Venture capital for biotechnology entrepreneurship in South-Africa

A research report submitted by

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Abstract

Biotechnology, especially in terms of the third generation applications found in medicine and genetic modification, is expected to be a significant contributor to national economies globally, with both the developed and developing world seeking solutions to properly create and support their own industries. The primary method found is the establishment of entrepreneurial enterprises with the support of local funding sources such as Venture Capitalists and government policies. This study explores the current environment of the biotechnology sector in South Africa with regard to Venture Capitalists and the potential mechanisms found that assist business survival from start-up to maturity. In-depth semi-structured interviews involving entrepreneurs, venture capitalists, representatives of grant giving organisations and academics were used to generate views of the current state of the South African sector. The main findings derived from content analysis were that South Africa's current ability to support Biotechnology entrepreneurs has been impacted by lack of available funding and confidence in the various mechanisms currently in place. This was found to be due to inconsistent policies and mismanagement at various levels of funding and support. In addition, South African venture capitalists currently lacked the knowledge and skills to properly understand the needs of the biotechnology business, with potential entrepreneurs lacking sufficient skills and knowledge to properly approach and develop their business ventures. This was especially the case in regards to the development and investment times required in the sector. The skills in the economic and academic sectors are sound, however cross-disciplinary individuals, with skills in business and science, are lacking who are capable of generating viable products for the market from research generated from South Africa's biotechnology academic strengths. However, there is constant improvement, with many respondents hopeful of the sector's future.

Declaration

I, Jason Johnstone-Robertson, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfillment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Signed at ……

On the …….. day of …… 20…..

Dedication and Thanks

To Ana-Maria Robertson, your support, life lessons and foresight will always be greatly appreciated and loved, despite my headstrong nature at times.

To Antony Soicher, my supervisor: your guidance and knowledge in understanding how to approach the world of Venture Capital and the High tech. industries for my research has forever changed my views on the business world, of which I thank you.

Finally, my thanks to Karen Eksteen and Heather Sherwin, your expertise, insights and networks proved beyond invaluable.

“One thing is obvious, for the first time in history we have a chance to steal fire from the gods. To turn away from it now - to stop pursing a future in which technology and biology combine leading to the promise of a singularity - would mean to deny the very essence of who we are. No doubt the road to get there will be bumpy, hurting some people along the way. But won't achieving the dream be worth it?”

Mary Demarle

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Chapter 1: Introduction

1.1 Purpose of study

Medical third generation biotechnology, within the fields of economic empowerment and business, is still relatively underdeveloped within South Africa. This is of particular concern within the entrepreneurship sphere, because it forms a distinct field within knowledge based business sectors. However, it stands at the forefront of human development and is potentially primed to provide the greatest impact on humanity, greater than any other field of research to date. Hence, the development of such an industry, both by entrepreneurs and established business, is of significant economic value to nations. However, such entrepreneurial endeavours require significant financial backing from venture capitalists and professional support from various sectors ranging from the academic, industrial and government in order to prosper. In addition, due to potential controversies and risks found in biotechnology, the impact of modified behaviors and views in regards to local biotechnology and its impact on capital support for these ventures need to be understood. As such, the purpose of this study is to holistically understand the possible affecters, enabling and detrimental, that impact medical biotechnology entrepreneurs seeking venture capital for their start-ups within the South African context, both in application and sentiment.

1.2 Context of the study

For the context of the study, the form of biotechnology being focused on is considered third generation, the “high-tech” iteration of its development. This means that third generation enterprises focus on molecular and genetic interactions of organisms with the intention of producing a product or service. Such products include implants and genetic therapies that address hereditary disorders. Further details are discussed below and in the literature. The following provides more understanding in the field in which the study occurs.

Biotechnology (Biotech) is a field of technology that merges the biological sciences with the engineering discipline by focusing on the development, manipulation and application of organic structures and systems (Coriat, Orsi, & Weinstein, 2003). As such, it forms

an area of technological innovation with applications in the industrial, agricultural, medical and general consumer markets, via the use of living organisms, including humanity (Mitchell, 2007).

For the context of the study, third generation biotechnology is considered the high-end form of biotech, with a focus on genetic therapy and advanced implants.

Some truly incredible innovations in the past 50 years have come from medical biotechnology, ranging from antibiotics, pharmaceuticals (Ahn & Meeks, 2008), and food security, with the creation of pest resistant food crops (Coriat, Orsi, & Weinstein, 2003) serving as notable examples. Biotechnology however, has grown to include more "visible" manipulations, such as attempts to overcome disability via the use of prosthetics and implanted technology, which include pacemakers and neural devices designed to combat Parkinson's disease (Mitchell, 2007).

Biotechnology is seen as a controversial science with some accepting the new developments while others treating new advances with scepticism, with yet others wishing to ban their use and research (Lazonick & Tulum, 2011).

The most common controversies found in the news relating to biotech typically involve Genetically Modified Organisms (GMO) and foods, as well as the use of stem cells in the treatment of certain diseases (Mitchell, 2007). It could be argued that most controversy occurs whenever a technology attempts to enhance an existing system rather than fix a broken one (Coriat, Orsi, & Weinstein, 2003). Common examples that most individuals have come across include advances in various cosmetic procedures, athletic enhancers and mood and memory enhancing drugs (Mitchell, 2007). Unfortunately, as with any technology, the risk of abuse will always be present, however in regards to biotech, the abuse can fundamentally change what you *physically* are (McNamee & Ledley, 2012).

Whatever the controversies, the basic tenets of biotechnology have been practiced for thousands of years, such as the selective breeding and domestication of animals and plants, with barley and cows being notable examples (Coriat, Orsi, & Weinstein, 2003).

Only in the last few decades of the 19th century, particularly the 1970's and 1980's, has biotech boomed as a viable industry (Coriat, Orsi, & Weinstein, 2003).

According to Lazonick and Tulum (2011), even though it has had numerous decades to develop, biotech is still considered an emerging market. This is due to the particularly long development cycles of roughly 10-20 years for products, before they could be marketable to the public. This development cycle is similar to those found in the pharmaceutical industries where development typically takes the route of: discovery of a molecular mechanism/ biological action followed by a decade of testing and refinement and finally, release to the public. Taking into consideration the life scales of various intellectual property and patent laws, a number of technologies only have a few years to return profits for the company, assuming they pass trials in the first place. Having said that, though, the development times are shortening due to innovative screening techniques and sample multiplication methods (Zawada, et al., 2011).

Despite this neoteny and excessive development times, governments around the world have considered biotech of such importance, that it is capable of affecting their economic competiveness on the global stage (Catherine, Corolleur, Carrere, & Mangematin, 2004). A nation that develops a revolutionary new technology that the world at large would rely on, would garner a massive boost to their global power (Powell, Koput, Bowie, & Smith-Doerr, 2002).

As such, there have a number of drives to develop such markets from multiple sources, with particular attention to entrepreneurship proliferation (Naidoo, 2009). However, biotech is still a relatively untapped market for startups (Lazonick & Tulum, 2011). This is due to its research driven nature, requiring specialist human capital and a support network consisting of a variety of institutions, both academic and private, in order to properly address social challenges and needs while fostering healthy technology and knowledge transfers (Meyers, 2012).

Due to these concerns, both individuals and investment organisations may shy away from such companies, considering that a typical start-up, one without intensive research like a biotechnology orientated firm, may take up to five years to see returns on

investment, unlike the potential decade long developments in medical research (Andersen & Kaspers, 2012). This long term financial investment is typically longer than many private investors would consider. In addition, this does not take into consideration the potential controversies discussed.

Despite this, as discussed by Baum and Silverman (2004), Venture Capitalists (VC) and firms are still considered the predominant source of not only financial aid to SMMEs and startups, but also impact the performance of the startup in multiple ways. VC's can be considered scouts for promising ventures via their use of "pre-investment" techniques of viability, allowing the selection of excellent ventures (Baum & Silverman, 2004). Alternatively, they may act as coaches, providing expertise and business judgement when applicable (Baum & Silverman, 2004).

However, in order to garner suitable attention from VC's and other funding groups, the entrepreneur needs a solid business plan, that is not only marketing the potential venture but also targeting the potential backer being approached. This is considered a counter measure against potential insolvency over the long term and is highly attractive to investors (Tannenbaum, 2000; Taylor, 2001).

However, while the business proposal helps, investors have a great deal of personal preferences in how they back potential candidates. These may include funding of a minimum or maximum amount for a given period; industrial preferences and exclusions; stage of development; and potential equity gained in the venture (Millson, 2005)

Finally, the context of the study needs to consider the impact that governmental policy and current economic process has on the decision making on potential VC's, especially with a relative unknown such as biotechnology, over long periods of time. In short, this study seeks to understand these situations that a South African biotech entrepreneur may come across when seeking capital, and provide insight to investors seeking to back such ventures by addressing the sectors particular nuances.

By understanding the decision processes and methods of interaction employed by VC's, one may identify the characteristics that would allow a biotechnology firm to be successfully backed and increase long term performance.

1.3 Problem Statement

To investigate and conceptualise the business sector that potential biotechnology entrepreneurs focusing on third generation applications, particularly within the fields of genetic therapies and implants, may face and determine possible shortfalls found in regards to capital generation from venture capitalists and support structures from public organisations in terms of monetary and legislative assistance. This investigation will focus on possible detriments faced by such a startup, exploring the relationships, issues and behaviours of VC's and public programmes, whether they are derived from social, business or legislative sources. This study is concerned with the above investigation in the context of South Africa's economic growth, with the intent of strengthening South Africa's global biotechnological position.

1.4 Significance of the study

Entrepreneurial research has been investigated extensively on the global stage, however developing nations, such as South Africa, are relative newcomers to international biotech and its markets are considered virgin territory (Cloete, Nel, & Theron, 2006). As such, there may be opportunities present that venture capitalists and entrepreneurs may act upon in order to facilitate long term startup viability.

However, there may be shortfalls in acquiring capital and preventing investment growth within South African biotech sectors. This is despite the South African Government aligning itself in such a way, that the nation may benefit from the emerging bio-economy (Arundel, 2009). Such ventures may need additional support or specialist knowledge in order for investors to gain a return on their investments.

This study seeks to provide possible understanding to the issues faced by entrepreneurs, venture capitalists and researchers, with the intention to provide suggestions and a possible recommendations to ensure the success of biotech SMME's and startups. Such insight may prove useful to those seeking to create start-up businesses, venture capitalists and potentially pre-existing medical/biotechnology firms seeking to branch out into new market sectors.

Such issues may include:

- Access to investors and capital able and willing to invest into the market (Baum & Silverman, 2004)
- There seems to significant interest in Africa from international firms and innovation incubators, however there is a perception that there is a lack of an entrepreneurial culture among researchers due to a variety of factors, as discussed in the literature review. (Cloete, Nel, & Theron, 2006).
- Patent fees and Intellectual property laws serve as a barrier to those that seek to bring foreign patents into the country (Cloete, Nel, & Theron, 2006).
- In addition, there is a view that developing nations are incapable of high-level research which impacts international funding and investment opportunity (Burton & Cowan, 2002).

1.5 Delimitations of the study

The type of biotech firms to be focused on, is those conducting third generation, medical grade products and bio-pharmaceutical development focused on genetic therapy and implants. This omits firms and ventures focusing on agricultural applications, due to the already extensive ground work and support mechanisms that exist for these sectors in the South African market and may be difficult for entrepreneurs and start-ups to enter due to cost-of-entry and insufficient foundation support.

This study focused on two aspects facing biotech entrepreneurs, capital generation and support. This is due to potential significant capital and time investments required.

- The focus on the capital generation was to understand investment behaviours and concerns of venture capitalists with regard to medical grade products and services generated by third generation biotechnology firms within the South African business environment.
- The focus on support was to understand potential opportunities and risks within government and academic institutions such as the Technology Incubation Agency (TIA) and university based incubation programmes.

The dominant sources of information was gathered from venture capitalists, founders or owners of medical biotech companies, as well as government and academic representatives in order to understand the sector as a whole.

The responses garnered from interviewees were treated as truthful, as developed from personal experiences.

This study was delimited to exploring the problem from the perspective of those who have previous experience and interest in biotechnology, and may not have been representative of the financial or general population at large.

This study sought to understand potential affecters impacting biotech startups however no hypothesis was specifically made regarding the inter-relationships that may exist among processes or performance measures utilised by the various respondents.

Information was gathered qualitatively via in-depth interviews and analysed via cognitive mapping.

While Intellectual property (IP) laws were raised as a significant concern from multiple respondents, this study was not geared toward investigating the impact of such in detail.

This study included qualifying small enterprises in early to medium growth stages and excluded companies or corporations that are situated later in the business life cycle.

This study was delimited to the responses received from interviewees and no tests were conducted to verify if the respondent's expectations were in line with those of the finical community at large through statistical analysis.

