biotechnology (The National Biotechnology Strategy of the Republic of South Africa (2001).

"The South African government has committed an initial R 750 million to these BRICs. In addition a National Bioinformatics Network has been established to specifically address the development of capacity and expertise in bioinformatics in South Africa. The National Research Foundation is responsible for funding research education at higher-education institutions and the Innovation Fund was established to promote technological innovation, increased networking and cross-sectional collaboration, as well as providing seed and start-up capital and human resource innovation. THRIP (The Technology and Human Resources for Industry Programme) provides funding to innovative research programmes that involve an industry partner. The aims of this programme are to increase the quality and number of appropriately skilled people for the management of technology for industry and to promote increased interaction between public researches and industry. GODISA provide nationwide pilot centres and technology incubators. eGoliBIO and Acorn Technologies are two of the incubators that focus on the biotechnology sector. Their portfolios are comprised of services that assist with the commercialization process of a product with the support of business infrastructure and guidance, legal and financial advice" (Cloete *et al*, 2006, p 3).

International partnerships were also seen as a priority as this would encourage the internal development of life science ventures (Cloete,T.E., Nel, L.H. and Theron, J. 2006).

Key points to emerge from the 2007 National Biotech Survey (BioSA 2008) are summarised below:

- 116 biotech companies;
- 38 core biotech companies
- 78 use biotech as a key activity
- 25 % were created in the last 3 years
- Majority (68%) of products are in agriculture
- Major investment is in human health
- 65% of companies collaborate with international companies (M+P, R+D)
- Investment is currently <1% of GDP;
- By 2018 the objective is to achieve 2% of GDP
- TIA (Technology Innovation Agency Bill): short-term focus = biotech; long term focus = innovation in general
- 622 projects were being worked on
- Since 1992, 2 new core biotech companies were set-up annually.
- At least 3,500 people were employed in the sector
- with an annual revenue of R 368 million.

South Africa has the potential to develop and establish a sustainable and globally competitive biotechnology industry. In fact, SRI International (representing the World Bank) has rated South Africa as one of the top five countries for biotechnology investment among developing nations in 2001, and the country is becoming an increasingly popular choice for investment and partnering for foreign firms and governments (Mulder and Henschel, 2003). In addition, South Africa is classified as the only mega-country in the African Continent and one of the 14 biotech mega-countries in the world (DST, 2007).

The Department of Science and Technology's "Ten Year plan" (DST, 2007) has the vision that South Africa should be "among the global top ten nations in the world in terms of the pharmaceutical, neutraceutical, flavour, fragrance and biopesticide industries" by 2018.

With the above in mind, South Africa is an attractive destination for overseas investors. As the biotechnology industry matures, a vibrant economy will develop in South Africa that will positively affect the standard of living in the country and potentially the African continent (Cloete *et al*, 2006).

2.1.5 *Clusters and Social Networks*

In comparing South Africa to other international biotechnology countries, (USA, Brazil, Cuba, Finland, The Netherlands, Sweden, Israel, Australia and Singapore) experience with clusters and the utilisation of social networks is recommended to yield optimal results in the literature.

Social networks, also known as informal networks, can be described as a complex set of personal or professional connections between individuals. These connections form a pattern which is discernable in communities, organisations, societies and nations (Putnam, 2000). Each network is established through a process of construction and continually changes over time by adding, breaking, forming or deleting ties (Bidart, 2005). A personal social network will have one person as a central point whereas group social networks involve associations between a group of people. Networks can exist in many contexts of which religion, civic groups and organisations are but a few (Putnam, 2000). Informal networks, i.e. networks thriving on the unplanned interconnectedness of people, rely on support of the members for each other and the reciprocity of specific support. For years the social capital engendered by successful informal networks has been used to promote

effective collaboration within groups, to support junctures in networks and to ensure integration within groups after strategic initiatives (Cross, R, Borgatti, S.P. and Parker, A. 2002).

Hall (2002) stated that dispersed co-workers can manage knowledge, find resources and solve problems easier. He also expounds on research that was conducted using two biotechnology firms. It was found that utilising boundary-spanning social networks increased both learning and flexibility in ways that would not have been possible within a self-contained hierarchical organisation. Brandon (2007) notes that it is not always feasible to meet face to face, and on line social networking helps build relationships that might not have existed otherwise, especially among geographically spread workers. Busang (2008) explains "the goals of each centre can be more effectively and more quickly reached through collaboration (vs. competition) and through harnessing the capabilities of the centres (Kopano, 2008).

Relationships are now regarded as enhancers or limiting factors in a company's ability to be adaptable (Beinhocker, 2006). Failure to engage in social network analysis would severely curtail the ability of relevant firms to bolster those useful links or constrain those that may do harm. In addition to a firm being able to learn directly about its own network, the exact same analysis, run on competitors, provides incredibly useful information. On a global level, information on the biotech environment could identify optimal areas for business-to-business intermediaries to fill (McCarthy, Pitt, Campbell, van der Merwe and Salehi-Sangeri, 2007).

In his study, Brandon (2007) identified 5 characteristics of social networking which will support learning and maintain a competitive advantage:

1. Sharing is an attribute that allows users to dispense knowledge, resources and content.
2. Relationships are the foundations of social networks.
3. Conversations support the social aspects of learning.
4. Identity within social networks is based on individuals' choices.
5. Groups within social networks often are where the day-to-day work happens.

The power of sharing and networking is evident everywhere today. It has become part of our learning strategy. By learning more about the tools of social networking, one can make the leap and reap the reward (Hall, 2007).

2.1.6 *Skills*

Skills are understood to refer to both qualifications and experience. Scarce skills, in the parlance of the Department of Labour and the Sectoral Education and Training Authorities (SETA), refers to occupations in which there is "a scarcity of qualified and experienced people, currently or anticipated in the future, either because such skilled people are not available, or because they are available but do not meet employment criteria" (Foodbev SETA, 2005,42).

This scarcity can arise due to either an absolute scarcity of these skills or a relative scarcity. Absolute scarcity refers to suitably skilled people that are not available, for example in a new or emerging occupation (e.g. biotechnology, information technology), a lack of sufficient numbers of workers with specific skills, or insufficient numbers to satisfy replacement demand (ibid,42). Relative scarcity, on the other hand, refers to a situation where suitably skilled people exist, but do not meet other employment criteria, for example they live in different geographical areas, or do not satisfy Black Economic Empowerment criteria (ibid, 42).

Critical skills refer to specific skills within an occupation. In the SA context there are two groups of critical skills: (1) generic skills, including problem solving and learning to learn; language, literacy or numeracy skills; and working in teams; (2) particular occupational skills required for performance within that occupation (ibid, 43). It is the latter form that accounts for the problems that emerge when a firm experiences technological change or reorganises production methods (ibid, 43). These definitions underpin the understanding of skills shortages and must be kept in mind when diagnosing the nature of skills shortages (Daniels, 2007).

A well-educated workforce is required in the biotechnology sector as the majority of biotech positions require more than four years of tertiary education (Krizner, 2004). South Africa needs to learn from overseas examples and try to emulate some of them to support their initiative of becoming a world contender.

One of the several countries that have embraced biotechnology is Singapore. For them, an area that is seen as essential to the growth of their life-science industry is manpower development (Finegold, Wong and Cheah, 2003). Finegold *et al* (2003) also advise that developing world class scientists and having them generate new research breakthroughs takes decades; thus short, medium and long-term goals are necessary to build the required skills. Attracting world renowned scientists form part of the short term objectives. This in turn, will act as a magnet to other influential scientists. Due to the lack of talent, recruiting experienced scientific and managerial leaders is necessary to head up start-up firms. Sending top students overseas to premier science and technology institutions is included in the medium–term strategy. The government pays towards the students' education on condition that they return to Singapore to complete their studies. The long-term initiative is

to work towards the development of universities and research institutes that are world class in Singapore which will attract their target audience (ibid).

Finegold *et al* (2003) explain that the talent needs are not just at the laboratory level: "experienced managers to develop products, manage clinical trials, and run companies; knowledgeable life science investors who understand the unique requirements of this sector; and life science IP specialists who know the intricacies of structuring licensing agreements are all needed to build a successful cluster of biotechnology firms"

As mentioned, South Africa has the biggest and most sophisticated economy on the African continent. In addition, it has the strongest higher education system. Several South African universities have world class research, and feature in the top 1% of the world's institutions (captured in the United States' Essential Science Indicators database) in nine of twenty two scientific fields (A Place to Study).

The Department of Home Affairs in South Africa, the issuing authority for work permits, business permits, life partner and spousal permits, retired permits and relatives' permits has recently announced a new permit allocation. This is designed to alleviate the skills shortages that may be offered by immigrants hoping to move to South Africa. Professions included in the extensive list are the chemical industry, pharmacology, biotechnology, astronomy and food technology. It is important to note that Home Affairs will check if the future immigrant has the required skills as well as five years of work experience before granting the quota work permit (James, S; 2008).

It has been noted that South Africa will not always be able to duplicate overseas initiatives but will be able to learn from them. Potential investors have realised that their current capacities are fast approaching saturation point. Resources are limited and exploring

alternatives have become essential in order for them to sustain their competitive advantage (BioSA 2008). This puts South Africa in an ideal position to leverage the situation to her advantage.

2.1.7 *The Role of BioSA*

BioSA was officially launched in October 2007 to support the National Biotechnology Strategy of the Republic of South Africa. The body represents the private and public biotechnology sectors, although its voting members are from the private sector. It was formed to be a collaborative network and independent voice that actively supports and represents emerging and existing biotechnology SMMEs, which in the final analysis are the key drivers of the biotech economy. In this way, BioSA is committed to the growth of the South African biotechnology industry in the global market (BioSA, 2008).

The buy-in from various stakeholders is paramount to the success of the initiative. The South African government, young entrepreneurs, students and international networks are essential components. Furthermore, intellectual property (IP), funding, regulatory, tax, financial issues and bioethics are to be addressed.

BioSA acknowledge the strengths and weaknesses of the industry and have proposed the following:

- Collaboration efforts to ensure that learning from each other is a priority in running the respective businesses.
- Joint R&D and commercialization initiatives.
- Attracting foreign investment and additional sources.
- Understanding of and access to the global markets.
- Capacity / skills development (e.g. interns shadow CEOs).
- Facilitated access to overseas Intellectual Property (and SA IP when this becomes attractive).

- Develop a comprehensive database for effective dissemination of information.
- Develop BioSA web site in order for it to be the first contact point for interested parties and to market SMMEs.
- Arrange workshops to address specific issues.
- Conduct surveys and research.

The author of this research report volunteered to assist BioSA in conducting research to partially fulfil their objectives and utilised their network and database to facilitate the research process.

2.2 Problem statement and objectives

2.2.1 *Problem Statement*

At present, South Africa has an emerging biotech sector that would benefit from enhanced coordination (BioSA 2008). The aim of this research will be to ascertain:

1. What skills are needed to drive curriculum development in tertiary education?
2. What impact do social networks and skilled personnel have on foreign investment decisions in the sector?

2.2.2 *Objectives*

The objectives of the study are:

1. To identify the criteria required to enable South Africa to become a dominant player in the biotechnology sphere.
2. To analyse the social networking and skills findings in order to develop a strategy that will allow South Africa to compete on a global scale.

3 Research Questions

The primary research question posed by this study is **"What skills are needed to drive curriculum development in tertiary education?"**

A secondary research question is **"Do social networks have an impact on biotechnology organisations and foreign direct investment decisions?"**

The detailed questionnaires are included in Appendices 1 and 2.

The structured skills questionnaire, as shown in Appendix 1, is split into 6 sections:

- Section A – Introduction.
- Section B – Respondent Data
- Section C – Techniques and Technologies
- Section D – Staff Profile
- Section E – New Appointments Planned
- Section F – Work Integrated Learning

The respective sections are further divided into the following questions:

1. Which techniques does your organisation utilize and likely to utilize in the future?
2. Which technologies are important now and will become important in the future?
3. Which specialist skills are important now and will become important in the future?
4. Which innovation/entrepreneurship skills are important now and which will become important in the future?
5. What qualification and specialisations are present in your organisation?
6. What new appointments are being planned in your organisation?
7. What qualification is being sought?

8. Is there a preferred institution for the candidate?

9. What skills are specifically being sought?

10. Do you differentiate between a degree and a diploma?

11. What value do you perceive the diploma qualification to have?

12. Would you company be willing to offer a nine month work integrated learning to a biotechnology student?

13. What monthly stipend will you/your company be prepared to offer the student involved with in-service training?

The "Social Networks in Organisations" survey (Appendix 2) followed the following format:

Section A – Demographic details

1. Age?
2. Gender?
3. Company name?
4. Highest level of education?
5. Race?
6. Nature of employment?
7. Years with current employer?

Section B – Other information

1. Do you intentionally target people that you want to build relationships with?
2. For professional contacts, would you rather network inside or outside the organisation?
3. Diversity of workforce – please estimate the percentage of people in your company falling in the following categories: % females; % white people; % people over 40.

4. Does your company actively facilitate the formation of networks?
5. Do you feel excluded from social networks because of your age/gender/race/personality/skill level/experience/ I do not feel exluded/other?

Section C – Network characteristics

- gender
- race
- age
- education level
- skill set
- frequency
- medium of interaction
- style of interaction
- planned or unplanned interaction
- proximity to contact
- position of contact in relation to position of respondent
- function of contact in relation to function of respondent
- department of contact in relation to department of respondent
- length of time known contact
- main reasons for interacting
- feeling excluded from networks or not
- deliberate networking or not
- preference for networking inside or outside of organisation

The purpose of this study is to identify and refine the nature of informal networks functioning in South African companies and abroad. Therefore, the secondary research question "Do social networks have an impact on biotechnology organisations and foreign direct investment decisions?" is further explored via questions 2a and 2b.