Respondents were provided anonymity in order to provide frank assessments of their representative organisations, and may not be the official views of those organisations

1.6 Definition of terms and Abbreviations used

VC	Venture Capitalist
IP	Intellectual Property
IPO	Initial Public Offering
TIA	Technological Innovation Agency
SMME	Small, Medium and Micro-sized Enterprises; a term to describe predominantly private owned business.
SANSI	South-African National System of Innovation
HIV	Human Immunodeficiency virus
TB	Tuberculosis
GMO	Genetically Modified Organisms; whose genetic structure has been altered or manipulated to create a new effect.
Biotech.	Biotechnology
Biotechnology Generations	Levels of sophistication and types of techniques used to differentiate the various possible applications of biotechnology.
R&D	Research and Development

1.7 Assumptions

- Biotechnology is not found in common parlance, however individuals involved in the industry should be comfortable with the various methods and jargon involved.
- In order to get a balanced perspective, the sample of respondents include entrepreneurs, VC's, government and academic representatives.
    - Interviewees are South African or ingrained in South African society.
    - The sample groups are an accurate representation for the South African context.
- Interviewees responded with personal experiences and truths.
- Interviewees from an academic background (researchers) might have had a different view to biotechnology than those from financial/entrepreneurial background.
- Various applications of biotechnology have differing personal biases (such as biotech in medicine may be more acceptable, than biotech in modified organisms) resulting in variation in respondents.
- Due to the interviewee limiters in place, the backgrounds of the interviewees did not reflect the South African average in terms of economics and education.
- Number of potential interviewees was limited due to nature of the industry
- South Africa was assumed to be a good candidate for the developing world.

Chapter 2: Literature review

2.1 Introduction

The following review is based on literature that has a focus on academic works discussing technological entrepreneurship, investor selection criteria and the roles and impacts that government and legislation has on biotechnological business and the associated challenges that researchers and potential entrepreneurs have in order to acquire financial backing for their products in developing nations such as South Africa.

The first section defines biotechnology and the context and trends it has in business, both in the developing and the developed world. This includes an in-depth analysis of the economics and capital generation that funds biotechnology globally. This is to provide a basis, as a developing nation may suffer from inadequate funding structures. This includes an analysis of biotechnology within the Israeli and Indian context in order to provide possible comparisons for South Africa.

Second, a discussion regarding the financial backing behaviours, methods and instruments present on the African continent and their impact on potential backing from VC's is undertaken.

Finally, a discussion of the factors and criteria that influence investors and VC's regarding entrepreneurial selection, as well as any associated techniques that they may employ is considered.

By having an in-depth understanding of the business from the global, to African to individual scale, a better understanding of the concerns and possible scenarios that VC's encounter and find themselves facing when backing medical biotech entrepreneurs can be attained.

This is to provide a basis that develops the research propositions that the study utilises in order to provide a solid grounding for exploring both investor and entrepreneur expectations and experiences within the biotechnology space in South Africa.

2.2 Nature of Biotechnology and Global standing

2.2.1 Definition

Biotechnology was first coined as a term in 1919 by Karl Ereky, an agricultural economist based in Hungary, as an attempt to classify the manufacture of products that utilised living organisms (Fári & Kralovánszky, 2006), however, the use of living organisms has been utilised by humanity in manufacturing for millennia, through brewing, baking and cheese production (Godfray, et al., 2010).

Due to the nature of biotechnology, it can be found in a number of sectors with differing levels of application, ranging from the medical and pharmaceutical industries through to agriculture and environmental control (Mulder & Henschel, 2004).

As such, biotechnology can be classified in three different generations or categories, according to how it is applied, namely:

First Generation

The use of wild or naturally occurring organisms such as yeast, in brewing, baking and general fermentation of beer and bread, and as well as basic breeding techniques such as animal husbandry (Hornsey, 2003; Mulder & Henschel, 2004).

Second Generation

The creation of products using tissue and cell cultures, that have been purposely selected, either through cross-breeding or trait specialisation techniques, that allow the organisms to do a desired action more efficiently (Mulder & Henschel, 2004). Such actions may include the production of molecular or chemical compounds for cheaper mass production (Zawada, et al., 2011). It should be noted that no foreign genetic material is introduced to organisms in this generation (Zawada, et al., 2011).

Third generation

This is considered the “high tech” iteration of biotechnology, where advanced techniques allow the direct manipulation of an organism’s genes and also the introduction of foreign genetic material (DNA or RNA) into the organism; the latter can be done across the species barrier (Commandeur, 1996). These recombinant DNA techniques could allow organisms to produce organic compounds and proteins that the unaltered organism would not have been capable of (Mulder & Henschel, 2004).

The majority of biotechnology endeavour is found in the third generation in the modern age due to its high efficacy in developing desirable traits and easier manipulations (Mulder & Henschel, 2004).

2.2.2: Biotechnology global trends

In the past few years, policy makers, business and the public in general have shown an increased interest in biotechnology (Coriat, Orsi, & Weinstein, 2003). Politicians and business alike view it as a potential source of economic power; while the public has generally mixed feelings, but still regards it with awe (Meyers, 2012).

As biotechnological business falls under knowledge based sectors, similar to information technology and engineering biotech is being heralded by some to be the catalyst for the next technological revolution in industry (DiMasi & Grabowski, 2007). As such, it should play a significant role in the development of the technological capability and economic power of a nation, facilitating a flow of capital that would inspire many to create new start-up firms (Mitchell, 2007).

Due to this nature of the biotech industry, especially as new start-ups seek to compete with established companies, trends have developed in an attempt to overcome challenges unique to a scientific, knowledge based industry, particularly with regard to economics and the way business is conducted (Catherine, Corolleur, Carrere, & Mangematin, 2004).This has created an environment that would be conducive to the proliferation of biotechnology business, particularly in the self started entrepreneurial sector (Herrington, Kew, & Kew, 2010). As such, the following examines how biotechnology, as a business, is conducted globally.

Biotech's modern and historical economics within Europe and the Unitead States.

Biotech on the global stage is currently dominated by the United States of America (USA) and Europe; this can be shown economically by viewing the sector value before the 2007-2008 subprime financial crises (Eichengreen, 2010). Biotech in the USA was worth $70.1 billion, with R&D spending making up $30.4 billion (Lazonick & Tulum, 2011). The sector was made up of over 1400 companies, employing over a hundred thousand individuals in 2008 (Lazonick & Tulum, 2011).

In France, as an example for Europe, 62 notable SME's employed on average, 33 individuals and generated turnovers of about € 3.2 million as of 2004 (Catherine, Corolleur, Carrere, & Mangematin, 2004).

A particularly significant contributor to biotech's burgeoning market value is prolific government support. As mentioned, biotech has significant potential as a contributor to a nation's economic prowess; with the hope that a few key developments can have significant impact on the global stage (Coriat, Orsi, & Weinstein, 2003).

As an example of such government support, between 1978 and 2004 the USA's National Institute of Health spent $365 Billion in life sciences research (Lazonick & Tulum, 2011). Unlike traditional markets, where capital input and demand can fluctuate, these research grants have been increasing year on year steadily since the 1970's, with an average rate of increase of 12% per annum (Lazonick & Tulum, 2011). Without such support, it can be argued that the world at large would not have invested as heavily into the industry.

This domination by the developed world was spear headed by the USA due to an early realisation of the potential of the sector and due to the USA's already formidable research base (Reiss, 2001).

While Europe would provide funding with the intended focus of developing new technologies, similar to the USA, it tended to fall short due to insufficient information transfer to the economy at large (Zechendorf, 2004).

This positioning and growth of the sector was further supported by venture capitalists, established economic leaders and everyday stock market investors willing to risk capital (Catherine, Corolleur, Carrere, & Mangematin, 2004). It should be noted that many of these biotech firms were yet to produce an actual product and quite possibly due to legislature, failed avenues of research, or simply due to a lack of economic incentive, may never produce a product (Lazonick & Tulum, 2011).

Good science versus Good Business and IP concerns.

Financially, biotech seems to suffer from the same dilemma as most other science based industries, the drive for development for the 'common good' and good science versus the drive of monetary gains through development of actual products (Mitchell, 2007). Typically this concept is best defined as a force between research activity and

innovative activity, with academic institutions both competing and working with, financially orientated firms (Coriat, Orsi, & Weinstein, 2003) .

To further explain, academic researchers would release new findings and research to the open world for peer review and to further spread the understanding of the field, however a biotech firm would develop new ways of utilising that research to develop products and technology that can be financially viable for the company to produce (DiMasi & Grabowski, 2007).

In return, in an effort to protect their investment, firms will patent their product, gaining exclusivity over that product for a period of time, in exchange for releasing the information regarding the technology to the public domain, continuing the cycle of innovation and research (DiMasi & Grabowski, 2007).

This can be seen in the pharmaceutical industry, where a pharmacological action is patented first and is further developed with the intention to release it to the public once human testing has been finalised, producing profits in the last remaining years of the drug patent (Lazonick & Tulum, 2011). When the patent expires, other companies would start producing ‘generics’ of the drug, and potentially allow the pharmacological action that first started the drugs development cycle, to be used in a novel way. (Coriat, Orsi, & Weinstein, 2003)

As noted by Coriat, Orsi and Weinstein (2003), patent infringement is a significant challenge in the pharmaceutical industry, and no doubt will affect the biotech sector in much the same way. Firms will need to spend significant capital, time and legal resources in order to protect their products via legislation and patents. Should this not be done, the firm can lose market value as their competitive power over their product is lost, with decade long research and cash injections being circumvented by competitors. Such protection methods may include patent ‘fences’ that cover most uses of a product.

Financial risks of biotech ventures

As previously discussed, there is significant interest in the biotech sector from investors, particularly as there are high hopes and expectations of new, more efficient products and developments for disease control, industrial development, consumer goods and new potential standards of living (McNamee & Ledley, 2012).

However, Gary Pisano, in his "Can Science Be a Business?: Lessons from Biotech" article from the October 2006 Harvard Business review has stated:

"Despite the commercial success of several companies and the stunning growth in revenues for the industry as a whole, most biotechnology firms earn no profit".

This is of particular concern as development of a new molecular technology can cost between $500 million to $2 billion, a substantial financial risk should profit not be made (McNamee & Ledley, 2012). As such, investors are wary of such endeavours as capital sourcing is typically derived from: 10% venture capitalists, 50% from established companies (particularly pharmaceutical businesses) and the remaining 40% from the public equity markets (Lazonick & Tulum, 2011).

Due to these costs and the need to get capital from outside sources, start-up firms may need to relinquish certain rights to their intellectual properties, particularly when research alliances with established companies are formed (Lazonick & Tulum, 2011). However, this initial cash injection from these alliances can convince investors on the stock market to accept potential IPO's from the potential firm, and as long as certain milestones are kept, further capital injections can be generated (Lazonick & Tulum, 2011).

Again, this scenario occurs despite the risk of no actual product being produced or a pre-established track record being present. This type of business model is then more speculative, particularly as a potential investor will have to wait for nearly a decade or more before an actual return may occur (Coriat, Orsi, & Weinstein, 2003).

Behaviours found amongst biotech backers.

The above risks create certain investor behaviours, that seek to minimise any potential loses, Examples of such behaviours may include:

- Venture capitalists investing in multiple, competitive, firms that intend to tackle the same area of research (Powell, Koput, Bowie, & Smith-Doerr, 2002). This acts as a form of hedging, allowing the investors a good chance of at least one of these start-up firms producing returns. Due to the rather significant returns that can potentially be garnered for a relatively small investment, one successful firm is usually enough to cover the losses of the others in a portfolio (Powell, Koput, Bowie, & Smith-Doerr, 2002).
- Alternatively, Investors may influence the startups development in such a way, either through sound business advice and practice, or industry contactsthat the startup garners the attention of larger companies. If successful the potential market return can be substantial, either through the firm's market value going up due to agreements between the firm and the larger company, or the larger company buying shares in order to gain a controlling stake in the firm (Powell, Koput, Bowie, & Smith-Doerr, 2002).

Alternativly,, rather than minimising riskhuman behaviours impacting growth in the biotech industry may create a situation of false worth as growth has been predominantly driven by speculation rather than actual product value; meaning that the business sector shares many similarities with the Dot.com crash, assuming sound market management solutions are not developed in due course (Howcroft, 2001).

This scenario is further compounded by the fact that technology based sectors in the market tend to be overwhelmingly complex for the average investor, who may not truly understand what companies are doing or researching, but are following the trends in the market (DiMasi & Grabowski, 2007).

To further expound, the effects of such behavioural financing as explained by Catherine (2003), created a trend amongst start-ups in France where well-known scientists, typically tenured with significant academic production and achievement, become

associated with a new firm in order to increase that firm's standing in the scientific community. However, while they do play an advisory role, the scientists have little involvement in the firm. In essence, the scientists act as 'sponsors' to get attention for the firm. Scientists that have less public standing, that are usually non-university based and currently working in actual industry, do involve themselves heavily in the firm, usually as the founders or CEO's, in order to increase their own reputations should the firm succeed. This is done so that such a scientist can capitalise on the knowledge and experience they currently have.

This 'human capital' can have a greater impact if the fields of research that the firm wishes to utilise is fairly unknown and where knowledge is held only by a few individuals, rather than masses of articles and journals (Catherine, Corolleur, Carrere, & Mangematin, 2004).

This brings up an additional worrisome trend with the same intent; in order to get more attention and financing, research funds are being used for dividend payouts and share buy-backs. These practices can create a false appearance of worth to potential investors (Lazonick & Tulum, 2011) .

2.3 Trends and challenges regarding capital generation within Africa

As discussed, biotech venture creation holds significant potential for African economies. However, there are a number of issues plaguing such endeavours, particularly with regard to capital generation. These range from improper financial instruments through to societal issues. Such issues may prove detrimental towards VC backing, particularly from foreign investors. These shortfalls are discussed below.