Research Question 2a: Do the social networks exhibit any patterns along the following parameters?

- gender
- race
- age
- education level
- skill set
- frequency
- medium of interaction
- style of interaction
- planned or unplanned interaction
- proximity to contact
- position of contact in relation to position of respondent
- function of contact in relation to function of respondent
- department of contact in relation to department of respondent
- length of time known contact
- main reasons for interacting
- feeling excluded from networks or not
- deliberate networking or not
- preference for networking inside or outside of organisation

Research Question 2b: Do overseas networks play an important role in collaboration efforts?

4 Research Methodology

Research is defined as "the systematic study of materials and sources in order to establish facts and reach new conclusions." (Compact Oxford Dictionary)

The objectives of this research proposal were to investigate what criteria are important, specifically from a social networking and skills development perspective, for encouraging foreign investment that would enable South Africa to become one of the global leaders in the biotechnology sector.

The proposed research methodology was quantitative research design as per Welman and Kruger (2005) where experimental, quasi-experimental and non-quasi experimental research is covered.

Data were gathered using semi-structured in-depth questionnaires.

4.1 Research Design

Based on research methodology literature, the research design is a master plan specifying the methods and procedures for collecting and analysing the needed information (Zigmund, 2003). The function of the research design is to ensure that the evidence obtained enables one to answer the initial question as unambiguously as possible. It also means that one must not simply look for evidence that supports one's favourite theory: one should also look for evidence that has the potential to disprove one's preferred explanations: (What is research design?).

The research methodology was a questionnaire. "Good questionnaire design is a key to obtaining good survey results" (Zikmund, 2003, p 361). The research design chosen for this proposal was primarily quantitative. "In quantitative research one's aim is to determine the

relationship between one thing (an independent variable) and another (a dependent or outcome variable) in a population" (Quantitative research).

Quantitative research is generally approached using scientific methods which include:

- The generation of models, theories and hypotheses
- The development of instruments and methods for measurement
- Experimental control and manipulation of variables
- Collection of empirical data
- Modelling and analysis of data
- Evaluation of results

(Quantitative research).

The research design involved semi-structured in-depth questionnaires. A semi-structured questionnaire is a "combination of the individual in-depth interview and the standardized, structured questionnaire. Characteristics of the semi-structured interviewing technique are:

- It is situated between the individual in-depth interview and the quantitative interview with a standardized questionnaire.
- It contains closed-ended, multiple choice and scale type questions, but also a lot of open-ended questions which, as in an in-depth interview, provide room for the individual train of thought of the respondent and allow them to shape their opinion.
- Closed-ended, multiple choice and scale type questions are processed with the usual statistical analyzing methods used by quantitative analysis, while the results of the open-ended questions are processed in a qualitative way."

  (Semi-structured interview).

Face-to face interviews were used as part of the interviewing process. Welman & Kruger (2001) highlight the disadvantages and advantages of using the face-to-face interview method to collect data.

The disadvantages are:

- High preparation, travelling and interview costs because of the time this takes
- Interviewees may give responses that they think the interviewer wants to hear.

The advantages are:

- The interviewer is in control of the interview process, so any misunderstandings or vague responses can be cleared up. Consequently the responses obtained are of a high quality and
- The response rate is very good, often better than telephonic interviews and postal surveys.

An alternative process would have been the use of focus groups, but owing to the differing backgrounds of the interviewees with potentially opposing views, it was believed that focus groups would not have been suitable to adequately address the research questions.

The respondents were assured that the information provided would be used for research purposes only and to provide results to BioSA and the CPUT. Anonymity was guaranteed unless permission is granted by the respondent to divulge details.

4.2 Population and Sampling

Population can be defined as individuals, groups, organisations, human products and events, and the conditions to which that population is exposed (Welman and Kruger, 2005).

The population consisted of 65 individuals, male and female, of varying age and race who are or were involved in the public and private biotechnology sectors. They included members of the groups listed on the BioSA and Cape Biotech mailing lists.

The population was limited to individuals in Gauteng and the Western Cape. This indicates a cross-sectional design (Welman and Kruger, 2005).

Sampling is required to construct a subset that is representative of the population under review (Easterly-Smith, Thorpe and Lowe, 1991).

The sampling technique used was non-probability convenience sampling.

Zikmund (2003) defines **non-probability sampling** as a technique in which units of the sample are selected on the basis of personal judgment or convenience.

Convenience sampling (also known as a haphazard or accidental sampling) is a sampling procedure used to obtain those units of people most conveniently available (Zikmund 2003).

The researcher interviewed 28 individuals from the population for the "skills" survey and 8 for the "social networking in organisations" survey. The list of participants is shown in Appendix 3.

4.3 Data Collection

The primary source of information was completed questionnaires which were mainly conducted via e-mail and face-to-face. Telephonic and e-mail follow-ups occurred when the response rate was poor.

The secondary sources of information involved researching the Department of Science and Technology, the various Biotechnology Regional Innovation Centres (BRICs), Universities, Technicons and Private Businesses. In addition, analysing and comparing international

biotech players was conducted. The medium used was the internet and attending the Bio2Biz Conference that was held at the Sandton Convention Centre from 15-17 September 2008.

In using structured questionnaires Welman & Kruger (2001) mention that the interviewer is limited to the questions and how they are asked as well as the order in which they appear on the schedule. There is relatively little freedom to deviate from the schedule.

The data for the questionnaires was captured directly into an electronic (Microsoft Excel) template after the interviews were conducted. Reasons for conducting the research were explained verbally at the onset of the face-to-face interviews. In addition, an introductory paragraph was included in the surveys that were sent out via e-mail.

The structured skills questionnaire, as shown in Appendix 1, was split into 6 sections:

- Section A – Introduction.
- Section B – Respondent Data
- Section C – Techniques and Technologies
- Section D – Staff Profile
- Section E – New Appointments Planned
- Section F – Work Integrated Learning

The structured social networking survey was divided into the following:

- Introduction
- Section A –Demographics
- Section B – Other information
- Section C – Network characteristics

The face-to-face interviews were held at the various respondents' place of work.

4.4 Interview process

The researcher explained the purpose of the research and provided an outline of what data would be required to the respondents via telephone, e-mail or face to face (depending on the medium used). The questionnaire data was captured after all the completed surveys were received on an Excel worksheet. The approximate time for each interview was 30 – 40 minutes.

4.5 Data Analysis

Data analysis is a body of methods that help to describe facts, detected patterns, develop explanations, and test hypotheses. (Levine, J 1996, 1).

Nominal and ordinal data results were expected.

Results captured manually and electronically were updated on an Excel spreadsheet. Various chart options and tables were used in Microsoft XP. Descriptive explanations were provided for each question.

4.6 Limitations

The following limitations were taken into consideration:

- Budgetary constraints prevented face to face interviews taking place across the country.
- Due to time constraints only a limited amount of the population was interviewed during the specified period.
- Only a limited number of questions were included in the questionnaire to keep it interesting and realistic to answer within the 30 -40 minute time frame.
- The sample was not fully representative of the population (only respondents in the Gauteng and Western Cape regions were interviewed) and therefore one may only generalise from these areas.
- Data and interviewer bias may have been present. Effort was made to minimise this risk.

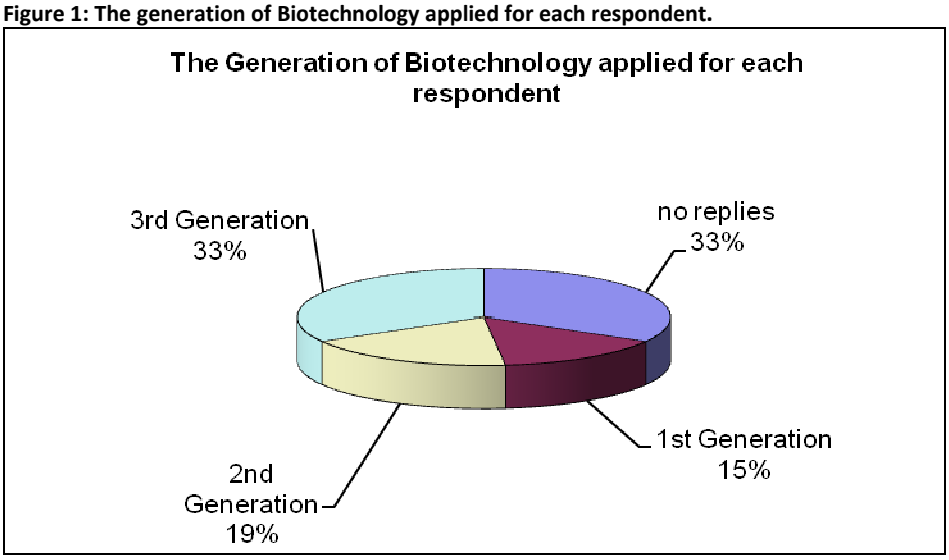
- Incorrect capturing of results could have incurred unwanted errors.

5 Results

5.1 Results – Skills Survey

1. Technology Information – What generation biotechnology is your company involved in?

Figure 1: The generation of Biotechnology applied for each respondent.



- 15% of companies indicated they were involved in 1st generation biotechnology, 19% in 2nd generation biotechnology and 33% in 3rd generation biotechnology. 33% of interviewees did not answer this question. A possible explanation for such a significant non-response rate is that the interviewees may not have been able to distinguish between the different generations or that they were involved in overlapping options.

2.a. Do you consider biotechnology central to your firm's activities or status?

- 24 companies consider biotechnology as central to their firm's activities and 3 not. 1 did not reply to this question.

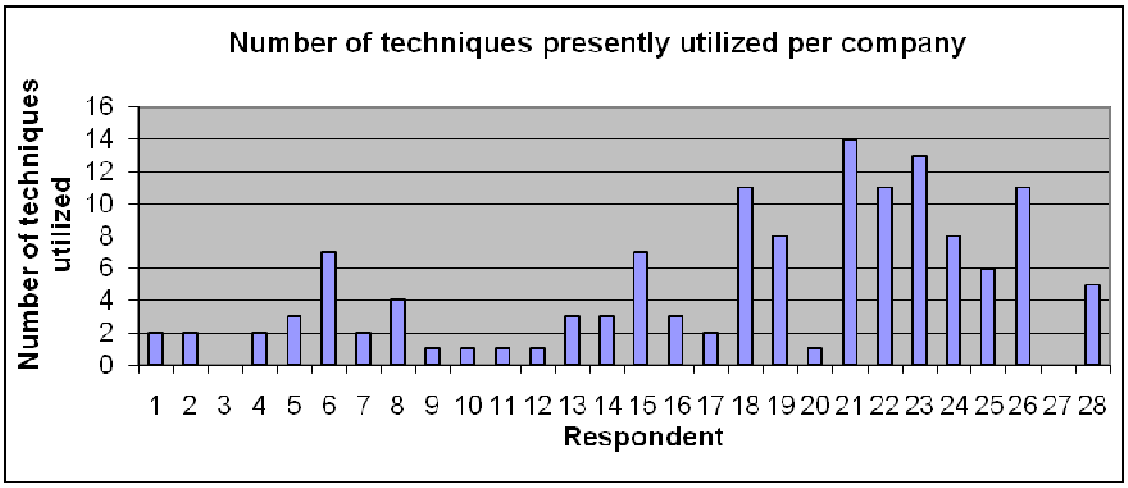
2.b. Do you support or undertake and research activities?

-25 companies support/undertake research activities and 3 do not.

3.a. Techniques

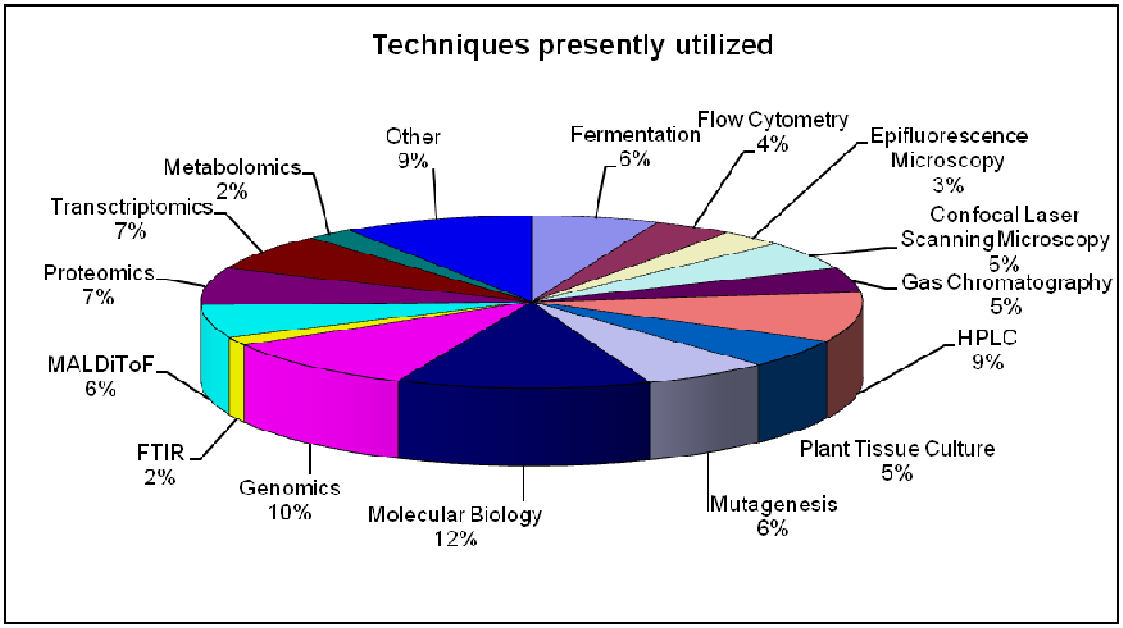
The Compact Oxford Dictionary defines "technique" as "1. a way of carrying out a particular task, especially the execution of an artistic work or a scientific procedure. 2. a procedure that is effective in achieving an aim. "

Figure 2: Number of techniques presently utilised per company.



Respondent 21 made use of the most techniques whereas respondents 3, 4 and 27 did not list any.

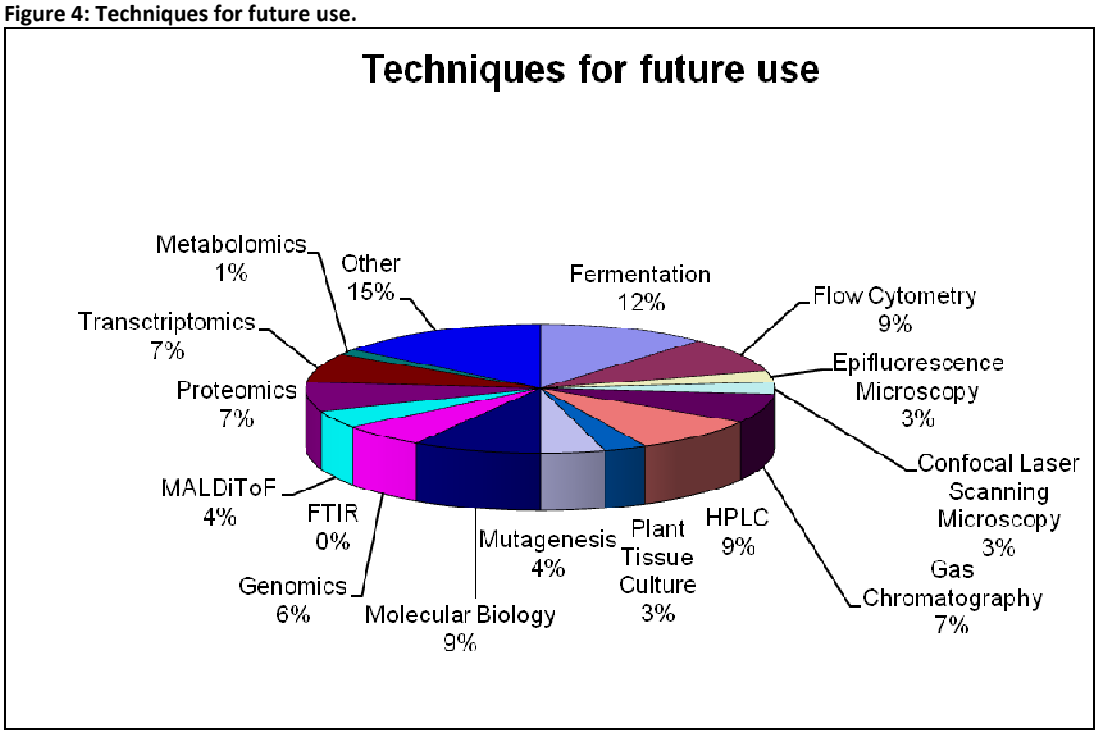
Figure 3: Techniques presently utilised.



3.a.1. Which of the following techniques does you organisation presently utilize?

– "Molecular Biology" was the predominant skill utilised by employed staff while "FTIR" (Fourier Transform InfraRed) was least used.

Figure 4: Techniques for future use.



3.a.2. Which of the following techniques is your organisation likely to utilize in the the future?

– "Fermentation technology, Flow Cytometry, HPLC, Gas Chromotography, Proteomics, Molecular Biology, Transcriptomics" and "Other" will be utilised in 3-6 years. "FTIR" reported no results for the future time span.

Figure 5: Equipment presently utilised

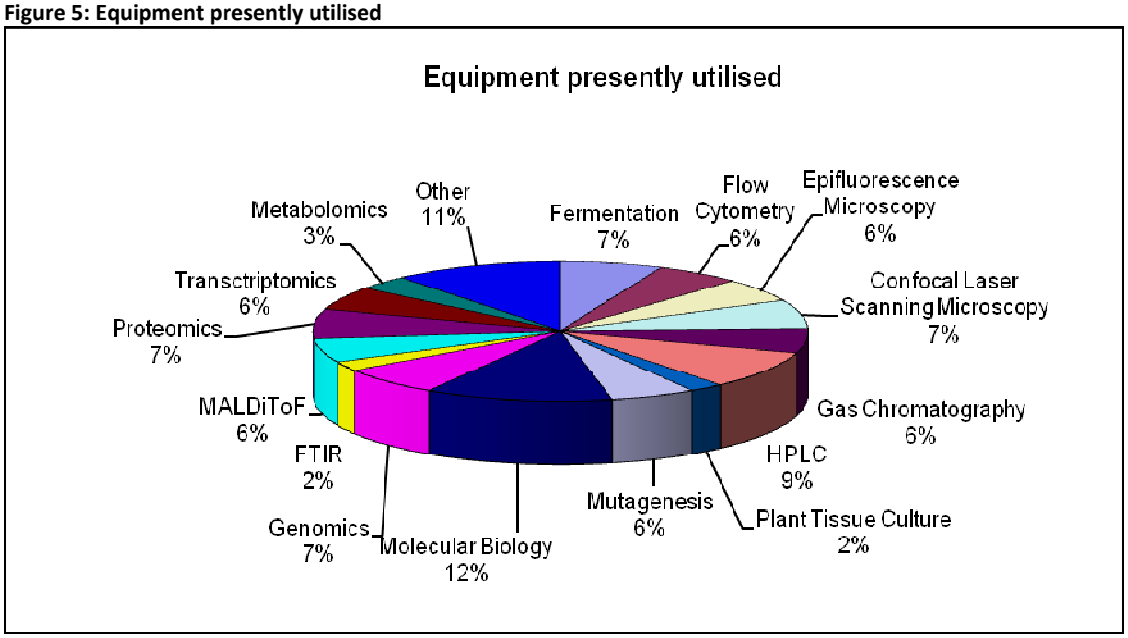
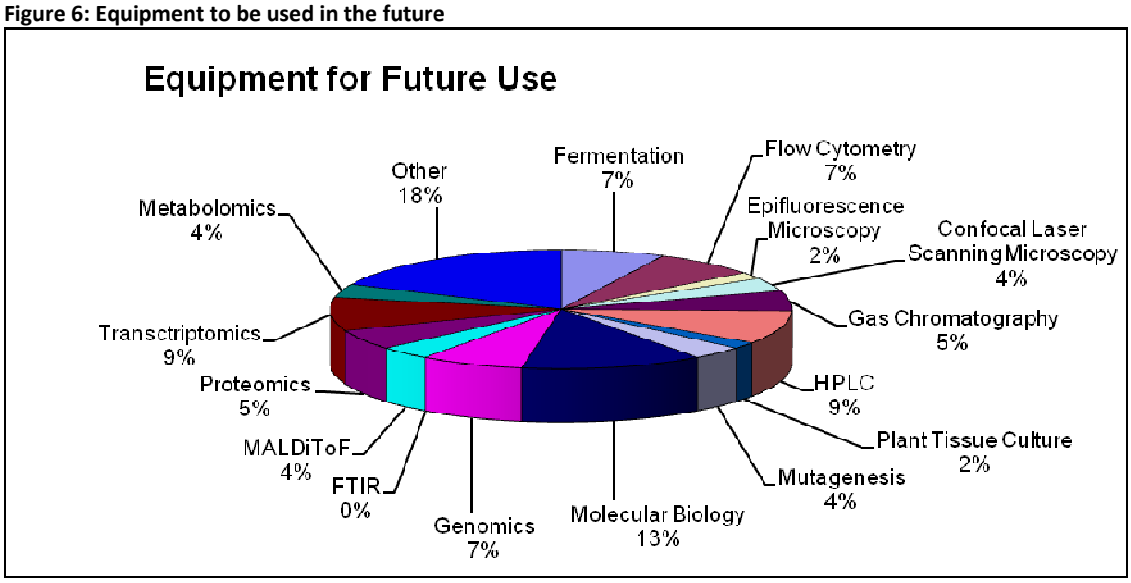


Figure 6: Equipment to be used in the future



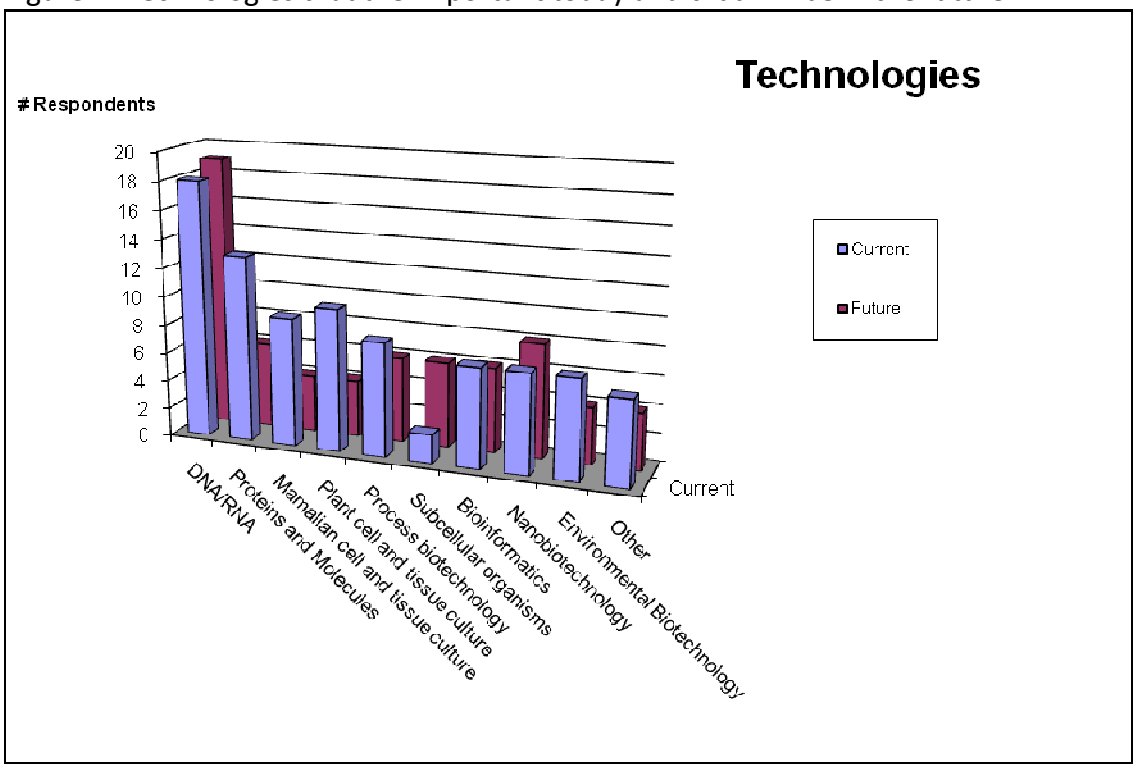
3.a.3. and 3.a.4. What equipment does your organisation presently utilize and will likely utilize in the next 3-6 years?

– Equipment for "Molecular Biology" techniques emerged as the forerunner for instruments that are currently utilised and the same results were recorded for the next 3-6 years. In addition, "Other" was also captured as important with 18%. What was interesting is that the list did not include any overlapping items.

3.b. Technologies

The Compact oxford Dictionary describes "technology" as "**1.** the application of scientific knowledge for practical purposes. **2.** the branch of knowledge concerned with applied sciences. "

Figure 7: Technologies that are important today and that will be in the future.

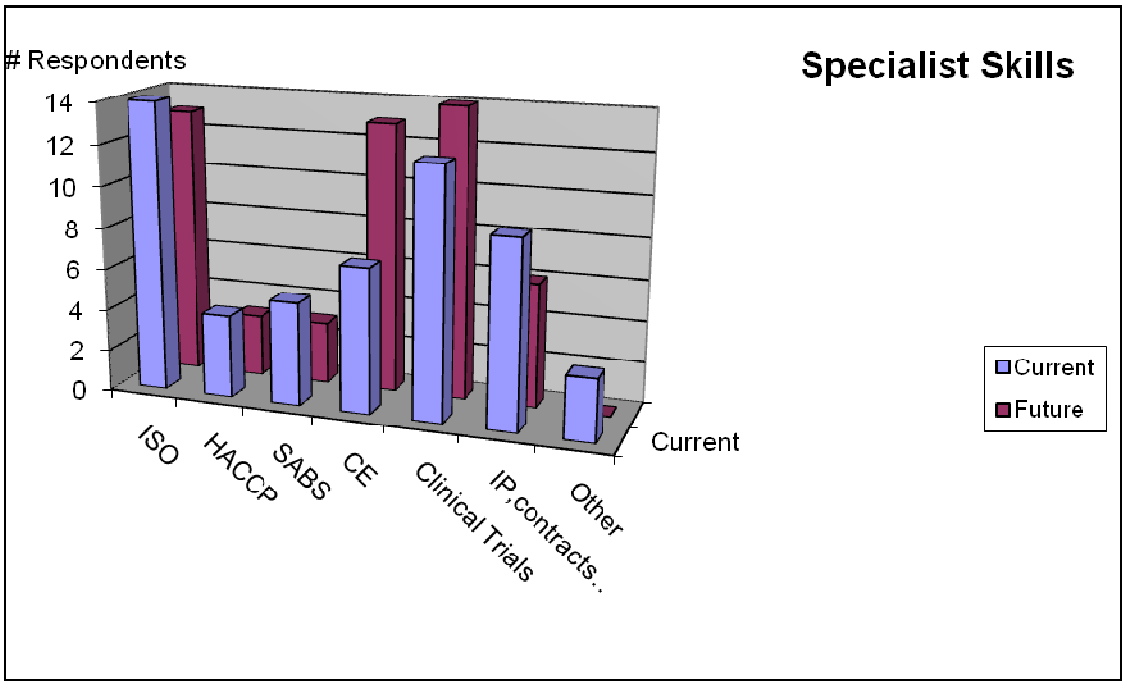


3.b.1. and 3.b.2. Which technologies are important today and will become important in the next 3-6 years?