2.3.1 African finance instruments and access to credit and impact on new ventures

Within Africa, there are limiting concerns impacting the number of local level VC's, requiring alternate forms of capital generation, however the development of venture capital mechanisms, financial generation and initiatives that promote entrepreneurship, still require significant research, with the majority of studies detailing access to finance; for instance, repayment terms of capital loans and factors contributing to entrepreneurial development are predominantly focused on the developed markets (Bigsten, et al., 2003).

In order for underdeveloped economies to mature, it has been traditionally suggested that methods that address unemployment and poverty shortfall, should simultaneously promote the creation of private equity and investment financial systems and should be a priority (Timmons & Bygrave, 1986). With suitable financing, either from private individuals such as VC's or institutions, entrepreneurship development can be stimulated, due to the increased ease of capital access (Bigsten, et al., 2003).

According to Bigsten and Colliers' (2003) study, this "ease" however has a number of limiting factors within African economies, an example of which can be shown by the demand of credit capital, but which is severely limited and constrained. In the study, six African economies were analysed via a panel data of firms requiring credit. It was found that only a quarter managed to obtain a formal sector loan. The study explains that banks are able to partition credit to applicants based on expected profits, resulting in ventures ranging from micro sized to medium being less likely to obtain loans than significantly larger enterprises. This can have a direct relation to the development of entrepreneur backed ventures not seeing fruition.

It should be noted however that outstanding debts, particularly when ventures seek additional credit to cover further debt, has a significant negative impact on business sectors, explaining banking institutions' reluctance to credit loans (Bigsten, et al., 2003)

The World Bank has highlighted the issue regarding demand for capital as one of the key impediments to SMME growth (Beck & Demirguc-Kunt, 2006). This is predominantly due to the credit scoring systems in place within banks in order to determine if a SMME venture will be able to cover the debt on a monthly basis and ultimately repay the loan. Such systems rely heavily on quantitative models based on historical data, in order to determine the probability of default (Beck & Demirguc-Kunt, 2006). These models then allow the placement of borrowers into differing risk profiles or classes. However such historical data is something that SMMEs and new ventures will be sorely lacking. This results in potential start-up ventures and entrepreneurs being excluded from financial backing from banks (Beck & Demirguc-Kunt, 2006).

2.3.2 African economies: shortfalls and risks

Apart from the financial backing shortfalls facing ventures, there are a number of issues being faced in African economies that are non-monetary in nature. These range from legislative through to societal issues (Singer, Amoros, & Moska, 2015). The societal issues tend to have a certain uniqueness to each nation and as such, South Africa's specific issues are discussed in the next section, however in general, financial backing issues can be derived from a nation's stance on regulation or support.

Without suitable support and clear regulatory policy, many new ventures may find it difficult to establish themselves. However, there are opposing methods on how to rectify this situation, as discussed by Van Stel and Storey (2007). The methods involve either the implementation of a low regulatory "free market" or the creation of large scale support structures.

The low regulation method would drive government policies towards the establishment of business as efficiently as possible, lowering potential development times and costs related to opening a business, by lowering the governance and policy burdens that

would be faced by start-ups. This route may be achieved via knowledge transfers and tax reductions.

As for the large scale support method, a possible method would be the introduction of networks and business monitors that allow entrepreneurs to find and facilitate their own business connections (Ahlstrom & Bruton, 2006). In addition, government may be able to support businesses via the use of state owned assets and financial grants derived from taxes (Van Stel, Storey, & Thurik, 2007).

However, it may be argued that both aspects fail to take into consideration the frailty of start-up companies. This is due to the unknowns in backing new start-ups and the long investment times before a return could be expected, which may take up to five years (Ahlstrom & Bruton, 2006).

2.4 Trends and challenges regarding capital generation within South Africa

2.4.1 Impact of Apartheid policies on South African economics

South Africa's history has seen many policies, both beneficial and detrimental, however the most significant contributor to the modern South African economy would be the lasting effect of apartheid. As discussed by the BEE commission of 2001, the general history and reaction needs to be considered below.

The concept of apartheid as a government policy was first introduced by the national party in 1948, as a framework of segregation of the various ethnic groups in South Africa. Ultimately, "races of colour" were considered subservient to those of white or European descent. These frameworks included restrictions on geographic movement, resources, education and what occupations were available to each group.

Such actions severely limited and in some cases, destroyed the potential capability of the majority of the population. Denial of skills development and jobs resulted in lowered living conditions, further deprived the potential business opportunities available to all aspects of South Africa's economy.

In order to rectify these issues, the Broad Based Economic Empowerment (BBEE) strategy was developed. It was developed based on the following actions:

- The introduction of a constitution that exemplified the values of equal rights for all, along with the freedom and capability to address historic imbalances.
- The introduction of a reconstruction and development programme was planned as a series of endeavours that would mobilise all South Africans in an effort to remove the legacy of apartheid from the South African economy, by developing non-segregative policies via a democratic process
- The growth employment and redistribution strategy GEAR, was developed as a springboard for accelerating the economic growth rate
- Industrial policies and strategies were introduced in order to deregulate certain economic sectors in order to attract potential investment, both locally and internationally

- Youth development programmes were pushed forward and remain today a national priority by providing education and skills.

These actions have formed the backbone that the modern South African entrepreneur and investor face.

2.4.2 Concerns regarding entrepreneurship and SMMEs

South Africa, as a nation, stands in a position where it shares aspects with both the developed world and the developing. According to the Global Entrepreneurship Monitor Report 2014, South Africa has the following traits and characteristics:

- South-Africa's economy is currently focused on efficiency of services and products.
    - Meaning that it is not driven wholly by addressing "needs" but in the application of fulfilling them in an effective way. However, there is a lack in development of innovative actions and support from the economy as a whole.
- Government has been slow to action in producing evidence based policies; however there is growing interaction between policy makers and researchers in establishing common understanding and implementations of workable legislation.
- Public opinion towards entrepreneurship is fairly high with 70% of the population respecting those who pursue such a vocation.
    - However, the amount of perceived opportunities to actually take advantage of this is drastically lower with 37% of the population being able to identify opportunities and the associated support for pursuing such. This runs opposite of the majority of African nations, as the general perception is that there is significant opportunity to establish new businesses.
- South-Africa has the lowest actively participating youth population (18-35 year olds) pursuing entrepreneurship.
- Education is seen as important, however its application, in primary and secondary education, is severely lacking, with access to tertiary programmes severely limited due to the failure of the previous stages.

- Government regulation is proving to be cumbersome, preventing ease of entry and compliance for those seeking to create and exploit opportunities.
- Labour laws prevent the removal of unproductive employees and create a drain on company resources
- Limited access to information facilitated by lack of IT coverage and access to the internet
- Corruption and incompetent governance.

2.4.3 Considerations of biotech ventures in South Africa specifically.

The below considers South-Africa's existing structure towards start-ups and its current social and economic situation. These considerations are at the forefront of a venture capitalists decision making, especially when viewing the future of any potential companies in which to invest. In addition, by discussing the current structures that allow the facilitation of VC's and entrepreneurs to network and develop relationships, one can determine if the South African economy is attractive and willing towards venture capital creation and development.

South-African policy towards biotechnology

The South African government has instituted numerous programmes to create solutions to housing, health care, education and social upliftment issues (Burton & Cowan, 2002). However, these programmes are limited due to severe financial restraints with poor administration and oversight (Burton & Cowan, 2002). With regard to biotechnology, as is the case in most developing nations, the amount of finance allocated within the national budget towards R&D is limited and highly prioritised towards certain areas of research, focusing on HIV and TB (Burton & Cowan, 2002). However, the fact that government has allocated resources to generalised biotech, despite these limitations, is indicative of the future hopes that the government has for the field (Burton & Cowan, 2002).

With a focus on Biotechnology Entrepreneurship, the following shows differences between a developed nation and a developing one such as South-Africa.

Table 1: Areas of concern between developing nations and the developed (Lingelbach, De La Vina, & Asel, 2005).

Area of Concern	Developing Nation	Developed Nation
Economics	Regulation, Environmental impact and politics increase economic insecurity	Most Risks are based on the free market and on business practice
Potential Opportunity	Can be far more general and easier to identify, with opportunities in all levels of society	Generally lower due to ease of entrance to markets and high completion, requiring specialised products and development
Access to information	Is limited, with access to technology being of primary concern	Easier and far more pervasive allowing quick access to information
Angel investment/venture capitalists	Lack of alternatives requires personal risk and lower capital power when entering markets	Existing venture capitalist frameworks abundant with many alternate methods of financial backing
Skills and training	Specialist knowledge and its application is rare and sought after, but lacking in resources Infrastructure	A greater knowledge base allows access to more specialists
Infrastructure	*Ad hoc* with poor logistics support	Already developed and generally pre-planned for growth

Government programmes

South Africa has, since 1994, attempted to produce as many SMME development programmes as possible. Examples of such programmes are the small enterprise development agency, the national youth development agency, and in the case of biotechnology, the TIA (Naidoo, 2009).

These measures to foster innovative activity within the scientific community resulted in the continued development of the SANSI program (Naidoo, 2009). In 1994, science and technology development was the purview of the Ministry of Arts, Culture, Science and Technology, but became its own Ministry in 2004. Initially, there was significant investment into scientific development, however without proper focus and controls it soon suffered from inefficient administration (Naidoo, 2009). This resulted in the formation of the Technology and Innovation Agency (TIA) as an evolution from the previous BRIC centers (Naidoo, 2009). The core focus of the TIA is to promote technological innovation via government intervention, in an attempt to lower dependence on foreign access to knowledge, and to create local pools of knowledge that can be more easily transcribed to the South African context (Naidoo, 2009).

2.4.4 Considerations for investors

South Africa has championed the role of biotechnology on a governmental level, however the country still suffers from issues resulting from misguided legislature and economic application.

In short, such efforts tend to be impeded by conditions that do not foster entrepreneurial activity, such as a lack of education, obtuse legislature and minimal access to information technologies (Singer, Amoros, & Moska, 2015). In addition, the amount of knowledge required to support developing nations is still in a state of neoteny, as the challenges facing each developing nation tends to be unique for that nation. Despite being fairly easy to categorise, such issues involving healthcare, food security and unemployment, tend to be the focus of concern in such nations (Singer, Amoros, & Moska, 2015).

However South Africa can learn to exploit the capabilities of biotechnology via the emulation of those nations that have managed to capitalise the sector. This can be done by the creation of well-funded agencies dedicated to the development of biotechnology, In addition to the developed networks of capital generation structures and venture capitalists, as evidenced by the TIA's.

2.4.5 Evidence supporting incubators

The purpose of creating incubator programmes is to ensure that there are support structures in place that better prepare start-ups during their initial, but critical, starting years (Hoy et al, 1991).

This preparation comes in the form of providing basic services and advice with the intention of creating a firm foundation for the start-up. These benefits and services may provide the start up with a working location, business and financial assistance and professional support in the form of marketing and administration knowledge. These benefits allow the entrepreneur to further develop their idea or research into a viable product that can be leveraged according to market demands. (Reynolds, 2000)

It has been found that incubated start-ups tend to have more employees, but with reduced labour and operation cost with the addition of experiencing increased sales (Mian, 1996). It has been found that there was an 87% chance of success with the intervention of technological incubators, compared to 80% failure rate of start-ups that received no such support (Cutbill, 2000).

Fundamentally, incubators act as a tool that filters and develops opportunities from many sources and provides seed capital, while acting as a source of economic development. There are well over 4000 business incubators globally, a 1000 found in North America, of which 75% operate as nonprofit organisations with support from local academia, government and businesses (Wiggins & Gibson, 2003).

Table 2: Examples of global incubator programmes

Country **Name of Incubator**	**Notable achievements**	**Reference**
USA Austin Technology Incubator	1.4 billion and 300 jobs generated	Wiggins & Gibson, 2003
Israel Technion technological incubator	Establishment of significant informal social networks and knowledge transfers	Rothschild & Darr, 2005
China	Considered the largest concentration of technological incubators with 131 incubators comprising 7693 companies which employed 128 776 individuals as of 2000	Harwit, 2002

2.5 Mini cases for how other developing nations achieved their biotechnology goals.

This section discusses how other nations, namely Israel and India, achieved success with regard to biotechnology start-ups and the challenges faced. By providing an understanding of nations that have experience in dealing with restrictive resources and severe national shortfalls, these may serve as examples that can be used to both determine and address concerns raised regarding South Africa.

2.5.1 India

This mini case focuses on how India leveraged pre-existing infrastructure in order to facilitate initial growth of new ventures, as well as the danger of not developing an entrepreneurial culture. India has a similar scenario to South Africa where a strong scientific base is present, but is hampered by social shortfalls.

As discussed by Ramani (2012), India's experience with biotechnology was introduced on a national scale with the introduction of state policy via the National Biotechnology Board, rather than private venture collection. The NBTB was introduced in 1982 as a reaction to developments in North America and Europe, and was developed with the intention of creating a road map that would increase India's capacity for biotech ventures.

Throughout the 1980's, public policy was based on developing public awareness among private investors and building scientific capability within the agricultural sector. However, significant developments in biotech in terms of economic potential were only developed after 1991 with the de-licencing and liberalisation of the economy. This licencing was a significant impediment as before 1991, any business that sought to manufacture and import/export goods was required to attain a licence from an appropriate ministry, limiting novel growth of ventures.