-"DNA/RNA, cloning, PCR, genetic engineering: skills linked to the manipulation thereof" were identified as technologies that are important in their organisations today and that will become important in the next 3-6 years. "Sub-cellular organisms: gene therapy, viral vectors" were least important today while "mammalian cell and tissue culture and the engineering thereof", "plant cell and tissue culture", "environmental biotechnology: sanitation, safety and hygiene" and "Other" were at the bottom of the list for technologies that would be important in the next 3-6 years.

4. Specialist skills

Figure 8: Specialist skills that are important now and that require additional training.



4.a.1. Which specialist skills are important now?

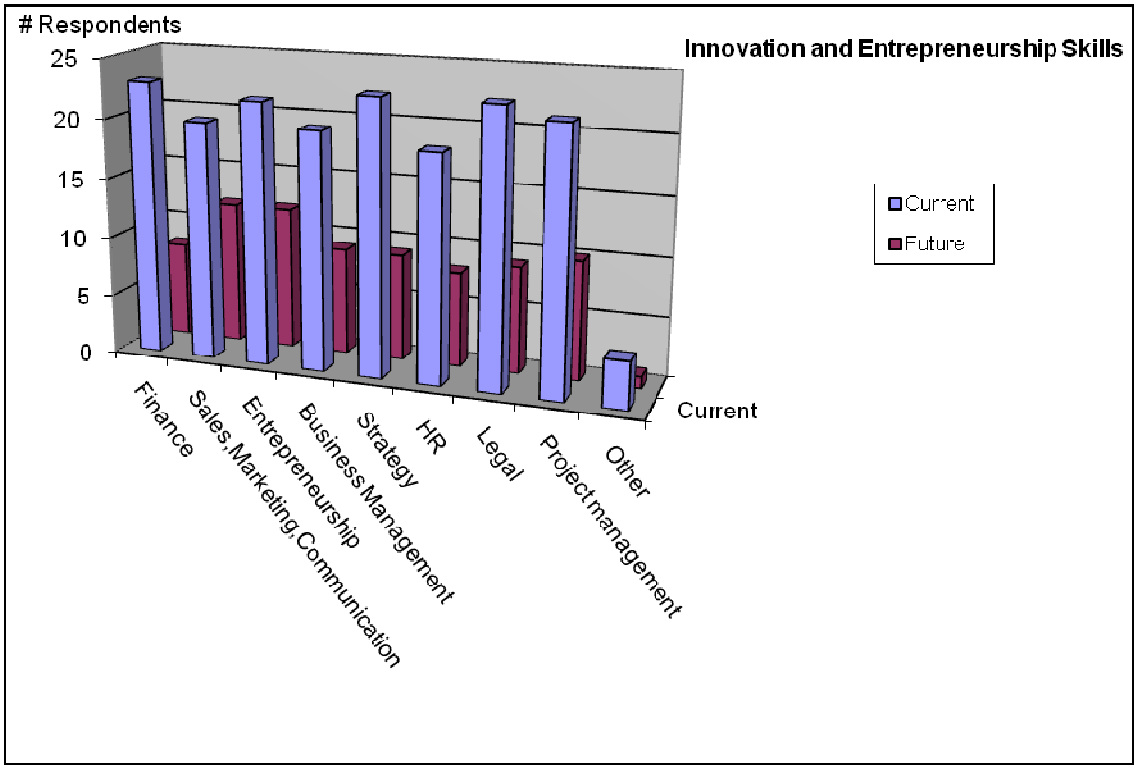
-ISO accreditations are the most important specialist skills in organisations today.

4.a.2. Which specialist skills require further training?

– "Clinical trials" followed by "ISO accreditations" and "CE Mark" are expected to require further training in the future.

4.b. Innovation and Entrepreneurship

Figure 9: Innovation and Entrepreneurship skills that are important now and in the future.



4.b.1. Which innovation and entrepreneurship skills are important now?

- "Finance", "Strategy" and "Legal" were identified as the most important skills now.

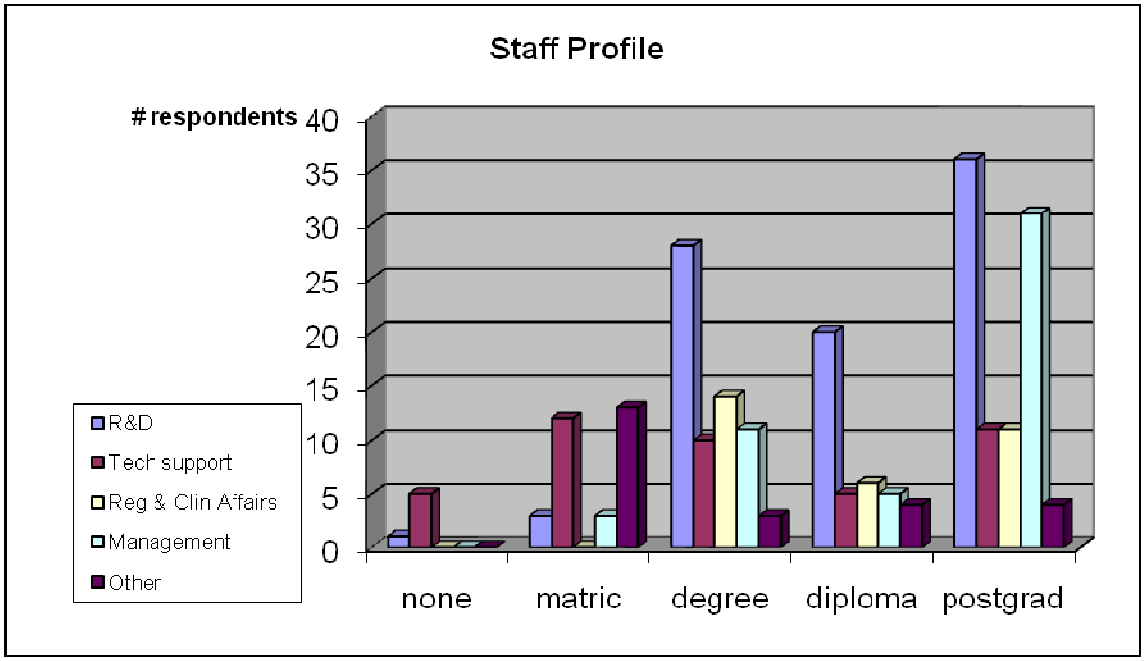
4.b.2. Which innovation and Entrepreneurship skills require further training?

- "Sales, marketing and communication" is an area that requires further training.

5. Staff Profile

Area of specialisation of staff members:

Figure 10: Staff profile



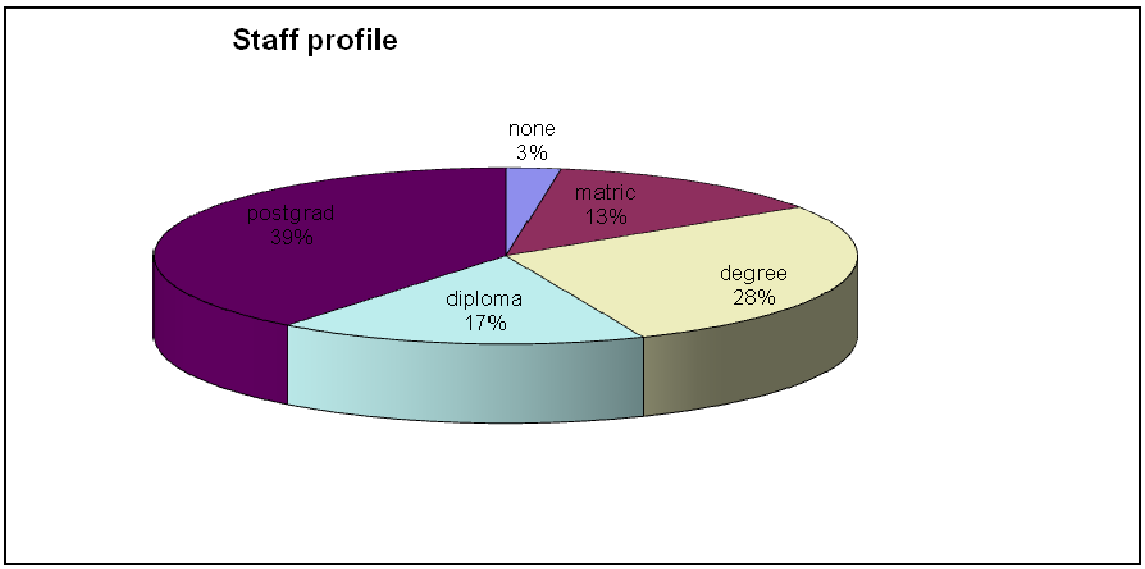
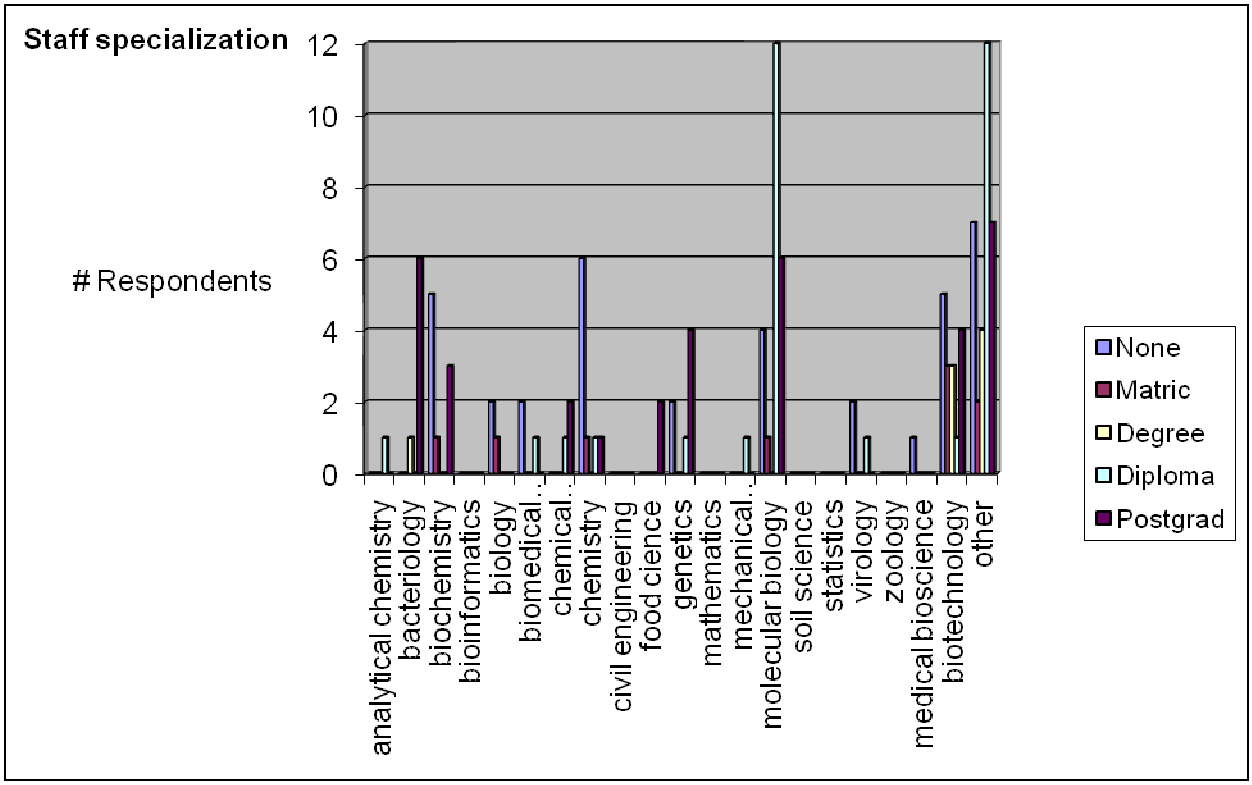


Figure 11: Staff specialisation



5.a. Research and Development Staff

Seventy nine staff members are involved in research and development and thirty one are post graduates.

The main specialisation was “Other” i.e. not provided in the list.

5.b. Technical Support Staff

Technical and support staff comprised of thirty one, with “matric” being the main qualification and “other” the predominant specialisation.

5.c. Regulatory and Clinical Affairs Staff

Among the eighteen regulatory and clinical affairs staff, fourteen had “degrees”. “Other” was the main specialisation.

5.d. Management

"Postgraduate qualifications" dominated the management sector with twenty seven out of forty three employees. Once again, "other" was the main specialisation (12) with "Molecular Biology" a close second (11).

5.e. Other Staff Members

"Biochemistry" and "other" were the specialisations for last section where eleven out of sixteen had a "matric" qualification.

6. New Appointments Planned

The following is a list of new appointments planned

- Technical Consultant: Wine
- Business manager: Biocontrol
- Quality manager
- Studentships
- Post docs
- Business/Marketing Partner
- Medical director
- Investment manager
- Research assistant
- Technical assistant
- Postdoc research scientist
- Immunologist
- Virologist
- Marketing manager
- Regulatory manager
- Sales representatives
- Production staff

There was no trend in the listing.

The main qualification sought was "any post-grad".

The preferred institution was "traditional university".

The main skills listed were the following:

- Winemaking knowledge, oenology, viticulture
- Business Management, microbiology, agriculture
- Entomology and Quality
- Negotiation
- Finance
- Biotechnology , IP management, research management
- Molecular techniques
- Surface plasmon resonance and phage
- HIV Drug susceptability
- Immunogen design
- Medical products marketing and sales
- Physical science
- Material science, biophysics

6.b. Do you differentiate between a degree and a diploma qualification?

- The majority of respondents do differentiate between a degree and diploma.

6.c. Please explain

- Various explanations were provided as to why the one was preferred over the other. A summary is that a "diploma is regarded as a lesser degree".

6.d. What value do you perceive the Diploma qualification to have?

- Various replies were received as to the perception of the "Diploma", but it is generally seen as a "basic level of qualification".

7. Work-integrated learning

7.a. Would your company be willing to offer a nine (9) month work-integrated learning to a biotechnology student?

- Twenty companies advised that they would be willing to offer nine month work-integrated learning at their companies and four were not willing to participate. Four did not complete this section of the questionnaire.

7.b. What monthly stipend (travel and living) will you/ your organisation be prepared to offer the student with in-service training?

-The majority of interviewees (5) were prepared to offer a R 4000 monthly stipend.

5.2 Results – Social Networking in Organisations Survey

Section A

Table 1: Demographics and Other Information

Respondent	Age	Gender	Education Level	Race	Nature of employment	Yrs current with employer	Intentionally target	Inside or outside Networking
1	39	f	Post Grad	W	Full Time	7	yes	both
2	-	m	Post Grad	B	Full Time	7	sometimes	-
3	46	f	Post Grad	W	Full Time	3	yes	outside
4	34	m	Post Grad	W	Full Time	2	yes	outside
5	37	m	Post Grad	W	Full Time	6	yes	outside
6	36	m	Matric	W	Full Time	<2	yes	outside
7	39	f	Matric	W	Full Time	0	yes	inside
8	-	m	Post Grad	I	Full Time	0	sometimes	inside
Average	38.5							

1. **Age** – The average age of the respondents was 38.5 years.
2. **Gender** – There was a response from 5 males and 3 females.
3. **Company name** – was excluded for anonymity sake.
4. **Highest level of education** – The majority of respondents (6) had a postgraduate degree.
5. **Race** – White respondents dominated the survey with 6, followed by Indian and Black, with 1 each.
6. **Nature of Employment** – All respondents were employed on a full time basis.
7. **Years with current employer** – The range extended from 17 months to 7 years.

Section B

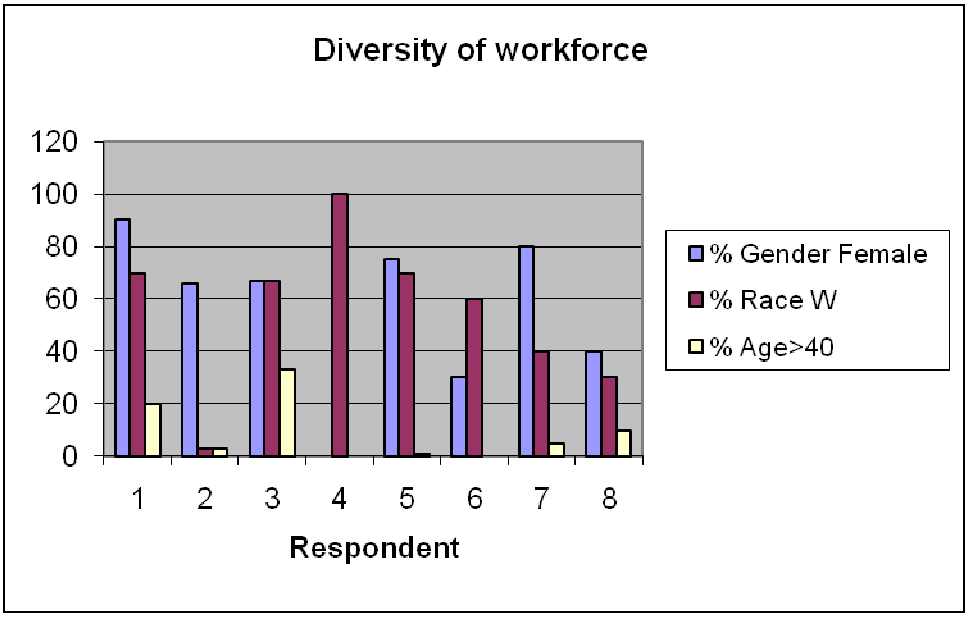
1. **Do you intentionally target people you want to build relationships with?**

   - Seven responded that they "do intentionally target" people to build relationships with and one replied "sometimes".

2. **For professional contacts, would you rather network inside or outside the organisation?**

   - "Only outside" was the preference (4).

Figure 12: Diversity of workforce



2.a. % Females – more than 50% of staff were females

2.b. % white people – more than 50% of staff were white

2.c. % people over 40 – the majority of employees were under forty years of age.

3. **Does your company actively facilitate the formation of networks?**

Table 2: Facilitation of networks

Respondent	Facilitation of networks
1	Active
2	Active
3	Some Facilitation
4	Active
5	Active
6	Some Facilitation
7	Active
8	0

– Five companies do "actively facilitate" the formation of networks and two do "some facilitation".

4. **Do you feel excluded from social networks at work because of your age/race/gender/personality/skill level/experience/I do not feel excluded/other?**

Table 3: Exclusion from social networks

Respondent	Exclusion from social networks
1	some exclusion
2	not excluded
3	not excluded
4	not excluded
5	not excluded
6	not excluded
7	not excluded
8	not excluded

– only one respondent replied that "sometimes" exclusion was felt whereas the difference "did not feel excluded".

Section C

The survey required the interviewees to list five of their most important contacts.

The following results summarise the findings:

a. **Gender –** Twenty males and fifteen females were identified in the survey.

b. **Race –** Fourteen Blacks and twenty one Whites were referred to.

c. **Approximate age of persons –** The average age was 34.8 years.

d. **Approximate education level of persons –** Twenty were "lower", nine "similar" and six "higher" to the qualification level of the respective respondents.

e. **Similarity of this person's skills set to yours**

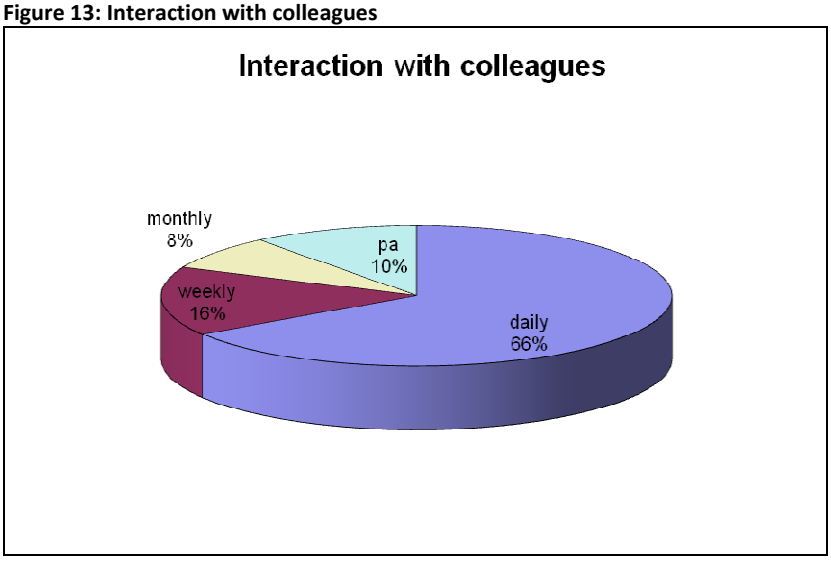
– Fourteen reported "not similar"

- Twelve "overlapping"

- Six "same"

f. **How often do you interact with this person?**

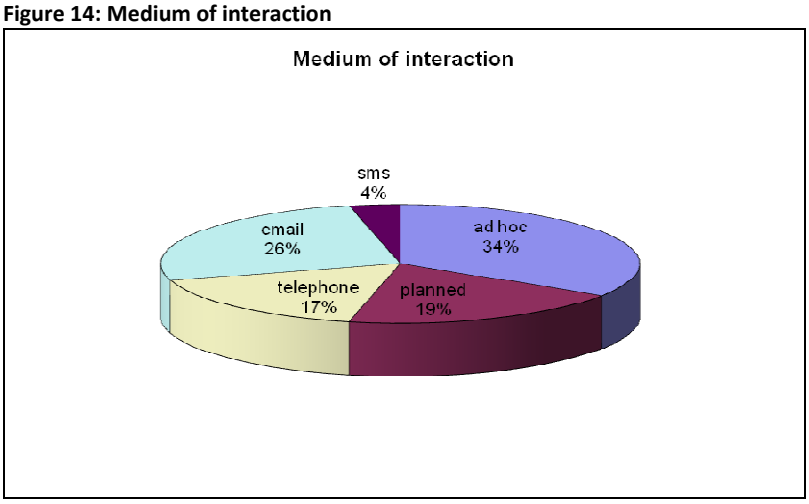
Figure 13: Interaction with colleagues



- 66 % responded that daily contact occurred, 16% made weekly contact, 8% monthly and 10 % per annum.

g. What is your main medium of interaction with this person?

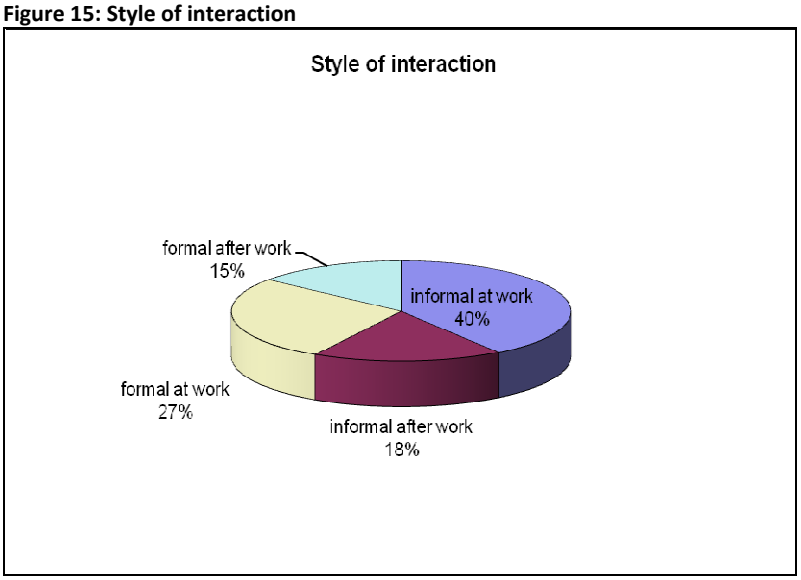
Figure 14: Medium of interaction



- The main interaction is “unplanned face to face” (ad hoc), followed by “e-mail”, “planned face to face”, “telephone” and finally “sms”.

h. Most frequent style of interaction?

Figure 15: Style of interaction



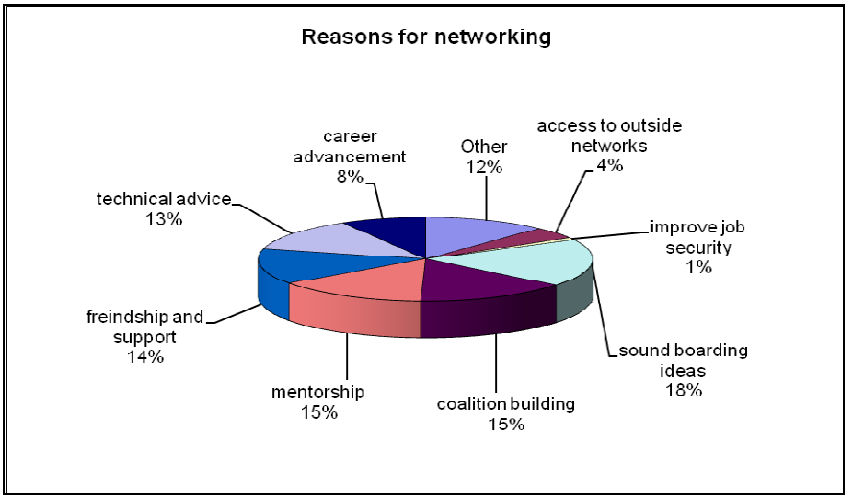
- The most frequent style of interaction reported was "Informal at work" which supports the ad-hoc meetings described above. "Formal after work" emerged as the least frequent style.

i. Is your engagement with this person planned?

- Twenty eight responded "sometimes", six "never" and one "always".

j. What are your main reasons for networking with this person?

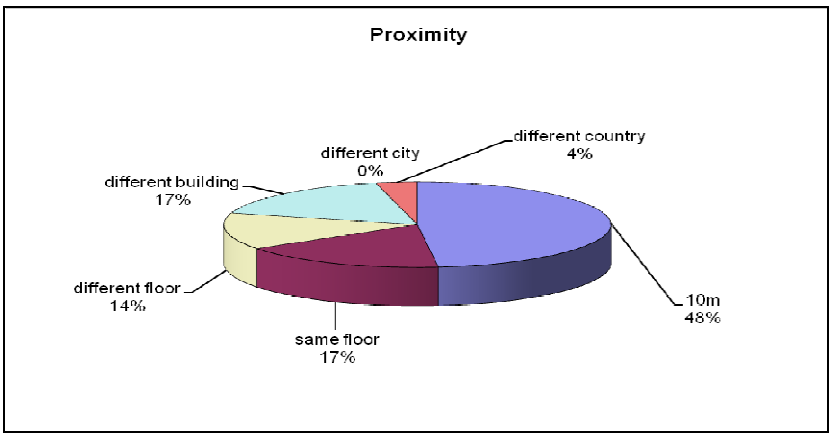
Figure 16: Reasons for networking



- The main reason for networking with certain people is for "sound boarding ideas" and the least reason, "improving job security".

k. What is your proximity to this person?

Figure 17: Proximity



- 48 % indicated that they were within 10m of each other.

- Only 4 % replied that they dealt with contacts outside of the country.

l. What is the position of this person in the organisation?

- Eighteen responded that their colleagues were in a "lower" position to theirs.

m. Is the person in the same type of function as you?

- an overwhelming response of "no" was received (26 vs 5).

n. Is the person in the same department as you?

- Nineteen "no's" were received as opposed to twelve "yes's".

o. How long have you known this person?