Post 1991, a number of firms within the pharmaceutical and chemical industries began investment in the biotechnology sector. However they experienced issues with gaps in knowledge regarding the life science techniques and data, as their previous industries

were firmly rooted in organic and synthetic chemistry (Ramani, 2002). These firms followed strategies that could be classified in four ways.

Namely:

- Marketing of diagnostic kits and vaccines for foreign firms
- Production of locally developed diagnostic kits
- Undergoing contracted research for foreign firms due to cheaper operational costs
- The production of specialised chemicals based on existing expertise.

(Ramani, 2001)

From the early 2000's, firms moved from these strategies towards drug development due to state funding (Chaturvedi, 2007). In addition, changes in state policy become more specific to the sector, because of recognition of the unique concerns of the biotech sector, and with the intention of integrating Indian innovation and production on a global level.

However, the social issues facing India has impacted its ability to fully realise its biotech sector, despite the state's continued support of the industry. As of 2006, R&D spending was 0.8% of GDP when compared to the US's 2.76% and China's 1.61%. However, 80% of that 0.8 is issued from the public sector, while the US and China only 30% is allocated (Ramani, 2001). This shows that the Indian government is committed to biotech, but is hampered by other concerns such as poverty and social imbalances.

Despite this commitment, currently one of the biggest hurdles face by biotech firms is the protection of IP, both locally and internationally. There is a lack of knowledgeable enforcement with the patent bureaucracy that is capable in both current legal requirements and the science of biotech (Barpujari, 2010).

As discussed by Natesh (2009), India is currently suffering from the following shortfalls

- Knowledge to skill issues

India once had a strong education base in providing knowledge to potential future scientists, despite only being found in a few universities and about 15 research institutes. However, there is a severe lack of translating this knowledge into real world skills, as evidenced by the low numbers of novel Indian patents, however a growing concern is that the level of education has been dropping as well. This has been attributed to universities having a high teaching load but minor resources in actual research, in addition to antiquated rules on faculty promotions and hires. This results in a situation where innovative thinking and leadership is not developed, but a strong general workforce is developed.

- Entrepreneurship

As a continuation of the above, few Indian universities actually foster and develop an entrepreneurial culture, due to India being immersed in a culture where failure is frowned upon and shameful, despite other nations that consider and recognise that most entrepreneurs will fail at some point, but consider the risk worthwhile.

In addition, there are shortfalls in public and private partnerships where technology and knowledge transfers are concerned. The publicly funded research centres are not industrially friendly, despite state policy (Ramani, 2001), while in turn, industrial companies actually do not seek to interact with local laboratories, rather focusing their efforts in international partnerships and IP acquisition.

- Risk Appetite

The Indian industry is also conservative in risk aversion, with Indian banks and investors unwilling to back biotech firms. However, the government has introduced financial measures such as relaxed drug price controls, subsidies on expenses, along with tax holidays for R&D.

In closing however, India has developed a hotbed of development and growth within the pharmaceuticals industries by leveraging the skills and industries they had and gearing national policy towards development of a biotech sector with a unified vision.

2.5.2 Israel

The mini case for Israel focuses on Israel's attempts at privatising their technological incubators, and the potential risks of doing so.

During the early 1990's, Israel had significant immigration from areas that were part of the USSR. A great many of these immigrants were trained scientists and engineers. This had the impact of bolstering Israel's technology sectors, which in turn, saw Israel introducing the Public Technological Incubator Programme (PITIP) in order to facilitate this boon (Shefer & Frenkel 2003).

As stated by Trajtenberg, (2000), the VC's present in Israel had little interest in the seed stages of high tech start-ups, however the government had identified the opportunity to leverage these start-ups for Israel's economic growth. However, this growth depended on the ability of the start-ups to acquire capital and the government developed support structures that assisted in raising this capital.

Government policies designed to create these support structures were first introduced in 1991 with the Government Insurance Company "Inbal", with the VC programme "Yozma" starting in 1992. Both these programmes provided funds for potential start-ups, with Inbal providing stock traded funds and Yozma acting as a $100 million specialist fund. The intention of these funds was to promote involvement of foreign institutions and local VC funds that would in turn, support technology start-ups in Israel. 1997 saw the government selling Yozma to private markets, however Yozma had established 10 private VC funds that had raised $2.7 billion as of 2002 (Avnimelech & Teubal, 2004)

The public Israeli technological incubator programme was designed to provide support from the ground up and to insure that 50% of employees of any potential incubator should be immigrants in order for these immigrants to have better access to Israeli

national business resources (Shefer & Frenkel 2003). By focusing in a ground-up methodology, the PITIP sought to encourage entrepreneurial culture from the beginning of a potential project and within the project's local communities in order to create a local support network that could develop its own projects. With this goal, the PITIP provided VC support, legal and business advisory and business plans filtering into rural and remote areas (Shefer & Frenkel 2003).

An evaluation done by Shefer and Frenkel (2003) conducted 10 years after the establishment of the PITIP had found that 86% of all projects between 1999 and 2001 had graduated with 78% of those securing funding afterwards. However, there were lower levels of success of hubs established in rural areas when compared to centralised economic regions of Israel. This was attributed to the lack of viable skilled workers in those areas. Further, it was found that that these incubators were capable of increasing their own budgets via the use of share sale, royalties and dividends. This provided a motivation to suggest that in time, such incubators could be weaned off government support and become more privatised. However, this was truer in the central regions than those hubs found in rural areas. It should be noted that public incubators allow support of a variety of sectors and promote national objectives while private incubators tend to focus on specific mandates and aggregate in major city hubs.

A study by Shefer, Frenkel and Miller (2006) found that initiators of private incubators were experienced in economics and business administration due to coming from industry, while public incubator initiators had access to greater levels of scientific knowledge and education but lacked the business sense found in the private initiators. The private incubators specialised in biotechnology with a focus on pharmaceuticals; but it was found that they could not replace their public versions.

This was due to:

- Those seeking admission to private incubators needing to finance their own initial development,
- A smaller scope of projects present in private incubators, and
- A reliance on government support.

Shefer and Frenkel (2003) proposed that private incubators may not survive over the long term.

It was suggested by Shefer and Frenkel (2003) that, based on the PITIP, there is no private programme capable of providing support from early stage to market entry and that support from government would still be necessary, despite have access to greater economic resources than the public programmes. The public programmes were seen to be extremely stable and more willing to support high risk start-ups. However, there is the shortfall of economic behaviours. As such, it was recommended that private should not replace public, but rather there should be a system where public and government support is still present but allows the continued privatisation of government programmes, creating national and business partnerships.

2.6 Venture capitalists: their roles, methods and selection techniques.

The section focuses on the factors and concerns that may influence the investment behaviours of venture capitalists based on potential constraints or activeness. Such factors may limit potential investment by increasing the potential risks involved in IPOs/SMME and reducing the potential earnings required by investors.

2.6.1 VC's as financiers and expectations.

VC's are ultimately financiers, providing capital to various projects and proposals, with the ultimate goal of being able to generate returns on that financial backing. However, investment capital is limited based on the scale of the financier of course, but ultimately financiers are restrictive on how they provide capital, particularly on how they minimise the risk that they take on.

As such, VC's will screen proposals presented by entrepreneurs with the firm intention of maximising returns and minimising risk (Proimos & Wright 2005). Due to the inherent nature of the biotechnology sector, the following quote is brought to the forefront "the challenge is to earn a consistently superior return on investments in inherently risky business ventures" (Zider, 1998, p.133), as such it is expected that small businesses are to perform financially in order to be attractive for backing. However, a number of government policies and objectives, such as BEE and the TIA, among others, impact on the expectations and perceptions that VC's and entrepreneurs will experience, compared to other "free market"economies.

2.6.2 Role of the VC in capital generation.

In the context of venture generation, entrepreneurs attempt to fill market needs by generating new strategies, products, and assets; and in turn, these ventures are then selected by backers or VC's in order to gain financial capital and growth (Aldrich, 1999). VC's in this context are considered the preeminent source of capital in the entrepreneurial setting. VC's may in turn, provide expertise or other resources in order to facilitate their investment, increasing the start-ups potential market power (Hellmann & Puri, 2002).

As such, VC's may fall under two categories of behaviour, Scouts and Coaches. (Baum & Silverman, 2004). VC's enjoy the reputation of being experts or at least highly informed in the business sphere, being able to not only identify a promising start-up but providing a form of approval for the start-up in the as seen in reputational capital. This backing can have the effect of enabling the start-up to acquire additional resources as they have been "scouted" (Hellmann & Puri, 2002).

This reputation of VC's is due to a tradition of various high diligence strategies developed via trial and error learning and research, which affords VC's a system of selecting for or against certain ventures (Campbell, 1965). Other investors will then rely on VC's to find suitable and predictably successful companies to back due to these systems.

2.6.3 VC's: scouts vs. coaches

The role of VC's has garnered a great deal of interest due to their influence in start-up formation, their success and quite possibly, the rate of technological innovation found in the entrepreneurial sector (Kortum & Lerner, 2000). Such interest has seen significant research, with certain "celebrity" venture capitalists' daily lives, activities and personalities being extensively documented (Byrne, 2000).

However, there is little information on how VC's may develop business, apart from the assumption that VC's happen to be particularly good scouts (Baum & Silverman, 2004). As Scouts, VC's ensure a venture's success by utilising pre-investment techniques, ensuring longer term success of any possible investments as discussed before, such pre-investment helps the potential startup in acquiring additional resources(Shepherd, Ettenson, & Crouch, 2000; Hellmann & Puri, 2002).

An alternate view of VC's is that on top of the pre-selection criteria, they also seek to improve the start-up and develop it via coaching (Hellmann & Puri, 2002). This is done by focusing on the post-investment of a venture by instilling management expertise and skills. This method also allows the startup to gain additional resources.

Which technique is more prevalent or effective is debated, but is little researched (Baum & Silverman, 2004). This is due to the entwined natures of both behaviours and

strategies, factors that would affect pre-investment scouts would impact post-investment activities as well, such as geographical distances between the VC's and the start-ups (Sorenson & Stuart, 2001).

2.6.4 Pre-selection criteria employed by VC's

The following discuss the predominant pre-selection criteria that VC's may employ. It should be noted that various VC's have unique systems that may or may not be shared with others.

Liquidity and cash flow

Studies have shown that a company's liquidity is seen as a significant factor regarding investor behaviours, a fluctuation in liquidity, either increasing or decreasing will alter the perceived risk of a venture (Amihud, Mendelson, & Lauterbach, 1997).

Pastor and Stambaugh (2003) put forward a study that shows that investors demand higher gains for high risk investments. Another demand that investors may make, is an increase in compensation for when transaction costs within a company are deemed too high. This can be seen in companies that have high asset costs or operate in niche markets where materials and services may be difficult to sell off in future (Ghysels & Pereira, 2008). This is a valid consideration for a medical biotech company due to the costs and specialist materials involved in product creation and research.

Access to company Information

Any investor, particularly a private venture capitalist, will hold information in high regard. As such, a company's transparency with regard to its operations, spending and strategic decision making will affect an investor's behaviour towards that company (Shepherd, Ettenson, & Crouch, 2000).

As proposed by Whited and Wu (2006), as investors receive less information, they will demand higher returns as they perceive a situation where the business owner or directors have more information than that of the investor, compared to a situation where all members have access to the same information. This is due to perceived risks in the

company owner's decision making. Whited and Wu (2006) further state that should a high number of financial restatements be present for a stock market listed company, it would create a situation of uncertainty and confusion, ultimately questioning the validity of the firm's financial management. This situation is equally applicable to venture capitalists, as while they may back unlisted start-ups and companies, their stake is considered higher than a layman investor, and should a situation occur where a VC cannot rely on the information given, such as in financial ledgers, they may exit the venture or as discussed, demand compensation as assurance.

Ownership structure of a company

Companies that typically require the interest of a venture capitalist will have a small group of shareholders or concentrated centres of company power. However, there is a perception of increasing risk as decision making power is contained in smaller and smaller groups (Shleifer & Vishny, 1997).

While this is to be expected in smaller to medium sized companies, larger companies that have a "royal" family that dictates all decision-making power in a firm will garner increased financial constraints; this is due to disproportion of effective company growth versus personal biases, in short you are buying the man not the company (Shleifer & Vishny, 1997). Such a situation may result in the individuals seeking to increase their own wealth at the expense of the company, via such examples where there is focus on pet projects and personal loans carried out using company assets as collateral (Gompers & Metrick, 2010). As a side consideration, there is lowered potential protection against takeovers, something that venture capitalist may avoid in case their investments are misappropriated (Gompers & Metrick, 2010).

Historically, a great number of bankruptcy cases have been caused or at least associated with theft and fraud, which is significantly higher with concentrated power as discussed above (Friedman, Johnson, & Mitton, 2003). As such, external investors have a natural avoidance against companies with centralised control, particularly for long term investments. This is due to little to no returns created by the lack of protection of minority share holders (Gompers & Metrick, 2010).

However, this is a risk that investors need to understand with start-up companies and small firms that are naturally controlled by a few individuals and the above holds true in cases where the company is listed on a stock exchange or is publically traded (La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 2000) . In cases of smaller companies, investors will place a premium or clause stating that their capital inputs afford them significant voting rights or sway in the company's directorship (Shleifer & Vishny, 1997). This right can be considered at the same level as the right to dividends.

It should be noted that, as discussed by Jose Mendoza (2011), companies that are controlled by well-known individuals, such as researchers and entrepreneurs may have a higher level of financial support and backing than normal. In emerging markets such as South Africa and Brazil, there exist companies where a single family has large controlling shares. These families' reputation is however well-known and a premium is expected for the companies' stocks and value. This is due to these families and individuals being standard bearers of reputation. However as discussed in the global biotech section, there is a very real risk of where reputation is used erroneously, but by that token, the higher the reputational capital an individual or family has, the less likely they wish to see it tarnished. This is further discussed in the reputational capital section below.

The secondary form of ownership that can be found in biotech and research firms, especially, is the potential of the company to be institutionalised, either by formally being owned by a larger organisation or by collaborating with one, such as the previously mentioned TIA's. Hansen and Hill (1991) conducted research that indicates that institutional support and ownership allowed the company to develop and contribute to a long term strategy. This helps to mitigate the issues regarding ownership as discussed above. As the "controlling" institute is considered a longer lived entity, investors are more willing to back such companies as the parent organisation will provide legal and financial backing, in addition to proper monitoring and policy adherence, thus preventing fraud and misconduct by insiders and increasing the reliability of information gained by investors (Grinstein & Michaely, 2005).

Company policy and Regulation

Any company that follows a system of control that is well-defined with rules and regulations that reflect a certain set of principals will prove to be attractive to investors. If such regulations not only follow the legal requirements, but also the standards enforced by larger professional organisations, this will mitigate potential concerns that investors may have (Gompers & Metrick, 2010).

This is particularly true for institutional or corporate investors looking for long term returns, as the proper transference of duties and responsibilities, while adhering to the strategies and business practices helps to manage potential risk and company reputation (Mendoza, 2011).

Dividend policies.

For larger companies, the dividend policy plays a significant role in the potential attractiveness of the company, and is a typical signal of a company's current and future financial state. By understanding the historical and expected future policies of the dividend pay outs will play a factor in the valuation of the companies and its shares (Healy & Palepu, 1988). The information regarding the payment of dividends within a company's policies and regulations serves as part of potential shareholders' decision making process with regard to backing a company; this is due to the information serving as an indication of a company's potential growth and financial strength (Nissim & Ziv, 2001).

Reputation

As previously discussed, reputation plays a significant role in the potential investment and backing of investors and shareholders. Just as a significantly known name can increase the attractiveness of a venture, poor management, scandals and embezzlement claims have, and will, significantly damage not only the offending company's strength, but potentially, the strength of the sector as a whole. (Mendoza 2010). Investors, particularly large scale and angel investors will place a large significance in the reputation of the key share holders and managing directorship of a company as a potential mitigator of risk (Mendoza 2010).

These various criteria have also been discussed within the South African Venture Capital and Private Equity Association (SAVCA) 2005 yearbook, which summarise the preferences of various financiers' decision-making processes involving the following prerequisites:

- The minimum and maximum investment capital required
- The entrepreneur's willingness to syndicate
- Preferences in industry or sectors, further compounded by preferences in a geographical sense.
- Potential gains and stage of the entrepreneur's business
- And finally, the equity to be taken in the business.

Ultimately, the VC's selection process will be heavily impacted by the proposal and planning put forward by the entrepreneur.

Business planning and impact on investor decision making

The typical structure of a business plan

The following process framework has been provided by Mazzarol (2000) in an analysis of what makes up successful business plans

- Mission statement preparation
- An analysis of the current business environment
- Potential future growth of the business
- Set goals of objectives
- Strategies in order to achieve said strategies
- Formal documentation of the plan

However, such plans typically fluctuate in formality and content, with French et al (2004) showing significant relationships between the level of quality of planning and net profit. However, sophisticated plans may be lacking in the South African context, as Perry (2001) has stated that even in the US, very little planning occurs in small businesses. However, the act of planning itself proves attractive to potential investors.

2.7 State of venture capital in a historical South African context

A history of South Africa's venture capital industry was discussed by Lingelbach et al (2009) in the study "The rise and fall of South African venture capital: A coproduction perspective". Within it the rise of venture capital in South Africa started with the establishment of the Johannesburg Venture Capital Club in the mid 1980's. This club was established due to exposure to business plans presented in the United States of America, and was initially supported by the Industrial Development Corporation and various private partners within the legal and private equity markets. However I was shut down by 1990.

From this position, the first formal fund for venture capital was founded in 1992 and was named Technifin, and was established as a joint partnership between the IDC and the Council of Scientific and Industrial Research (CSIR). It was established with the intent of commercialising technologies found in South Africa.

As further discussed by Lingelbach et al. (2009), South Africa venture capital has closely followed the current governments desire to support small and medium enterprises and is largely in support of the black economic empowerment initiatives and previously disadvantaged demographics. However, towards the end of Apartheid, private ownership and assets became highly centralised in a majority of sectors, preventing potential entrepreneurs from establishing a foot hold. In response to this behavior, in 1999 the Department of Trade and Industry developed four recommendations:

- Develop and maintain infrastructure supporting venture capital
- Support of an entrepreneurial environment
- Development of a government backed research and development bodies
- Motivate the availability of seed and early-stage capital via the introduction of venture capital funds.

These recommendations served as the core intention behind the IDC.

However Lingelbach et al. (2009) has suggested that there has been little formal investigation into government support programmes and in general, the informal agreement is that they have not seen success.

The reasoning behind this failure was suggested to be long term distrust between the private and public sectors post apartheid, despite South Africa having adequate pools of capital, with specialised financial entrepreneurs and institutions post apartheid. (Gilson, 2003). Lingelbrach et al (2009) further establishes that the current venture capital environment in South Africa is heavily influenced by the majority of capital being provided by government programmes, where in developed nations such capital would be sourced by private institutions. Unfortunately the growing tensions between the private and public sectors may have been due to ingrained racial animosity between white business and black government.

2.8 Propositions

Three propositions have been derived from the literature

- The biotechnology VC sector in South Africa is currently hampered by funding and management issues. This issues may be caused by:
    - South Africa's smaller economic foot print compared to other nations.
    - Change in policy according to current objectives of government
    - Poor knowledge and skills present, due to still being young in development.

- In developed markets, VC's have refined specific strategies for biotechnology; however South African VC's may not have the same level of specialist expertise.
    - South Africa is still a "young" nation to attempt long term developments of biotechnology, especially third generation. This is due to biotech's development times and there may be a lack of suitable information and experience available.

- Bio-entrepreneurs that are heavily academic may have inadequate skills for fund generation and acquiring funds for business proposals from VC's and angel investors.

    - This is due to potentially limited experience and knowledge available to allow such entrepreneurs from succeeding in such a manner.
    - VC's in developing nations may be put off by the jargon or level of detail presented to them due to South Africa's education shortfalls

Chapter 3: Research methodology

3. 1 Introduction

The purpose of this chapter is to explain the methodologies used to analyse the propositions as discussed in chapter 2

3.2 Research paradigm

The paradigm to be utilised for this study is qualitative in nature with use of cognitive mapping as a support tool. The purpose of such is to confirm or disprove the research propositions stated above.

The goal of this research is to determine the perceptions, interpretations and experiences of professionals with regard to their behaviour and their environment (Gubrium & Holstein, 2001). The reason for gathering information via a qualitative method is that it provides information that best describes the nuances found in the sector while testing the validity and possible verification of assumptions and insights in the South African environment.

As Leedy and Ormrod (2005) recommends, the use of qualitative studies provides large amounts of data generated from face-to-face encounters. This is due to a qualitative study not being constrained to set parameters such as quantitative studies as variables are not usually controlled, allowing for greater natural development and representation of concepts being researched. In addition by explaining concepts in forms of arguments, derived from data and literature, one gains deeper understanding of phenomena being researched (Henning, 2004)

The methodology used within qualitative research has been described as highly naturalistic, with creative approaches when considering research techniques and data collection when dealing with small groups (Creswall 2007). As suggested by Leedy and Omrod (2005), questions brought forward to interviewees will have been based on broad term concepts. These broad concepts are then explored in detail with previously identified individuals, with responses analysed

Creswell's (1994, 4f.) assumptions regarding qualitative research was used as a basis and considered throughout. Namely:

- "researchers interact with that being researched"
- "Value-laden and biased" information
- "reality is subjective and multiple as seen by participants in a study"
- Research is "informal, evolving decisions, personal voice…"

In short, the use of qualitative in-depth, semi-structured interviews allows the researcher to make significant comparisons and notes between the points and issues raised by participants and literary research, while being aware of possible bias and personal experiences of each participant (Leedy, 2001)

The use of the cognitive maps is to visualise and exploit experiences and knowledge of the interviewees in order to further analyse the context of the environment (Kosko, 1986). The propositions generated from the literature regarding the biotechnology setting in South Africa as well as the decision making techniques of VC's are to be tested for validity.

3.3 Population and sample

The population that this research considered is the various forms of financing available to entrepreneurs, as well as the entrepreneurs themselves. All venture capitalists, investors, funders and entrepreneurs that had involvement within new and early growth enterprises within biotechnology, were considered as matter subject experts in such. The sample comprised fund managers, venture capitalists and government funding agencies.

The use of multiple sources of information allows for the mitigation of weaknesses that a single homogenous group may entail. This allows an objective understanding of data being collected (Yin, 2013).

3.3.1 Sample and sampling method

The population consisted of two groups for purposes of understanding different contexts. The primary group consists of individuals with direct experience within capital generation and support of biotech startups, while the secondary group provides insight into what knowledge, presumptions and skills that potential entrepreneurs may have when entering the sector. The secondary group provides additional holistic information regarding the challenges faced by biotech entrepreneurs, but does not necessary have “real world” experience.

The primary group consisted of:

- 5 Venture Capitalists
- 5 Biotech Firm and company owners and founders
- 3 Platform Managers with a focus or interest in biotech
- 3 Government Agency representatives from incubation hubs.

The secondary group consisted of

- 4 Academic Scientists
- 3 PhD Students

Interviewees' were all residents of South Africa, with most residing in Johannesburg and Cape Town. Sampling was predominantly convenience based but judgement sampling was carried out (Marshall, 1995), based on the following criteria:

- Experience level of VC based on the number of years and ventures invested, with a minimum of at least five years of experience.
- VC's had some experience of the nuances of technology based firms
- A distinction was made between VC's that are private individuals versus those based within a group or firm.
- Business owners were selected based on their companies' product portfolio, with 3rd generation biotechnology for medical purposes being selected for
- Business owners had to have developed their companies entrepreneurially and had experience in capital generation and pitches for their respective companies
- Platform Managers represented large scale organisations that represented significant financial capability.
- Academics were chosen based on experience and expertise within the biotechnology sector, with a preference for heads of units with a particular focus on those that oversaw PHD students. This was to determine the type of expectations that PhD students and supervisors of such had in terms of bringing their research to market.
- Each PhD student was selected from different schools to minimise similar experiences.
- Each PhD student was in the final year of research at the time of the interview.
- The representatives of governmental agencies were selected based on position and authority with regard to providing insight into the selection criteria of suitable projects and startups

3.4 Research Design and data collection

Data was collected via the use of personal, in-depth, semi-structured interviews; semi-structured interactions revolving around four core proposition statements, as listed under chapter 2, supported by general questions to elicit response and conversation, as based on the interviewees' responses.

Questions are meant to be broad and open ended to allow discussion with the interviewee (Gubrium & Holstein, 2001), and provide large volumes of information. It is intended for the interviewer to maintain direction during in the interviews, despite the open nature of the discussion.

Potential interviewees were approached either telephonically or electronically at least one to two weeks before the proposed interview date, with all interviews recorded and notes taken. The interviews were then transcribed for data archival purposes. All interviews were done in person by the researcher. All interviews were recorded electronically, with the consent of the interviewees, with the understanding that personally identifying information would not be made public.

Notes were taken in order to record possible changes in interviewee demeanor and body language during the course of interview. This was to avoid any misinterpretations when transcripts were analysed later. In addition, the researcher was expected to be objective to contrasting views and information gathered.

Due to the semi-structured nature of the interviews, the researcher gained additional information that would not have arisen otherwise, should a pre-generated questionnaire have been used. This allowed all participants in these interviews to raise additional insights and issues that were not previously mentioned in the literature research.

However, while there are advantages to semi-structured interviews, there are disadvantages that need to be considered. A discussion of the advantages and disadvantages is provided below based on paradigms discussed.

Advantages

- The opportunity to discuss a variety of information and topics
- The researcher is able to control the flow of questions and the context based on current interview insights.
- The researcher is able to both elicit a response and probe statements made by the interviewee
- Interviewees may be able to provide clarification and experience regarding statements or problems posed by the interviewer
- The interviewer has the ability to observe non-verbal behaviours that certain questions or statements may elicit in the interviewee
- The ability to access information to which other research methods may not have access

Disadvantages

- Personal bias can creep into discussions due to interviewees' own experiences
- The researcher may misinterpret a respondent's response and intended meaning unlike the binary options provided in quantitative research
- The researcher themselves may elicit different responses based on how the interviewee perceives them
- "not all people are equally articulate and perceptive"

3.5 Data analysis

Analysis was expected to be carried out via the use of Content analysis (Gubrium & Holstein, 2001), where information was analysed via a systematic and detailed method, taking into consideration possible nuanced, hidden or double meaning turns of phrase and discussion. These nuances may be prevalent when compared to the notes taken regarding body language. However, due to the nature of the methodology, analysis of data did not follow a linear fashion where analyses took place once all data was collected (Leedy, 2001). As such, data analysis and interpretation was ongoing.