- The median was three years.

6 Discussion of Results

6.1 Discussion of results - Skills Survey

The primary question was: **"What skills are needed to drive curriculum development in tertiary education?"**

The findings report that the majority of companies are involved in 3rd generation biotechnology and that biotechnology and research activities are central to their respective companies.

It is noted that three companies reported that they do not utilize any techniques in their organisations. An explanation for this is that their companies are not directly involved in biotechnology, but offer ancillary services.

The techniques that are presently utilised by employed staff are "Molecular Biology" followed by "Genomics". What was interesting is that the techniques for the future included 15% of "Other". The techniques listed by the respondents did not overlap with any of the options made available in the survey (i.e. a different name for the same technique) and there were no duplications in their responses either. This indicates that there was no oversight in the design of the questionnaire. "Fermentation technology, Flow Cytometry, HPLC, Gas Chromotography, Proteomics, Molecular Biology" and "Transcriptomics" were other areas that are expected to be important in the future. FTIR reported no results for the future time span.

Equipment related to "Molecular Biology" emerged as the leader for equipment currently used and expected to be required in the future. A significant increase in "Other" (from 11% to 18%) needs to be highlighted as, once again, there were no overlapping areas. (The list included microfluids, nanotechnology, biomedical engineering/product development,

clinical research, AA, ICP, LECO, gold conjugates, LC-MS, quality control, protein expression and purification, peptide synthesis, surface plasmon resonance, circular dichroism and isothermal titration calorimetry, clinical trial services/training, regulatory and development strategies for getting a medical device/diagnostic or medicine to market).

The technology that is important now and in the future was "DNA/RNA, cloning, PCR, genetic engineering: skills linked to the manipulation thereof". This is in line with the techniques that were recorded in the previous questions and the results obtained in the National Biotechnology Audit 2007 (DST, 2007).

In terms of specialist skills, "ISO accreditation" was listed as important now while "CE Mark" and "Clinical Trials" were disciplines that would require further training in the future. South Africa is currently regarded as a favourable Clinical Trial destination due to the fact that labour is cost effective, a diverse population and expertise are present, and the exchange rate is favourable from most outsiders' points of view (BioSA,2008).

It was concluded that a need exists for customised training and other courses as some industry players currently provide in the South African sector. This could be rolled out on a national basis as opposed to one region in the country.

The "Innovation and Entrepreneurship" skills that are seen as important now are "Finance, Strategy" and "Legal". For the future, "Sales, Marketing and Communication" were deemed valuable.

"Employers continue to struggle to find employees with good technical skills and, consequently, identify technical skills as a high training priority. In addition, good communication skills are an important training need that may also be reflected in the demand referenced for supervisory/management, customer service and sales training"

(Local Skills Shortage Assessment for the Greater Rochester Area Rochester Resource Alliance).

"Skills specialisation" was dominated by "Other" in the various sectors ("Research and Development, Technical Support, Regulatory and Clinical Affairs Staff, Management and Other Staff members)

"Other" consisted of the following disciplines that were not provided in the list:

- Finance
- Marketing
- Life science
- Knowledge Management
- Forensics
- MBA
- Human resources
- Business Management
- Quality Assurance and Administration
- Tissue culture
- Master practitioner
- Psychology
- Environmental Health
- International relations
- Labour law
- Lab services

A trend was not exhibited in the new appointments planned, however, a "post grad" was preferred as well as a "traditional university". This supports the fact that the respondents favoured a degree to a diploma as, according to the replies, a diploma is regarded as a "basic qualification" or a "lesser qualification" to that of a degree.

One respondent reported that a diploma and degree have different NQF levels and thus the degree is preferable to them.

It also emerged that it would be ideal for training programmes to be linked to the National Qualifications Framework (NQF).

The introduction of "wet labs" for general use by interested parties was also recommended. Distributors of equipment and consumables could sponsor the respective products free of charge in leu of training or marketing opportunities on the respective product lines.

In line with what this research project uncovered, the MIHR reported in 2005, "Despite a general skills shortage in the supply of scientists and qualified researcher managers, biotechnology companies in South Africa show a relatively even distribution of employee qualifications ranging from technical staff to post-graduates. As to be expected, research groups are dominated by employees with at least a degree qualification. The reason for this is that skills distribution between the private and public sector favours the former. Most biotechnology groups in South Africa belong to the private sector and private R&D facilities typically offer more attractive salary packages, state of the art facilities and equipment, and better working conditions. South Africa's economy is growing at a faster rate than there are available skills to meet this growth. The bio-economy needs industry-relevant skills to create a competitive environment that is able to deliver appropriate biotechnology goods and services. To achieve this, South Africa has adopted a number of parallel strategies that include incentives for skills development that look at recruitment, training and capacity development; partnerships with industry; career guidance and youth mentorship; and funds for bursaries and scholarships. Such programmes set out to achieve:

- Faster transfer of skills to previously disadvantaged communities.

- Address competency gaps caused by skills migration, brain drain and the HIV/AIDS pandemic.
- A decrease in unemployment through job creation.
- More even demographic representation.
- More rapid skills development to fulfil the needs of a growing economy." (Pefile, 2005)

The majority of companies were prepared to offer work integrated learning to a student and surprisingly, R 4000, per month (the highest option) was chosen.

Employers identified that they needed graduates to have better problem-solving skills, and the majority of employers identified the lack of work experience as a major problem (Daniels, 2007).

It was also mentioned that it would be ideal for interns to obtain supplementary funding from the DST / BRICs/ Government.

The 2006 N.C. Skills Market Survey reports that "registered apprenticeship is the best way for employers to ensure that workers are trained the way they want them.

Results also show that apprenticeship programs reduce turnover and improve productivity, quality workmanship, recruitment, employee problem-solving, employee versatility and skills of employees.

Paid internships are easier to arrange in large firms than in the smaller firms or universities. Internships are difficult for small firms and universities to maintain, due to economic pressures. But even if difficult, internships are valuable to firms, schools, and students" (Berry, 2006).

For interest sake, "Africa have universities in nearly sufficient numbers – eighteen public and private in Egypt and 36 in South Africa, according to the 2005 edition of the *Unesco*

Science Report. This is reflected in the dominance of these countries in tables of scientific publications from AU states. Roughly half of all scientific output in the continent comes from Egypt and South Africa; a quarter comes from Kenya, Morocco, Nigeria and Tunisia. The remaining forty three countries in the AU are responsible for the final quarter of science from the continent.

Indeed, compared to the rest of the world, AU countries as a whole have fallen behind in scientific and technological development. From 1988 to 2001, the number of articles published in scientific journals worldwide grew by 40 %, yet in Africa publication counts actually declined by 12 % over this period in absolute terms. In 1988, AU countries accounted for 1.26 % of all scientific publications, but by 2001 their collective share was down to 0.76 %. Of the 10 larger countries, Kenya, Nigeria, Senegal, South Africa and Zimbabwe all published fewer articles in 2001 than in 1988. Of the countries that showed an increase — Cameroon, Ethiopia, Ghana, Tanzania and Uganda among them — none published more than 100 articles annually at any time from 1988 to 2001. Add to this curricula in need of modernisation, under-motivated staff, hierarchical management styles and very limited R&D and the picture – and the urgency for change — becomes clear. At the same time, much is changing in the broader university world in both developed and developing countries. Indeed, it is these changes that represent an opportunity to reinvent the university in Africa" (Juma and Serageldin, 2007).

The MIHR report to CIPIH provides the following background information which enables the reader to put the research findings in perspective :

"South Africa is one of Africa's fastest growing economies. This expansion is draining South Africa's skilled workforce. There are a number of concerns with respect to the country's

ability to build skilled capacity at the rapid rate required, and to retain professionals. A big weakness lies in its education system, where performance in science and maths is generally poor. South Africa's secondary education pupils scored significantly below the international average in the Trends in International Mathematics and Science Study (TIMSS). It is discouraging to note that the 2003 TIMSS scores were hardly an improvement on the 1999 scores. Science and maths are required for the study of the biosciences and with such a low rating the education system will struggle to meet the demands by the bioscience sector for skilled individuals.

Statistics show that in the 10 years ending 1999 an estimated 10 000 South Africans engaged in science and technology emigrated, mainly to developed countries. South Africa's brain drain is listed in the 2004 World Competitiveness Yearbook as one of the country's key challenges – it ranks 58th worldwide in terms of the rate at which professionals are emigrating; 60th in the availability of skilled labour; and 50th in drawing on foreign highly-skilled labour. Overall, this indicates that South Africa is in a weak position as far as the availability of skilled labour is concerned. The major cost to the country is in lost production and the export of human capital in the form of education, training and experience. In addition to the export of human capital, emigration also results in the export of real and financial assets. As a result, this dire situation has forced many employers to leave posts unfilled, finance training programmes, and/or hire abroad.

In 2004, South Africa ranked 40th in the world in the technology index. Technology is at the centre of economic growth and is generally seen as the most critical factor in driving sustained high growth. The Global Competitiveness Report, which is responsible for this ranking system, differentiates countries that are "core" and "noncore" innovators. Countries that fall in the former category produce at least fifteen patents per million

population. South Africa's patent rate is 2.5 patents per million population and is therefore classified as a non-core innovator. This means it is highly dependent on technological adoption from abroad as opposed to its economic growth being driven by its own capacity to innovate. To get closer to the technological front, South Africa needs stronger political commitment and administrative strength to ensure that technologies imported from abroad are current, appropriate for the needs of the country, are transferred in a systematic manner, and create real opportunities for growth and development" (Berry, 2006).

An Ernst and Young report by Gold says that the quality of technical and science skills is very high in South Africa's universities, he notes that there is a shortage of experience amongst technical staff in terms of commercialising research. "Addressing this, internship programmes are being introduced which we hope will provide exposure to the real business environment," he says.

As a nascent industry, biotechnology requires collaboration between government, the private sector and academia if it is to develop into a viable and sustainable industry. Gold says the Report has identified this as a key challenge in the South African industry. "Even within different governmental departments there are often different mandates which may initially be inconsistent with each other. As a result, this can create barriers to policy implementation," he explains.

However, Gold is confident that with ongoing communication and formal channels being opened between departments, this issue is receiving attention. "The industry has also expressed frustration in its efforts to partner with universities. These relate mainly to what

is seen as high levels of bureaucracy, as well as the inconsistencies in the allocation of intellectual property rights," he adds.

In terms of human capital – and in the context that South Africa is in the midst of a much-publicised skills crunch – Gold points out that there is a shortage in the number of technical people with the abilities and vision to set-up and run their own business. "The shortage is exacerbated since most university graduates seek the safety of an academic or big-corporate environment; what is required is the availability of courses to provide scientists and lab technicians with the skills needed to open and run their own business to exploit opportunities in the biotechnology sector," he says, further stressing that experience in the commercialisation process is necessary to develop concepts to marketable product.

"Intern- and mentorship programmes (as advocated by BioSA) are also necessary to provide an opportunity for others to learn from people who have such experience; gaps in technical skills are opening up as the market moves from being research/supply driven to commercial/demand driven. In effect the country may not have the necessary technical skills for some of the areas where commercial opportunities are becoming available," he says (Kolia, 2007).

6.2 Discussion of Results – Social Networking Survey

The secondary research question**: "Do social networks have an impact on biotechnology organisations and foreign direct investment decisions?"** was further divided into the following:

Research Question 1: Do the social networks exhibit any patterns along the following parameters?

- **gender** - The majority of "most important contacts" identified were males (20) while fifteen females were listed in the survey.

  Concern with regards to the numbers of females in the biotechnology industry is raised in the MIHR report:

  "Unlike in more advanced developing countries, Women in many AU states make up a relatively small number of the total population of scientists and engineers. Changing this is both necessary and urgent. Human resource development strategies must aim specifically to increase women's enrolment in the biosciences and in engineering at university level. R&D infrastructure could be improved to better meet the needs of women, and feature conditions and services such as part-time work, flexible hours, infant care support, extended maternity/child care leave. In addition, funding schemes that provide incentives for girls to study science and engineering need to be explored. There are other measures that can be used to strengthen the participation of women in the sciences in Africa. A quota system can be used to ensure women receive at least a proportion of opportunities offered by biosciences networks, such as training scholarships, fellowships and research grants. Mentoring arrangements, web-based outreach programmes, networks of women scientists and indicators of the involvement of women in the sciences could play a key role in strengthening the role of women in the life sciences in Africa" (Pefile,2005).

- **race** - Fourteen Blacks and twenty one Whites were referred to.

This could be as a result of South Africa's previous legacy of affirmative action for whites, but subsequently, reverse affirmation action is now taking place and should be reflected in the figures in the years to come.

An interesting article relating to Black Economic Empowerment in NATURE BIOTECHNOLOGY reported that "Difficulties have arisen because investment banks and traditional industries are all bound by law to reach BEE goals. It's not clear yet whether this type of affirmative action is discouraging investors in biotech and other sectors. A survey of foreign-owned multinational's perception of BEE measures published in early 2006 by Ernst & Young in Cape Town found that 35% of the respondents felt them to have a negative impact on investment in South Africa, the same proportion of people questioned felt it would be positive and the remainder had a neutral view" (Louet, 2006).

- **age** – the average age of the contacts was 34.8 years which is lower than the average age of the interviewees (38.5 years). This result was expected as the respondents were typically heads of organisations or departments and are thus usually older than their colleagues.
- **education level** – the majority of relationships (20) had a lower level of education to that of the respondents. This could be due to the fact that most of the interviewees were either business owners or heads of department.
- **skill set** - Once again, the main response (14) was "not similar" . There were areas where skills sets overlapped (12) and a few answers (6) indicated the "same". An explanation for this result is that the respondents were part of the management

team and would therefore have different skills to their contacts which are typically in their employ.

- **frequency** – 66% responded that daily contact occurred, 16% made weekly contact, 8% monthly and 10 % per annum.
- **medium of interaction** - The main interaction is "unplanned face to face" (ad hoc), followed by "e-mail", "planned face to face", "telephone" and finally "sms".
- **style of interaction** - The most frequent style of interaction reported was "informal at work". This is in line with the findings above. "Formal after work" emerged as the least frequent style.
- **planned or unplanned interaction** – Twenty eight responded "sometimes", six "never" and one "always." This corresponds with the findings above.
- **proximity to contact** - 48% indicated that they were within 10m of each other.

  -Only 4% replied that they dealt with contacts outside of the country.
- **position of contact in relation to position of respondent** - Eighteen responded that their colleagues were in a "lower" position to theirs. Once again, this highlights the hierarchy in the organisations.
- **Function of contact in relation to function of respondent** - an overwhelming response of "no" was received (26 vs 5) i.e. that the contacts performed different functions to the respondents of the questionnaires.

- **department of contact in relation to department of respondent** – Nineteen "no's" were received as opposed to twelve "yes's" i.e. they worked in different departments.
- **length of time known contact** - The median was three years. The longest relationship was twenty years and the shortest just under one year. The average being 4.39.
- **main reasons for interacting** - The main reason for networking with certain people is for "sound-boarding ideas" and the least reason,"improving job security". This result implies that the older group is communicating their thinking with the younger group, probably to obtain their buy-in.
- **feeling excluded from networks or not** – the majority of respondents do not feel excluded from networks. This creates a healthy atmosphere as open communication is apparent.
- **deliberate networking or not** – deliberate networking is done to enhance relationships.
- **preference for networking inside or outside of organisation** – outside networking is preferred. This initiative supports growth and development opportunities for employees. A famous quote "it's not what you know, it's who you know" underpins the importance of networking.

Research Question 2: Do overseas networks play an important role in collaboration efforts?

Only 4% of respondents indicated that they had overseas contacts. This response is surprising as it has come to light after delving into the various literature that international collaboration efforts are essential to development within the biotechnology sector.

"In both the informal and formal case, the marginal cost of transmitting new economic knowledge, particularly tacit knowledge, across geographic space is non-trivial. This means, as the studies by Audretsch and Feldman (1996) and Adam B. Jaffe et al (1993) imply that geographic proximity matters when knowledge spillovers are informal. But an important conclusion is that when knowledge is transmitted through formal ties between researchers and firms, geographic proximity is not necessary, since face to face contact does not occur by chance but instead is carefully planned" (Audretsch D.B. and Stephan P.E., 1996 Pg 651).

Regional economic integration in Africa should embody the building and accumulation of capacities to harness and govern modern biotechnology. Regional economic integration bodies are key institutional vehicles for mobilizing, sharing and using existing scientific and technological capacities, including human and financial resources as well as physical infrastructure for biotechnology R&D and innovation. The loci of action are primarily local innovation areas which have core research and business institutions. International partnerships in biotechnology are critical to the realization of Africa's biotechnology strategies and should be pursued aggressively.

The main recommendations include the need for individual countries in central, eastern, western, northern and southern Africa to work together at the regional level to scale up the development of biotechnology. A key vehicle is through "Regional Innovation Communities"

and “Local Innovation Areas”. These would include clusters of expertise, sharing knowledge, creative ideas, personnel, and working on problems and projects collaboratively. Regional Innovation Communities might include institutions that are already situated close together, such as universities, science-based industry and science parks. But today, institutions do not need to be in close proximity to work together (Louet, 2006).

For South Africa it would be advantageous to facilitate an environment where there was a transfer of skills from foreign to local workers, but even if this did not happen, the productivity gains associated with the employ of foreign skilled workers would help raise the competitiveness of SA firms (Daniels, 2007).

Furthermore, Gold says that the Ernst & Young Report has found that the local biotechnology sector tends to work within silos; “Some respondents feel there needs to be more collaboration between different scientific disciplines, and with other industries. For example, in the biofuels sector, there is an apparent synergy between the agriculture and energy disciplines,” he notes. Support agencies are helping to bridge these gaps by creating forums for people of different disciplines to network and discuss opportunities (Kolia,2006). Examples of some of these support initiatives are BioSA, AfricaBio and Bio2Biz, to name but a few.

7 Conclusion

The biotechnology industry faces several challenges. A range of solutions, involving education, government, business, parents and students—working together to build a first-rate workforce, will be required.

Education and skills are critical to economic development. Without an educated and skilled workforce, efforts to attract new industry will be hampered. In addition, threat of the brain drain is ever present as well as SMMEs going out of business because they do not have the resources to recruit, train and keep skilled workers.

Employers value work experience and employability skills. Job applicants with prior work experience are more likely to have developed the right attitude, soft skills and behaviours that employers say they want to see in people applying for their entry-level jobs.

Employers should take leadership in creating viable business-education partnerships organized to improve employment-readiness of graduates and have agreed upon benchmarks for accountability. As a minimum, partnerships should have employers assist in developing work-relevant curriculums. They should contribute to the design and establishment of programmes at tertiary level to correspond with the needs in the sector and increase the use of student internships with industry. Validation of any new curricula to certify that it meets immediate and anticipated needs should also be done. In addition, educators and industry periodically should jointly review and update existing curriculum content as well (Berry, 2006).

The acknowledgement that South Africa has pervasive skills shortages implies that closed-economy solutions to the problem are necessary but not sufficient; firms must have the option to import scarce skills and to do so quickly and efficiently.

For South Africa it would be advantageous to facilitate an environment where there was a

transfer of skills from foreign to local workers, but even if this did not happen, the productivity gains associated with the employ of foreign skilled workers would help raise the competitiveness of SA firms (Daniels, 2007).

For foreign entrepreneurs setting up companies in South Africa, the bureaucracy of the South African administration can also be a significant impediment. Meanwhile, currency fluctuation and 'exchange control'—designed to counter currency speculation and prevent money from leaving the country—are hurdles for companies considering entering the export market.

On a positive note, South Africa is an attractive destination for some overseas investors as jurisdiction for patents are concentrated more in China, Singapore and India.

Another recommendation from the survey results is to establish an incubator at the various BRICs to include facilities for "wet lab" activities. Free of charge placement of equipment by suppliers to the industry could be used as training and marketing opportunities. In return for participation in the incubator, staff from firms could commit to help teach students and offer student internships and mentoring as part of their compensation for use of the incubator.

Glover, Hershey and King (2005) advise that workforce preparation is only one component of a broader strategy needed to promote the development of the bioscience industry cluster. Also necessary are efforts to improve the process for commercializing innovations (especially from university researchers), to attract venture capital for early-stage financing, and to provide an effective incubator/accelerator infrastructure that fosters the development of start-up firms. The process of developing new biopharmaceutical products is uncertain, time consuming, and expensive. Development of a new drug typically takes

between five and twelve years. Given the lengthy period required for product development and approval, "patient" venture capital is especially important in this industry.

Bioscience in Virginia (2008) go on to say that bioscience investors are searching for a low-cost business climate that provides efficiency in laws, regulations, tax structure and policies, enabling them to save time and money. Wage and payroll costs that are below the global average are also important criteria.

On average, Ernst & Young estimates biotech companies get $300,000 at seed stage in South Africa, compared with $1 million in Europe and ~$2 million in the US. South African firms raising $1.4 million/$2.5 million compared with $5 million/$15 million in Europe and $10 million/$20 million in the US, respectively. As yet, Africa is not on the map of US VC funds with a foreign mandate, which predominantly focus on Brazil, India, Russia or China. Meanwhile, non-specialist South African VC funds, when interested, tend to ask for an unattractive 80% ownership of enterprises (Louet, 2006).

Food security, nutrition, healthcare and environmental sustainability are among Africa's biggest challenges.

Cooperation and collaboration is vital to progress in science and innovation. Indeed, Regional Innovation Communities and Local Innovation Areas will need to develop strong links with international partners (Juma and Serogeldin, 2007).

It is also important to continue to develop a bioscience network to increase the visibility of the industry and to communicate industry needs to education and training providers. (Glover *et al,*2005).

McCarthy *et al (*2007) advise that firms do have a choice in whether or not they choose to recognise and exploit networks. However, failure to do so may reduce a firm's competitive advantage and unknowingly strengthen its rivals.

South Africa needs to: develop and expand national and regional human resources development strategies that include: (1) a biotechnology curriculum that focuses on specific areas and targets that offer high economic potential; (2) a consortium of clearly identified and designated universities and research centres that develop and offer regional biotechnology training courses for South Africa and the African continent; (3) a focus on female education, training and recruitment in the sciences.

Future research could investigate how relationships between firms, customers and suppliers impact on each other.

From the skills perspective, companies could be asked to identify particular skills constraints and then quantify the expected productivity losses associated with the respective shortages.

In the end, solving the skills crisis is not the responsibility of a single institution but the responsibility of all, which include schools, government, business and even parents and students themselves. The success of the general education system must be stressed if the skills shortages are to be alleviated in the medium- to long-term.

The United Nations Conference on Environment and Development held in Rio de Janeiro, stated that biotechnology: "Promises to make a significant contribution in enabling the development of, for example, better health care, enhanced food security through sustainable agricultural practices, improved supplies of potable water, more efficient

industrial development processes for transforming raw materials, support for sustainable methods of aforestation and reforestation, and detoxification of hazardous wastes."

In conclusion, discoveries in biotechnology can significantly enhance our quality of life in many areas, from the food we eat, to the medicines we use, to the environment in which we live. This important research enables the development of new medicines and foods to improve the lives of people around the globe (Bioscience in Virginia).

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9 Appendices

9.1 Appendix 1 – Questionnaire – Skills Survey

INTRODUCTION

The accredited Biotechnology academic programme was officially launched at the Cape Peninsula University of Technology in 2006.

The introduction of a biotechnology academic programme is congruent with the vision of CPUT to be at the heart of technology education and innovation in Africa as Biotechnology is considered the technology for the new global bio-economy.

At the first Advisory committee meeting of the Biotechnology programme (2007) it was recommended that an industry needs analysis questionnaire on a national basis be devised to determine how to drive curriculum development of the programme and provide industry with information of the In-service training.

The process of identifying the skills needs in biotech sector is being driven by Cape Biotech Trust, an instrument of the Department of Science and Technology, and is supported by BioSA, the collaborative network and independent voice representing biotech SMME's that is committed to the growth of the biotech sector in the global market.

Your co-operation with the completion of the survey will thus be greatly appreciated as the information obtained will aid in the continued training of highly qualified people, with comprehensive competencies, catering to the rapidly expanding biotechnology industry.

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Please provide the following information about you (as respondent) and your company.

RESPONDENT DETAILS		
Name of person completing the form		← data entry
Position within the organization		
E-mail		
Telephone number		
Fax number		

COMPANY INFORMATION		
Name of Company/Organization		← data entry
Physical address		
Postal address		
Website address		

TECHNOLOGY INFORMATION			
1st /2nd /3rd generation biotechnology [1st generation technology is……etc.]			
1st generation biotechnology (1st generation biotechnology involves the use of wild type or natural biological organisms to produce a product, for example, the use of yeast to make beer or wine)		☐	← check-boxes
2nd generation biotechnology (2nd generation biotechnology refers to the production of specific products using a pure cell or tissue culture of organisms that have been specifically selected, through random cross-breeding or similar techniques, for their superior production or expression abilities without introducing foreign DNA.)		☐	
3rd generation biotechnology (3rd generation biotechnology involves manipulation of the genetic make-up of organisms, by introducing selected foreign (across the species barrier) DNA, through recombinant DNA technology, to make them produce small molecules, compounds or proteins.)		☐	
Support services (Support services for biotechnology include those activities that do not directly make use of biotechnology activities but provide essential support to those groups that do, e.g. legal services, business and financial support, equipment or reagent supplies, etc.)			← check-boxes
Do you consider biotechnology central to your firm's activities or status?	Yes ☐	No ☐	
Do you support, or undertake, any research activities?	Yes ☐	No ☐	

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Information is required on the techniques, technologies, specialist skills and innovation/entrepreneurship skills you currently use or have, and those which you anticipate you will need.

	TECHNIQUES	↓ check-boxes			
	Which of the following *techniques and equipment* does your organization utilize, and is likely to utilize in the future?	Skills of employed staff		Equipment	
		Presently utilize	Will utilize in 3-6 years	Presently utilize	Will utilize in 3-6 years
	Fermentation technology	☐	☐	☐	☐
	Flow Cytometry	☐	☐	☐	☐
	Epifluoresence Microscopy	☐	☐	☐	☐
	Confocal Laser Scanning Microscopy	☐	☐	☐	☐
	Gas Chromatography	☐	☐	☐	☐
	HPLC	☐	☐	☐	☐
	Plant Tissue culture	☐	☐	☐	☐
	Mutagenesis	☐	☐	☐	☐
	Molecular biology techniques (PCR, blots, cloning)	☐	☐	☐	☐
	Genomics (DNA Sequencing)	☐	☐	☐	☐
	FTIR	☐	☐	☐	☐
	MALDI TOF	☐	☐	☐	☐
	Proteomics (2D gels, protein isolation)	☐	☐	☐	☐
	Transcriptomics (microarrays)	☐	☐	☐	☐
	Metabolomics	☐	☐	☐	☐
	Other: (provide details)				
→ data entry		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐

	TECHNOLOGIES	↓ check-boxes	
	Indicate which *technologies* are important now, and which will become important in the next 3-6 years	Important in your organization today	Will become important in next 3-6 yrs
	DNA/RNA, cloning, PCR, genetic engineering: skills linked to manipulation thereof	☐	☐
	Proteins and molecules-the functional blocks: skills linked to manipulation thereof	☐	☐
	Mammalian cell and tissue culture and engineering thereof	☐	☐
	Plant cell and tissue culture and engineering thereof	☐	☐
	Process biotechnology: fermentation, bioprocesssing, bioremediation, biofiltrations	☐	☐
	Sub cellular organisms: gene therapy, viral vectors	☐	☐
	Bioinformatics	☐	☐
	Nano-biotechnology	☐	☐
	Environmental biotechnology: Sanitation, safety and hygiene	☐	☐
	Other: (provide details)		
→ data entry		☐	☐
		☐	☐
		☐	☐
		☐	☐

	SPECIALIST SKILLS	↓ check-boxes	
	Indicate which *specialist skills* are important now, and which will become important and require further training.	Important in your organization today	Require further training in this area
	ISO accreditations	☐	☐
	HACCP	☐	☐
	SABS approval	☐	☐
	CE Mark	☐	☐
	Clinical trials	☐	☐
	IP, contracts management and law	☐	☐
	Other: Provide detail		
→ data entry		☐	☐
		☐	☐
		☐	☐

	INNOVATION & ENTREPRENEURSHIP SKILLS	↓ check-boxes	
	Indicate which *innovation/entrepreneurship skills* are important now, and which will become important and require further training.	Important in your organization today	Require further training in this area
	Finance	☐	☐
	Sales, Marketing, Communication	☐	☐
	Entrepreneurship	☐	☐
	Business Management	☐	☐
	Strategy	☐	☐
	HR	☐	☐
	Legal	☐	☐
	Project Management	☐	☐
	Other: Provide detail		
→ data entry		☐	☐
		☐	☐
		☐	☐

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For each of the different areas listed below, please indicate the area of specialization of the staff you have.