As such, the use of the Inductive analysis approach was used as a basis. Such an approach follows these guidelines:

- Immersion and familiarisation of data - this serves as a starting point of understanding the context of the data
- Theme generation - by grouping responses to questions by similar concepts that have arisen as focus areas during research
- Coding - various points of data were assigned a suitable mark due to relevance to above formed themes
- Elaboration - once data was suitably codified within their themes, nuanced subdivisions was further explored within the established themes.
- Interpretation – the data as a collated whole was used to develop an overall understanding and to develop conclusions.

This method was further reinforced by the use of cognitive maps, where changes in node generation were analysed and new maps developed after each batch of interviews. This was to provide a re-enforcement mechanism to indicate if certain areas of concern are common and if so, common to what type of interviewee (Kosko, 1986). For instance, legislature may be of greater importance to highly experienced VC's in Johannesburg than those found in Cape-Town.

The purpose of this examination was to identify themes and biases that formed a basis of the proposition formation and development.

3.6 Delimitation of study

The access to information and data was reliant on the availability and accessibility of potential interviewees. Interviewees all had different levels of exposure to the nuances of biotechnology entrepreneurship, with differing concerns. This study took no quantitative approaches to data acquired and this could be seen as a limitation in a greater statistical sense in representing the national average.

3.7 Validity and reliability

Leedy and Ormond (2001) describe validity as a measure where accuracy and uniformity are treated as devices to ascertain the reliability of a data sample.

As such:

The population being considered is thought to be small due to the nature of the medical biotech sector in South-Africa, when compared to other knowledge and high technology sectors, however the number of experienced VC's in general is considered medium to large with institution based VC's being in the majority.

3.7.1 External validity

Findings need to be general in order to be properly considered for external validity, while the use of foreign models will be applicable to studies outside the scope of this research (Gubrium & Holstein, 2001).

3.7.2 Internal validity

As information and data is expected to be gathered through impromptu responses, internal validity for the sector should be assumed for the sector (Gubrium & Holstein, 2001).

3.7.3 Reliability

Reliability is proposed as a measure of how repeatable the data being gathered is, and if it can be replicated in similar studies. Due to the qualitative nature of the proposed research, it is expected that personal interpretation of interviews may creep into analysis. This is proposed to be mitigated by having all interviews done by the

researcher. In addition, the researcher has a background in biotechnology that was utilised to mitigate interviewee bias and misinformation.

In addition, all statements were sent as batch summaries to interviewees in order to confirm thoughts and concerns that may have arisen.

3.8 Pilot test

A pilot test of the interview structure was carried out with the aid of an employee of the National health laboratories. This is in accordance with the recommendations made by Leedy and Omrod (2001) in order to verify the potential validity and reliability of the data collection process. Thereafter each interview was scrutinised in order to minimise unclear statements and ambiguities that may have arisen.

Chapter 4: Discussion of research findings

4.1 Introduction

The purpose of this chapter is to present summarised findings of the research derived from the in-depth semi-structured interviews. All quotes taken from transcripts have been reproduced verbatim.

This chapter begins by describing the general situation and bias present in the biotech sector, with additional focuses of key areas of concern, followed by an analysis of a successful Biotech venture birthed in South Africa.

4.2 General situation of venture capital within South Africa biotechnology.

It was found that there is a general consensus that the current venture market sector in South Africa is limited in capability, however this was not due to potential opportunities or proposals being forwarded to the VC's. It is limited by funding, IP concerns and government legislation and support. Most VC's stated that if these issues, particularly funding, was overcome, there would be greater interest on their part.

The majority of funding resides within equity funds according to respondents, which operate differently from VC investing. Private equity investors are generally mandated to seek out opportunities that are primarily BEE driven, with strong revenue streams. Due to the financial risks of biotechnology, very few biotech firms met such requirements. Venture capitalists however seek capital growth opportunities. This can result in VC's actively competing with other asset based investments in attempts to get funding from private and corporate sources. One VC was quoted that "South Africa is currently undergoing changes in active and passive asset management strategies, with a preference for passive", this passive nature was suggested due to the conservative nature of investors seeking low risk and cost effective opportunities. Due to the high risk and lack of verifiable product, this is a significant hurdle in biotech investing, as it is becoming more difficult to up-sell the high risk high reward strategies found in more aggressive investment environments elsewhere in the world.

In terms of experience, it was noted that a number of VC's in the sector actually have little venture capital experience due to coming into the sector directly from university or

from directorships in companies or private equity and banking roles. This is further compounded by South Africa being a "young" economy in terms of global standing. While growing, the current experienced pool of fund managers that have seen a successful investment cycle within biotech, from initial start-up to final exit, is almost nonexistent when compared internationally. There have been only a handful of successful biotech platforms in South Africa, such as Bioventures, which are actively adding to the knowledge available. The IDC also attempted a biotech platform but ultimately shut it down for a number of reasons that are discussed in the following detailed sections.

4.3 The perceived profile of the South African VC and their sentiments

The majority of VC's in South Africa typically come from banking backgrounds, and provide coaching and access to networks in exchange for equity in the venture. The VC's with backing backgrounds are considered to be conservative in what ventures they back with a focus on the quality of the paperwork of the entrepreneur's business proposal and research. However, the non-banking VC's held the belief that such paperwork, such as IRR documents, "are nothing more than creative writing". These VC's were more interested in the person presenting the business proposal and if they are realistic in scope. In addition, all funders interviewed consider themselves as coaches and mentors, as South Africa cannot afford the hedging strategy that VC's practice with start-ups overseas.

The VC's, both with and without, banking backgrounds held the general belief that they would not deal with entrepreneurs with pure academic backgrounds, as the general assumption is that such individuals are not grounded in basic business and generally had strong views on their research and their perceived worth of it. However, should an entrepreneur have a business partner with some economic training, the VC's were more willing to hear out the proposal.

VC's want companies that allow for scalability and the capability of being started offshore, particularly within the USA.

While the VC's interviewed had little knowledge of the detailed science of biotech they all agreed that it is indeed the future of global business, as they felt most aspects of global business will have some form of biotech involvement.

Most VC's stated that while they have hopes for biotech, they would rather invest in business that they know, and there are few, if any, VC's that have a scientific biotech background on the individual level. Typically, platforms that back biotech consist of experienced individuals, but not an independent VC.

As for backing ventures that have government support, they state that becomes a trap in and of itself. The entrepreneurs need grant and seed funding, however VC's will only invest if a viable product can be manufactured. Hence, most biotech firms will get state funding to support development, but because of the legislation and processes involved the VC's would rather not back such a company, as there is a general feeling that the Reserve Bank and other state enterprises have policies that are killing start-ups.

VC's interviewed also considered that the time to actually back biotech was within the early 2000's with current focus being towards the energy sector. In addition it was suggested that less than 3 billion rand went towards pure venture capital since that period, which in isolated numbers sounds impressive but significantly less than what other nations were capable of providing with similar economic backgrounds. In addition

4.4 Funding limitations

As discussed above, the amount of funding is considered low, with many respondents believing that the actual available capital is actually decreasing and won't see improvements for some time. There was considered a period between 2005 and 2008 that there was strong growth for high risk ventures however from 2010 onwards, in line with the global recession, that growth had halted. However, one respondent believed that the recession was only partly to blame for the current "drought". The reasoning is that many investments during the 2005 to 2008 period are currently the main focus of many VC's, as they seek to grow their ventures and consolidate their finances for the next wave of innovation, again within the energy sector.

In the general state of biotech ventures, funding is considered the primary limiter affecting biotech start-ups in South Africa. It is considered that the difference between the available funds in South Africa can be seen where the average start-up in South Africa may generously receive $300 000 in funding but the same start-up would receive $2 million in the US and $1 million in the Europe. This is further exacerbated as in following rounds of funding, these numbers become more disproportionate. As such, VC's need to be far more restrictive in what ventures they wish to back. It was found that a number of VC's are actually utilising a strategy of "exporting" the potential start-up proposals to the US and Europe in order to not have greater access to funds but to utilise better licencing and IP laws. IP concerns are discussed below. This behaviour is in line with the scouting behaviour discussed in literature; however the VC's do coach their potential "clients" on how to better be attractive to foreign investors.

The additional rounds of investment present an issue for biotech companies. Unlike IT based ventures where one or two rounds of funding can result in a product, biotech may take more than 3-4, depending on the nature of the research. South Africa investors have a bias to believe that two rounds of funding is sufficient and that should a company request more than that, it is a substantially high risk to back, despite the long term potential of the product.

The private equity interviewees have also stated that there is a precedent that funds allocated for funding is instead used in buy-out situations, such as BEE deals in the form of replacement capital. This replacement capital does not provide a benefit to the venture and by and large the economy, as it "in essence buys more of the same…". An interviewee for the Industrial Development Corporation discussed that the biggest impact on the funding network in South Africa was the confusion of the various parties involved and their respective roles. Between 2004 and 2010, the government agencies that were set up to provide research and development grants were in essence acting like venture capitalists, being highly restrictive and demanding an actual product before giving grants. While the IDC, during that period with their biotech platform, was acting as a granting agency which resulted in a number of financial issues for the IDC, ultimately shutting down the platform, which is considered to be a significant blow to

biotech start-ups, since the IDC is considered one of the more important investors in developing South Africa's economy, and should they be apprehensive about investing in something, the already conservative nature of South African investors will certainly take note of such.

4.5 Government support issues

In the current South African political landscape, decision makers are appointed for a limited time or have limited exposure to the area that is meant to be overseen. The platform managers stated that long term appointments in government ministries would be ideal, despite the potential abuse of power. This is due to most appointments usually lasting less than five years, an extremely short time for biotechnology policies to be adequately provided. Another suggestion was to develop an independent government body whose sole purview would be biotechnology, similar to the India and Israel cases.

The VC's in turn, have stated that they would rather back a company that has no government ties than one that has support. In short private sector backers lack confidence in the government to properly execute biotechnology as a national economic source, with the general consensus that it is currently too spread out to adequately insure proper foundations for start-ups.

In addition, it seems that government actually treats startup ventures it backs as "employees serving state interest", rather than as grant receivers. This is similar to a founders quote "government is the worst kind of angel investor", where state representatives would attempt to co-opt the operations of the venture without actually adding value or experience, limiting the entrepreneur's ability to expand on their potential advisor pool and capability. This is similar to the stereotype of an angel investor stating that they will do what they wish with the company as it is their money, or what one investor dubbed "shark angels". This is further compounded by the private equity respondents actively stating they want full control of the venture before they would back it.

This mentality has also been compounded by the number of actual agencies present with different mandates that do overlap each other and wish to provide support for

biotech start-ups. This creates confusion amongst agencies as to who provides what and to what stage of the venture's development.

4.6 Concerns involving TIA directly

TIA has a reputation of long lead times in regards to providing support funding as well as decision making, which in one case a founder stated that he actually lost an investment opportunity because TIA took more than three months to respond to an issue. This was confirmed by a TIA representative.

According to the representative, the normal times for funding applications and decision making is meant to be nine months, however there have been cases that had taken up to 18. The reasons stated that caused such lead times were:

- The applicant does not submit all the necessary information and it takes time to get all the necessary information with all the to-and-fro questions and responses.
- The TIA portfolio manager might leave or move to another position and the hand-over process is not as smooth as it should be
- TIA went through restructuring during 2013 and 2014, where "things went extremely slow"
- Lack of funds at TIA due to budget cuts

However, the new CEO, Barlow Manilal, who replaced Simphiwe Duma who was fired for gross misconduct, had made it clear to TIA employees that the lead times need to be brought down to four months in total, from application for funding to final decision. This is meant to be achieved through the use of a new electronic tracking system that prioritised applications and timelines.

An issue that was brought up by the investors and founders that had experience with TIA funding, was vague or unfair exit clauses for their ventures. In addition, the IDC representative had suggested that TIA acted more like a VC firm than a grant support institution, causing confusion amongst entrepreneurs.

The TIA representative replied in regards to the exit clause: “It basically depends on the type of technology, history with TIA, funding amount and the partners”. TIA would seldom take equity as it is considered a schedule 3A agency, receiving 100% of its funding from the national treasury. However, there have been cases where it has, hence the public perception discussed by other respondents. The typical funding structure would involve grants with the expectation of royalties. This structure is meant to allow the venture to first generate income before TIA expects returns, while allowing the venture to continue without fear of repayment obligations should it not generate revenue.

The current equity ownership experienced by TIA are considered hold-over’s from the regional innovation centres, with a recent example of equity sale involving Kapa Biosystems that was owned by Cape Biotech.

Another issue was that as TIA was being formed or restructured from the Bric hubs, many deals and entrepreneurs were actually dropped as management had not taken steps to have proper hand-overs. This has resulted in a sentiment within the founders interviewed that many budding entrepreneurs are apprehensive about doing business with TIA and the community “ …has been poisoned by poor bureaucratic nonsense, that almost all aspects of life science funding has some form of depression.”
In closing, despite these issues, many agreed that TIA is on the right track and would be invaluable in time, it may take a decade or more before its issues are fully resolved however.

One of the positives that was universally acknowledged by respondents is that the current partnerships of Swiss incubators with TIA is providing much needed support and training to entrepreneurs with the intention of assisting them to present to actual angel funders and VC’s.

4.7 South African advantages in biotech

South Africa has a history of innovation in the biological sector with advances in medical and life sciences being the better known. South Africa is also currently developing a

generic pharmaceutical industry that a number of interviewees suggested would be an excellent source of long term funding for other biotech ventures. South Africa also is traditionally known as a reservoir of natural resources with an abundance of genetic diversity in both plant and animal kingdoms. The cost of skilled labour and development is considered significantly lower than the US and UK.

In addition, South Africa has a number of forums and road shows, as the investors and founders both stated, have proven to be invaluable as most participants have at least an entrepreneurial predisposition, allowing the development of business networks that operate on a grass roots level.

4.8 Entrepreneur shortfalls

The predominant issue is that bio-entrepreneurs are typically scientists' first, and business people a far second. There is a general concession among respondents that the biggest downfall for scientists seeking to capitalise on their research is that they have little knowledge of economic practices, with one academic respondent directly stating "let the scientists be scientists, and let someone else be business leaders". This statement was generally considered untrue as the investors have stated that it is the scientists that come forward with at least some business knowledge and expectations that tend to be funded without a great deal of concern. An equity manager mentioned that in her experience, the scientists that came with a business proposal but without an economic long-term goal usually returned to research without further attempts at growing and developing their proposal. In essence, once a budding bio-entrepreneur was asked what was the real world "customer pain" that the product was meant to rectify or satiate, their proposals would fall apart.

The scientist/academic would return to research and allow others, "technologists" to actually develop a product based on their findings. This usually resulted in the scientist not receiving an economic incentive for their research, beyond "for research sakes".

Finally, many VC's stated that the biggest issue they have with entrepreneurs is that they are too committed to ownership within their companies and see such ventures as

life style supporting rather than wealth generating. The owners of such ventures are unwilling to allow more experienced business people to act on a board in order to increase the potential of the venture in exchange for equity, out of fear of “losing their babies”.

It was suggested that the best advice for entrepreneurs was that instead of chasing after VC’s with proposals and business ideas, the entrepreneurs should rather be developing their networks. This was suggested as the reasoning behind the majority of biotech success stories in South Africa come from Cape Town where there exists close knit communities of high tech entrepreneurs that are capable of supporting new ventures within their “enclosed” networks. These networks are considered lacking in Gauteng, despite Gauteng being considered the economic hub of South Africa.

4.9 Investor concerns

Investors are currently off put by the size of the potential market in South Africa, in addition to large term commitment of resources funding and time. In addition, there is a lack of confidence in the capabilities of the country as a whole when compared to a single biotech investment platform in the USA. A long standing belief exists that government is biased toward the research development as a means of itself, rather than a process to develop products and services.

The various government backed initiatives are considered to be run by individuals without sufficient experience in business practices. This was refuted by the government representatives who stated that they did indeed have individuals with commercial backgrounds and who have worked with private sector organisations to create their strategies. The primary concern is that these mandates and strategies change too often, relative to the needs of biotechnology. The greatest concern reported by the government representatives is that there is a lack of realism amongst investors, with many treating biotech in the same way as other technology enterprises but with far greater potential. These false expectations can result in the industry abandoned by both investors and government should results not be delivered. In short, investors, both private and government, need to be willing to commit to a decade or more in order to see fruition.

A possible solution was to seek out international VC's to supplement the local markets, but short of moving over to the USA and Europe. The founders stated that international VC's did not wish to invest in outside markets with a particular concern regarding South Africa's exchange control and IP legislation.

These sentiments are usually derived from a sense that South Africa, and Africa in general is a poor investment, despite changes in attitude found in respondents, with low support from governments with grant payments taking close to year versus a few months in the USA and Europe.

The following are experiences derived from the interviewees and current laws may have changed to better facilitate this but this is not the focus of this research.

Foreign companies and VC's usually wish to lock international start-ups and opportunities via the use of shared equity in order the share the risk of such a partnership. In short, a US firm would buy a foreign company for a portion of cash and equity; however the experiences suggested by interviewees stated that a South African company could not hold offshore equity unless it owned more than half of the foreign entity. In addition, it may be possible to sell IP to the US firm, however the process is expensive, and requires Reserve Bank approval. This approval may take six months to a year depending on necessary banking protocols, during which time investors would lose interest.

This comes down to the point that was considered beyond crippling in terms of venture creation, exchange control. As mentioned above attempts at taking the newest innovation into global markets is generally deflated as one of two situations are faced : foreign investors are discouraged to face local bureaucracy in attempts to bring in seed capital and locally derived capital needs to exit the country before growth is seen.

4.10 Factors limiting bio-entrepreneurship on a business level

The following were identified as significant factors that hinder effective development of bio ventures

4.10.1 Knowledge and skills

The majority of respondents confirmed that there is a clear lack of skills in the bio sector, especially in the public space when it comes down to adequate business development. The skills being referred to are those that are capable of supporting the entrepreneurs' scope. The entrepreneur typically has a highly focused area of knowledge but is severely lacking in basic understanding of other aspects vital to business. This is of particular note when discussing the expectations that potential entrepreneurs had when approaching financiers. It was found that the academic nature of potential bio-entrepreneurs proved to be a hindrance to certain investors. One investor was quoted "I love the concept of Biotech, but I have yet to read a business proposal that explained it to me as if I were 5 years (old)"

In short, scientists lack the skills to create viable products from their research and development and have severely limited links with the industry at large.

4.10.2 Management skills

There is a lack of viable project management skills found in the sector that can effectively deal with the unique concerns of biotech development. An entrepreneur stated that he had received most success from a consulting programme manager that were involved in large scale civil work projects, compared to the ICT manager he had previously. He attributed that the methodical nature of a civil works project over a large scale of time was a better foundation than the short, almost micromanaging demeanor of the ICT project manager. This was further confirmed by a platform investor that stated that micromanagement in the macro scale of lab development provides no ideal working goals. In high turnover projects such as ICT daily goals and scrum has proven remarkable.

However, effective management is, regardless, a vital skill. Effective supervision and administration is required for the long term developments of the business venture, but

was found to be in short supply in the public sectors, requiring the use of specialist consultants.

4.11 Closing suggestions as provided by VC's and founders in terms to new ventures.

The following were suggested points of concern that potential new entrants into the biotech sector should consider.

As biotech is considered such a risky and difficult to comprehend industry, combined with the lack of suitable deep pocketed Angel investors that could be found in the United States, that are not afraid of high risk – high return investments, start – ups need to create an environment around themselves that would be conducive for success.

Points to be considered for such an environment are:

- Seed capitalists are human and may be influenced to news articles that may promote or adversely impact their perception of the sector.
- Related to the above point, be capable of explaining the technology in language that can be fully understood by the investor, minimise exaggerated preconceptions in essence. Investors will more likely invest in something they understand and feel comfortable with.
- South African culture is generally conservative in nature, and as such many VC's are apprehensive if not skeptic about newer developments and business practices. Again risk aversion if a prevalent issue.
- Ensure that there are management focused partners or employees within your venture, and not wholly scientist run.
- Be capable of providing a product that can secure a growing market, despite how niche it is, on the onset. This will allow investors more trust in providing capital for long term research and development.
- Insure IP is protected beyond reasonable doubt, however this is where it becomes tricky as previously mentioned as to whether to consider government partnerships. If a situation can be achieved where the start-up is the primary owner of the IP, that is the situation you should strive for.

4.12 Mini-Analysis of Synexa Life Science investment and growth as a biotech company

The purpose of this section is to provide an example of a biotech venture that has seen successful investment and growth since inception and is currently a viable company.

Synexa Life science was successfully funded by collaboration between Bioventures and the Industrial Development Corporation (IDC) in 2003. It received seed capital of 5 million Rand from both backers. Synexa was positioned as provider of molecular tools that assisted in diagnostics of various mechanisms related to disease, with the intent of developing new therapies.

Synexa held a proprietary cellular culture technology that was co-developed between Prof. Patrick Bouic, the late Dr. Winston Leukes and Dr. Justine Devine, along with a highly developed automated purification system for use in the biomedical research fields. These products allows Synexa to be an example of a suitable biotech company venture that has long term development goals but currently had viable products ready for the market.

Synexa leadership at the time of receiving this capital had already received capital from a series of smaller investments provided by the founder shareholders of the company that allowed the development and refinement of its core product, the cell culture technology.

This technology itself was initially developed in collaboration with the founders along with Rhodes University and the Water Research Commission. As a side note, additional research that was developed by Dr. Leukes for use in bioreactors was used to establish Quorus biotech, which itself was funded by the IDC in 2011 with seed capital of 13 million rand.

As of 2017, Synexa Life Sciences has offices in Berlin, Cape Town, Dublin and London and have a diverse product portfolio involving Biomarkers, Bioinformatics, analysis and study management for other organisations. This diversity was funded by the cellular culture technology and each provides a product and service that was developed quickly for South African markets. This development of additional products allows funding of

more diverse research as a snowball effect of financing occurs with each new service or product.

Some takeaway lessons that can be garnered from Synexa :

- The founders developed the company in such a way that additional services can added in order to provide additional income streams, which in turn was initially supported by an existing product that was funded by VC's.
- This initial product, the cell cultures, was developed and made into a viable market ready service before the founders approached Bioventures and the IDC, eliminating the typical fears that VC's may have with investing in early stage research and development ventures.
- Despite development with Rhodes University and the Water Research Commission, the founders maintained intellectual rights to their research without compromising it to potential bureaucracies.
- As shown with the Dr. Leukes example, there was successful knowledge transfer of research that developed additional companies.
- Focus on providing a global product as soon as economically viable

Chapter 5: Synthesis of research results and recommendations

5.1 Introduction

In this final chapter, the concepts discussed in the research results are tested against the research propositions presented in chapter 2, with the intention of testing validity. This is to be followed by general conclusions and recommendations that have been developed from insight gained in both the literature and the research findings. The chapter closes off with proposed concerns for further research affecting biotech entrepreneurship

- The biotechnology VC sector in South Africa is currently hampered by funding and management issues

- In developed markets, VC's have refined specific strategies for biotechnology; however, South African VC's may not have the same level of specialist expertise.

- Bio-entrepreneurs that are heavily academic may have inadequate skills for fund generation and acquiring funds for business proposals from VC's and angel investors.

5.2 Propositions

Proposition 1: The biotechnology VC sector in South Africa is currently hampered by funding and management issues.

Throughout multiple instances among the research presented in chapter 4, it has been clear that South Africa does indeed suffered from significant shortfalls in funding and management as suggested by Singer (2015) in the Global Entrepreneurship report. A number of failures have occurred from the state level through to the individual entrepreneurial levels which are normally due to:

- Lack of skills that cross between the business and science worlds,
- Lack of co-operation between academic and economic stake holders;
- Lack of general funds at a national level,
- Hampering legislation and policies that are not fine-tuned and lack long term impact to properly meet biotech requirements.

These issues have hampered the two methods proposed by Van Stel and Storey (2007) in establishing a healthy environment to foster new venture growth. The introduction of contradictory and ever changing legislation goes against the low regulation method proposed, creating an environment where many ventures and VC's are required to incorporate time and expenses in order to ensure that they legally sound, effort that would be better spent in securing the ventures position in the market.

This legislation may have served as a base for large scale support efforts as was proposed by many respondents; however the changing nature of the legislation and confusion regarding the actual responsibilities of each of the institutions created to fulfill this strategy. This results in attempts to use state assets and grants, as suggested by Van Stel (2207), failing. This may be due mismanagement or corruption in certain cases. Delays caused by these issues, results in many ventures losing a potential opportunity for funding as VC's would rather have their capital generating returns rather than wait for suitable clearances.

However, as supported by the literature, developing countries are able to overcome their shortfalls, if they create policies that are adhered to and developed with the intention of future growth as discussed in the Indian mini case by Ramani (2012). These policies in turn, require management that is intent on maintaining the well-being of the purpose and spirit of such policies.

Despite issues in mismanagement, issues are further compounded by the limited funding that nationally can be allocated in both the public and private sectors. Much of this funding is wasted due to poor hand-over or buy-outs that allow no actual growth in the sector. This further worsens the current global trend shown of biotech being another potential Dot.com crash (Howcroft, 2001). As such, the already conservative natures of the few successful VC's and angel investors limit the risk appetite of actually supporting an enterprise such as biotechnology.

Factors not mentioned in literature

A factor that was strongly presented by respondents was that policy makers tended to be the biggest detriment towards any long term success. This was due to each minister, Innovation CEO or other leader in a position of power tendency to recreate, remove or ignore previous policies laid out. Whether this is due to personal bias, political leaning or competency has not been tested. However, while it is true biotechnology requires more streamlined processes, it can be argued that if the process is stable and all involved are aware of roles and requirements, it is of far greater benefit than experimenting every few years with legislation. This would allow biotech firms to generate and adhere to long term business plans that are compliant with all business and state aspects.

This can be seen with the general bias of VC's and certain founders against the Technological Innovation Agency (TIA) due to its history of mismanagement. However there remains some benefit, in that TIA is attempting to overcome its past shortfalls and is partnering up with international entities which prove attractive to all parties involved.

Proposition 2: In developed markets, VC's have refined specific strategies for biotechnology; however South African VC's may not have the same level of specialist expertise.