↓ check boxes		↓ data entry	↓ data entry	↓ data entry	↓ data entry
R&D STAFF					
Qualification		**Number of staff**	**Specialisation**	**Specialisation**	**Specialisation**
None	☐				
Matric	☐				
Degree	☐				
Diploma	☐				
Postgrad	☐				

TECHNICAL SUPPORT STAFF					
Qualification		**Number of staff**	**Specialisation**	**Specialisation**	**Specialisation**
None	☐				
Matric	☐				
Degree	☐				
Diploma	☐				
Postgrad	☐				

REGULATORY & CLINICAL AFFAIRS STAFF					
Qualification		**Number of staff**	**Specialisation**	**Specialisation**	**Specialisation**
None	☐				
Matric	☐				
Degree	☐				
Diploma	☐				
Postgrad	☐				

☐

MANAGEMENT					
Qualification		**Number of staff**	**Specialisation**	**Specialisation**	**Specialisation**
None	☐				
Matric	☐				
Degree	☐				
Diploma	☐				
Postgrad	☐				

OTHER STAFF MEMBERS					
Qualification		**Number of staff**	**Specialisation**	**Specialisation**	**Specialisation**
Matric	☐				
Degree	☐				
Diploma	☐				
Postgrad	☐				

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For planned new appointments, please fill in the following.

NEW APPOINTMENTS BEING PLANNED

What position is to be filled	Desired qualifi-cation	Preferred Institution/s	What skills sought specifically
↑ data entry	↑ pull-down menu	↑ pull-down menu	↑ data entry

Do you differentiate between a degree and a diploma qualification?		
Yes	☐	← check-box
No	☐	
Please explain?		

What value do you perceive the Diploma qualification to have?

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Please indicate whether or not you are prepared to host an intern for Work-Integrated Learning.

Would your company be willing to offer a nine (9) month work-integrated learning to a biotechnology student of CPUT?

WORK-INTEGRATED LEARNING	↓ check-box
Yes (9 months)	☐
No	☐

What monthly stipend (TRAVEL & LIVING) will you / your organization be prepared to offer the student involved with in-service training?

WORK-INTEGRATED LEARNING	↓ check-box
R 3,000	☐
R 3,500	☐
R 4,000	☐

specialisation	staffnumber	GEN	qualification	Institutions
analytical chemistry	1	1ST	degree	Traditional University preferred
bacteriology	2	2ND	diploma	University of Technology preferred
biochemistry	3	3RD	any post-grad	UCT
bioinformatics	4			SU
biology	5			PU
biomedical engineering	6			CUT
chemical engineering	7			UWC
chemistry	8			WITS
civil engineering	9			TUT
food science	10			NMU
genetics				RU
mathematics				KZNU
mechanical engineering				UFN
molecular biology				
soil science				
statistics				
virology				
zoology				
medical biosciences				
biotechnology				

Source: V. Ramburan

9.2 Appendix 2 – Questionnaire – Social Networking in Organisations

SOCIAL NETWORKS IN ORGANISATIONS

Dear Reader,

Thank you for taking the time to complete this brief questionnaire. We really appreciate it. We have set out some information below to assist you in completing the survey.

Confidentiality
We assure you that the information contained herein will only be utilised for research purposes. We do not require names and therefore your anonymity is ensured.

Purpose of the research
We are interested in gauging the informal network activity of individuals in South African organisations.
By that we are referring to the relationships people have with others in their work environment to gain access to information, enhance their career prospects and meet their social needs among other things. These people may or may not form part of the official hierarchy in the organisation. In other words you may interact with your boss because of other reasons than work as well, or you might enjoy discussing your personal life with a colleague over a cup of tea. You may not use all the contacts for the same reasons.

We are interested in the social networks you currently have in your organisation.

The format of the questionnaire is as follows:

Section A - Your demographic details
Section B - Other information
Section C - Your most important contacts

To answer the questions, kindly change font colour to red and save as your organisation name before returning.
Thanking you again for your participation.

Regards

Sabine Hellyer

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SECTION A **DEMOGRAPHIC DETAILS**

Please tell us a bit about yourself.
Fill in OR circle the correct answer.

1/ age

2/ gender: male | female

3/ company name

4/ highest level of education:
- less than matric
- matric
- tertiary qualification
- post graduate

5/ race:
- black
- coloured
- Indian
- white

6/ nature of employment:
- full time
- part time

7/ years with current employer

SECTION B **OTHER INFORMATION**

Please tell us a bit about your networking habits.
Please fill in OR circle the appropriate answer.

1/ do you intentionally target people that you want to build relationships with?

yes | no | sometimes

2/ for professional contacts, would you rather network inside or outside the organisation?
(indicate your preference on the scale below)

1	2	3	4

only outside — only inside

Please tell us a bit about your work environment.
If you work in a big company, please focus on your immediate department.
If you work in a small company, consider the whole company.

Diversity of workforce

3/ Please estimate the percentage of people in your company falling in the following categories:

% females	
% white people	
% people over 40	

4/ does your company actively facilitate the formation of networks?

1	2	3	4

active facilitation — no facilitation at all

5/ do you feel excluded from social networks at work because of your
(you can circle more than one answer here)

- age
- gender
- race
- personality
- skill level
- experience
- I do not feel excluded
- other (please specify)

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SECTION C NETWORK CHARACTERISTICS

We now would like you to provide details of your 5 most important relationships in your company, i.e. the people you most commonly interact with within your organisation. We have given an example of what the answers may look like.

We suggest that you complete one person before moving on to the next.

Please complete all 5 columns.

Please circle OR fill in the appropriate answer.

			Example	1	2	3	4	5
	Initials of person being described		AB					
a	gender of the person	f - female m - male	(f) m	f m	f m	f m	f m	f m
b	race group of the person	b - black (include coloured and Indian) w - white	(b) w	b w	b w	b w	b w	b w
c	approximate age of the person (estimate of age)		35					
d	approximate education level of person	A - lower than yours B - similar to yours C - higher than yours	A B (C)	A B C	A B C	A B C	A B C	A B C
e	similarity of this person's skill set to yours?	A - more or less the same as yours B - some overlapping areas with yours C - not similar to yours at all	A (B) C	A B C	A B C	A B C	A B C	A B C
f	how often do you interact with this person?	A - once a day B - a few times a week C - a few times a month D - a few times a year	A B C (D)	A B C D	A B C D	A B C D	A B C D	A B C D
g	what is your main medium of interaction with this person? if you have more than one - please rank using the most important one on top	A - unplanned face-to-face meetings B - planned face-to-face meetings C - telephone D - e-mail E - instant messaging	C E A					
h	please mark your style of interaction (most frequent on top)	A - informal discussion during working hours B - informal discussion after working hours C - formal discussion during working hours D - formal discussion after working hours	D C B A					
i	is your engagement with this person planned?	A - never B - sometimes C - always	A B (C)	A B C	A B C	A B C	A B C	A B C

	NETWORK CHARACTERISTICS (Continued)	Example	1	2	3	4	5
j	what are your main reasons for networking with this person? ***tick appropriate reasons***						
	career advancement						
	technical advice	√					
	friendship and support						
	mentorship						
	coalition building	√					
	to gain social acceptance						
	sound boarding ideas	√					
	improving job security						
	to gain access to outside networks	√					
	if you network for other reasons not mentioned above please indicate the reasons below						

k	what is your proximity to this person ?	A - works within 10 metres of you B - same floor C - different floor D - different building E - different city F - different country	A B C D E (F)	A B C D E F	A B C D E F	A B C D E F	A B C D E F	A B C D E F
l	what is the position of this person in the organisation?	A - higher than yours B - equal to yours C - lower than yours D - not applicable E - do not know	A (B) C D E	A B C D E	A B C D E	A B C D E	A B C D E	A B C D E
m	is the person in the same type of function as you? (secretary, management etc)	y - yes n - no	n					
n	is the person in the same department as you? (marketing, accounting etc)	y - yes n - no	y					
o	how long have you known this person? please state number of years		3					
p	which one of these 5 relationships is the most important to you? ***(please tick the appropriate one within the double lines)***		√					
q	why is he/she the most important? (please use the block provided to explain)							

THANK YOU FOR YOUR PARTICIPATION!

Source: S. Zaaiman

9.3 Appendix 3 – Interviewee Database

Respondent #	Description of Organisation
1	SMME
2	SMME
3	Agency
4	SMME
5	Government Institute
6	SMME
7	SMME
8	SMME
9	SMME
10	SMME
11	SMME
12	SMME
13	SMME
14	SMME
15	Government Institute
16	SMME
17	SMME
18	SMME
19	SMME
20	SMME/Government Institute
21	Government Institute
22	University 1
23	University 2
24	University 3
25	University 4
26	University 5
27	Government Institute
28	SMME

9.4 Appendix 4 – Social Networking in Organisations - Summary

RESPONDENT	1					2					3					4		5					6					7					8		
GENDER	m	m	f	f	f	m	f	f	m	f	f	f	f	m	m	m	m	f	f	m	m	m	m	f	m	m	f	f	f	m	m	m	m	m	m
RACE	w	w	w	w	b	b	w	b	b	b	w	w	w	b	b	w	w	w	w	w	b	w	w	w	b	w	b	w	b	w	b	b	w	w	b
AGE	41	43	35	42	42	35	41	33	36	30	30	40	25	25	25	37	34	43	40	33	30	28	40	27	23	40	23	50	39	39	37	23	40	35	35
EDUCATION	LOWER	LOWER	LOWER	LOWER	LOWER	LOWER	LOWER	LOWER	LOWER	LOWER	SIMILAR	SIMILAR	LOWER	LOWER	LOWER	SIMILAR	SIMILAR	HIGHER	HIGHER	HIGHER	SIMILAR	SIMILAR	HIGHER	LOWER	LOWER	LOWER	LOWER	HIGHER	HIGHER	LOWER	LOWER	LOWER	SIMILAR	SIMILAR	SIMILAR
Highest SKILL	3	1	1	1	1	2	3	3	2	3	1	1	2.5	2.5	2.5	2	3	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2
INTERACT	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	1	2	3	3	4	1	1	1	1	1	1	1	1
MEDIUM	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	1	2	1	1	1	2	4	3	4	1	1	1	3	5	1	1	1	1
	4	4	4	4	4								2	2	2	1	2	3	1	3	2	2	4	1	2	2	2	4	3	4	3	4	4	4	2
																3	5	4	3	2	3	3	3	2	4	1	4	2	4	5	4	3			5
																4		2	4	4	4	4	1			3									
STYLE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	1	1	1	1	1	1	1
	3	3	3	3	3											3	2	3	3	3	3	3	1	1	4	4	4	3	2	2	2	3			
																2		2	2	2	2	2	2	4				2	3	3	3				
																4		4	4	4	4	4	4	2											
ENGAGEMENT	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	1	1	1	1	1	1	2	2	2
																												2	2	2	2	2			
																												3	3	3	3	3			
REASONS	10	10	10	10	10	2	3	1	1	1	1	1	1	1	1	2	3	3	2	2	2	2	3	3	5	5	5	2	1	2	2	4			
						3	4	3	2	3	2	2	2	2	2	3	5	4	3	3	3	3	5	5	7			3	2	3	3				
						4	7	4	3	4	4	4	4	4	4	5		7	5	5	5	4	7	10	10			4	4	4	4				
						7		7	4	7	5	5	5	5	5	7		9	7	7	7	5	10					7	5	7	5				
									7	9	7	7	7	7	7				9			7							7		7				
									9		10	10	10	10	10							9							8		9				
																													9						
PROXIMITY	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	6	4	4	4	4	4	1	3	3	3	3	1	4	1	1	1			
POSITION	1	3	3	3	3	1	2	2			3	3	3	3	3	2	2	3	4	4	4	4	1	3	3	3	3	3	1	3	3	3	2		
FUNCTION	N	N	N	N	N	n	y	y			n	n	n	n	n	n	n	n	n	n	n	n	y	n	n	n	n	y	y	n	n	n	n		
DEPARTMENT	N	Y	Y	Y	Y	n	y	n			y	y	y	y	y	y	y	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
TIME	6	4	4	3	3	3	2	1			9	5	2	3	3	6	20	9	4	3	2	2	9	4	4	3	3	2	2	3	8	1	3		
IMPORTANCE	1LL	ALL	ALL	ALL	ALL	x					x					x	X	x		x			x						x				x		