It was found that in chapter 4 that funders with experience from the banking sectors and private equity, maintained very traditional strategies towards venture selection, but had actually very little experience in actually backing any biotech firm. However, VC's that were typically older with their own entrepreneurial experiences were more likely to back biotech ventures and pay less mind to the risky paperwork and business history presented. This is based on the assumption that the VC could at least understand the concepts behind the venture and the entrepreneur was open to coaching. These VC's are still severely limited by funding and have resorted to strategies that would generate the most income while lowering government involvement.

Banking sector VC's usually attempted to analyse the start-ups in accordance with formal credit loans and long term equity strategies, with many ventures being denied. This is similar to the results put forward by Bigsten and Colliers 2003 study. This risk aversion is understandable as many of these types of "bankers" worked for funds with ROI timeframes significantly lower than those expected in a biotech venture, as well as adhering to strict fund guidelines laid out by shareholders. In addition such backers did not typically use Pastor and Stambaugh's (2003) higher gains for high risk investments in regards to biotech companies. The reasoning being, that while biotech hardware and patents may be sold off in case of insolvency, the human knowledge cost would still move on and could not be recouped in such a case.

The entrepreneurial VC's however would position the ventures in such a way that they would be exported overseas rather than focused on local development. Significance was placed on IP and the ability to develop that further with scalability. The intention is that either a foreign nation would support the development of the IP with far more attractive grant and legislation policies, or the IP is outright bought by a foreign company with the funding to be more risky in its investment. As mentioned in literature,

a single successful venture would pay for multiple failures, however the capital to do so over long periods of time is currently only found in foreign markets.

These points suggest that both “banking” and “entrepreneurial” VC’s would both act as scouts, but with different goals in mind. In addition the entrepreneurial VC would be far more willing to position themselves within the venture as coaches, and as such were not has adherent to pre-investment techniques as suggested by Shepherd, Ettenson & Crouch (2000)

In addition, due to the poor funding present, VC’s tend to invest more time and resources into their chosen ventures, with most VC’s going well beyond advisory roles and participating in company operations, in order for the company to succeed. This is a differing factor to foreign VC’s that tend to offer advice but not spend more time beyond that of board decision making.

However due to the mix of strategies, this proposition is only semi-supported and may be due to the relative “newness” of the biotech industry in South Africa, resulting in a few VC’s willing to create new strategies to improve the biotech sector in South Africa itself, rather than export IP to nations with long standing biotech traditions.

Factors not mentioned in literature

The importance of IP in terms of South Africa was not fully realised until more in-depth discussions had taken place. Many respondents stated that should a state owned entity have any interaction with an IP, many investors would rather not back such a venture. This sentiment towards state involvement was a striking insight, particularly as many bio-entrepreneurs would seek funding from academia and state before approaching VC’s to seek backing for product development.

This results in VC’s being extremely wary of grant backed ventures, but also not willing to support the sheer investment needs of time and funds required to develop the venture from start-up. This creates a poor situation for entrepreneurs to actually succeed over the long term without some form of actionable co-operation between the private and public sectors.

Proposition 3: Hampering Legislation and policies that are not fine tuned and lack long term impact to properly meet biotech requirements.

IP and exchange control legislation was the primary area of concern for VC's and unfortunately many government policies are created with the intention to maintain South African interests in South Africa. As such, many potential biotech start-ups lack the actual market for a successful product once they reach that stage of development. The majority of the existing biotech markets are unfortunately on the international stage, and attempts to protect IP's by "fencing them in South Africa" severely impacts the potential of any business.

Despite the intention, government policy has caused in many economically viable IP's to be spirited away to foreign interests, ensuring South Africa never actually sees economic benefit. The Indian establishment of creating internationally friendly IP laws is one of their biggest strengths, despite current issues in regulating it. Again, this comes down to poorly implemented legislation on South Africa's part.

5.3 Conclusions

As found in literature and in interviews, the potential lack of management and business skills is heavily impacting the biotech sector in South Africa. However, this can be attributed to teething problems as a new economy seeks to establish itself on the world stage. This issue is that unfortunately state policy is consistently being changed or revisited in some way. Without adequate management skills capable of deftly dealing with such change, industries that require long term stability are being crippled. Biotech may be able to overcome harsh legislation if given time, but having unfriendly policies that change fine details often creates disruptions. IT industries are able to quickly adjust to new rulings, as was evident in the project manager example in 4.10.2, but to re-iterate, this is not ideal for biotech.

South Africa is committed to successfully generating a biotech industry and the growth of the Brics through to the current vision of the technological innovation agency is proof

as such. However, it still requires time in order to develop the necessary skill and knowledge to deal with South African issues.

So in closing, why do nations such India, Israel and the USA have such success with biotech? They introduced policies well over 20 years ago and have sought to maintain the spirit of those policies of creating biotech industrial success till now. They also are heavily reliant on the private sector, but the evidence suggests that the private sector cannot succeed alone. South Africa can learn and emulate such successes, however, the political landscape and attempts to find its own place in the world is currently proving difficult to overcome.

Chapter 6: Recommendations and suggestions for future research.

6.1 Introduction

This chapter seeks to provide recommendations for the conclusions and proposition synthesis discussed in chapter 5.

6.2: Recommendations for primary areas of concern

The primary areas of concern that require attention, in order to better make the biotech sector viable for investors and potential entrepreneurs are: better management business skills; understanding of responsibilities among regional biotech hubs and entrepreneurs themselves; reduction of potential financial shortfalls for biotech startups and the creation of viable incentives to attract private sector funding for biotech ventures.

Government is currently attempting to create a foundation for biotechnology that has been on-going for a number of years; however, the constant change in policy, miscommunication regarding responsibilities and lack of a long-term adherence to a strategy is delaying that foundation drastically. It is recommended that government creates niche areas of focus such as are found within India as described in the literature review. This focus would allow a solid foundation for an industry that would support itself in time and allow research into other supporting technologies. However, this will limit the potential opportunities for entrepreneurs that have products or research that fall outside this scope. This can currently be seen with the focus of HIV and tuberculosis research taking precedence over others. Unfortunately, with the limited funding potential available, this focus is necessary. Similar to the policies introduced in Israel and India, it would be of worth to create a single governing body whose core focus would be the development of biotech business without being distracted by other forms of economic action. If properly managed, the various agencies may be able to work in tandem, passing off ventures as and when required to appropriate bodies; Research grants – seed capital – VC involvement being the simplified route.

In addition legislation changes regarding currency exchange controls and IP's need to be considered in order for South Africa to better develop and export local developments without crippling companies in the process.

A possible solution is to develop research partnerships with other nations and private organisations, similar to the Bill Gates Foundation of research grants and the co-development of technologies with the Swiss. This could occur where funding is provided from an international partner, but the research and development is carried out in South Africa due to cheaper production and development costs. In exchange, shared ownership of IP between themselves and the original developer would allow production in all partner locations. This is similar to what TIA is doing on the local level, and while the original entrepreneur may lose more stake in their company, they have access to more international markets with the blessing of the partner nations and organisations.

6.3 Recommendations for investors seeking to invest in biotechnology startups

The following recommendations take into consideration the various challenges discussed through literature and the interviewee results with the intention to provide assistance to potential VC's and insight for entrepreneurs seeking backing in order to increase their own start-up's attractiveness.

- Due to time concerns, a realistic period of investment needs to be considered that best suits the VC's needs while maintaining value for the startup. This goal may be to invest in the start-up for five to seven years, providing advice and expertise for the start-up, after which the VC would sell their share of the company to a larger biotech firm. This allows the VC an attainable end point.
- Due to the size of local markets, the VC needs to consider international opportunities while the local market has a solid base of skilled scientists that are less prohibitive cost-wise, the IP concerns may require the VC to consider any products that are developed to be done so with the intention of supplementing international markets.

    - This can be further worked on through the use of listing on stock exchanges. The AltX is the JSE's board for smaller firms seeking development; however a better valuation may be attained by listing on the NASDAQ in the USA as American analysts tend to be more interested in the technology than on the financial situation, unlike the conservative nature of the equity markets in South Africa; an example of this is Aplitec, which delisted in 2005 from the JSE at ~$3 per share and relisted on the NASDAQ at $28 per share. However, this is currently being restricted by the Reserve Bank and its exchange controls as share holders were allowed to keep shares and see significant gains during that exercise.
    - Additionally, local biotech firms cannot place their IP developments in a parent holding company should the firm own shares in the holding company, thus requiring the need to sell the local firm outright to foreign companies.
- Value potential start-ups taking into consideration additional sources of funding available. Government based support and academic seed funding and grants may have been acquired or can be attained. These forms of funds are typically non-competitive with the goals of venture capital and provide a source of investment stability, reducing long term risk.
- Start-ups that seek to utilise South Africa's rich biodiversity should be valued higher, as they may yield significantly more products and research while allowing the opportunity to create divergent products beyond the targeted goals of the start-up
- Despite the issues regarding the long term development, the VC's personal security and risk mitigation needs to be of focus. Ergo, a focus on short to medium term of profit generation needs to be considered. This can be mitigated in companies that have long term high risk goals, as long as they are capable of generating numerous low risk short term products. This is similar, but inverted, with the concept of working with government to develop the South African generics market, with funds generated to back more risky innovations.

- There have been many cases of where there were amazing scientific breakthroughs that yielded fundamentally no products. The VC needs to concern themselves with understanding whether there is indeed a suitable market for the research and if any viable products generated would actually be economically viable.
- Finally, it would be of value to seek the rare individuals that have experience in seeing biotech companies become successful in South Africa, as this knowledge is limited and does need to circulate within the sector.

6.4 Recommendations for academic institutions

One of the core concerns is the lack of cross discipline skills amongst scientific entrepreneurs; this could be addressed at a core level by two methods.

Firstly, by introducing clubs that allowed networking opportunities between the various schools present in academia, thus allowing BSc students to interact with BCom and BA students. These clubs however have to be developed with the intention of entrepreneurship, requiring activities and thought exercises that fostered such behaviours. A possible application could be the introduction of six-month courses in partnership between the science and business schools in order to teach innovation and interest in scientific research between all parties involved.

Secondly, it may be prudent to introduce core BCom courses to the science curriculum. Not degree level teachings but enough to inform students of certain concerns that may be relevant to their studies, the difficulties of IP law and grant funding as examples.

6.5 Recommendations for future research

- Case study of successful biotech platforms.

  This study is qualitative and based on views from a number of sources; however a case study approach to a successful biotech platform, such as Bioventures may reveal detailed insight in the selection and final exit of a biotech start up

- Quantitative analysis of biotech professionals and VC's in South Africa

  A quantitative survey-based study looking into the interactions and experiences of VC's and biotech professionals may show trends overlooked by this study. These may include growing or decreasing alignment to certain types of industries and flow of venture capital.

- In-depth analysis of South African IP and exchange control legislation

  Due to the apparent issues found regarding IP and exchange controls, an analysis of the current legislation and its impact on biotech IP export and import would be of great benefit to the sector. Further research would provide valuable input towards the strategies employed by investors, incubators and entrepreneurs alike.

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Appendix A: Proposed questions

Questions are proposed in groups in order to better ascertain the nature of each section. In addition, questions may flow from each section based on the experience of each respondent.

General Questions

Investment Experience

- What experience do you have regarding investing in medical firms and other biotechnology based ventures?
- What is the most interesting medical/biotech/technology venture that you have experience with?
- What are the sectors or markets that are the most interest to you?
- What were your experiences in obtaining capital? (VC/Grant/Angel)
    - What sources were the most and least successful?
    - Do you regard venture capital scarce in South Africa, and why?
- Recommendations for improving the sector.

Concerns regarding South-African Biotech Investments

- Are there particular concerns regarding the industry that alter your normal decision making?
- Are there any particular risks or trends that are predominantly South African in nature?
- Do you believe that the industry is worth investing in and why?
- Do you believe that there is certain behaviours' impacting the industry?
- Do the current banking models impact the sector?
- Are there any suggestions that you have that can improve the attractiveness of the sector?
- What, if any, legislation has given you issues or raised concern?

Questions Targeted towards VC's, Private Equity and grant-giving representatives.

Methods of finding new ventures.

- Have you ever utilised government or other support structures to find new ventures to back?
- What are your typical sources of information regarding the sector and its investment potential?
- What is your opinion on IPO's and SMME markets requiring capital currently?

Business evaluation techniques.

- How do you evaluate a possible company and its business venture?
    - What questions do you ask of the entrepreneur?
    - Are there specific questions you would ask for a medical venture?
- How do you measure the performance of the companies you invest in?
- Do you assist the company beyond the initial financial backing?
- What is your view on potential partnerships that your venture may become a part of?
- Do you, as an investor consider the following when deciding on backing a company and to what detail?
    - Access to information and the liquidity of the venture
    - The type of ownership involved with the venture and their reputation
    - Adherence to any particular policies or governance
    - Dividend structures
    - IP in the form of patents and similar
- What concerns are present regarding reputation, both of self and potential venture seekers?

Questions for Academics and Entrepreneurs/Founders.

- What have been your typical interactions with VC's and other sources of funding
- What were the process's you utilized to approach various sources of funding?
    - Were you aware of any programmes and possible reputations of such?
- Were Venture Capitalists concerned of any particular issues of your business proposals?
- What was the process that your business proposal was scrutinised?
- Did the Venture Capitalists provide additional support beyond funding?
- What experiences did you have with the inner working of organisations such as TIA

  Do you feel the academic environment is supportive of entrepreneurial activity and developmen