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Carnarvon Science Visitor Centre: Commercial Feasibility Study



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ABBREVIATIONS:

AGM	Annual General Meeting
ATM	Automated Teller Machine
BN	Billion
CAPEX	Capital Project Expenditure
CBO	Collateralized Bond Obligation
COD	Cash On Delivery
CSI	Corporate Social Investment
DJ	Disc Jockey
DOE	Department of Education
DST	Department of Science & Technology
GPS	Global Positioning System
IDB	Inter-America Development Bank
IDP	Integrated Development Plan
IFRIC	International Financial Reporting Interpretation Committee
IFRS	International Financial Reporting Standards

INSITE	International Science and Technology Exhibition
KAT	Karoo Array Telescope
KM	Kilometres
KZN	Kwa-Zulu Natal
LM	Local Municipality
MIF	Multilateral Investment Fund
MN	Million
MPR	Marketing and Public Relation
MSET	Mathematics, Science, Engineering and Technology
MTN	Mobile Telecommunications Network
NC	Northern Cape
NDP	National Development plan
NGO	Non-Governmental Organisation
NSI	National System of Innovation
NSW	National Science Week
OPEX	Operational Project Expenditure
P.A	per Annum
P/P	per Person
PDI	Previously Disadvantaged Individuals
PFMA	Public Finance Management Act
POP	Point Of Presence
PPP	Public Private Partnership
PR	Public Relations
PSDF	Provincial Spatial Development Framework
PUB	Public Understanding Biotechnology
PUSET	Public Understanding of Science, Engineering & Technology.
S.C.S	Science Centre in Singapore
SA	South Africa
SAASTA	South African Agency for Science and Technology Advancement
SAASTECC	Southern African Association of Science & Technology Centres
SAICA	South African Institute of Chartered Accountants
SALT	Southern Africa Large Telescope
SETA	Sector Education and Training Authority
SIP	Strategic Infrastructure Project
SIPs	Strategic Integrated projects
SKA	Square Kilometre Array
SMME	Small Micro Medium Enterprises
SOE	State Owned Enterprises
STAC	Science & Technology Advisory Committee
STEM	Science, Technology, Engineering & Mathematics
SWOT	Strength, Weakness, Opportunity & Threats
TV	Television
UCT	University of Cape Town
USA	United States of America
VFR	Visits to Friends and Relatives
WSW	World Science Week

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1. Background To The Study

The construction and establishment of the Carnarvon Science Visitor Centre is in essence a project to develop a visitor attraction of local, national and international importance. It will not only link the public and specialist interest in the science related to the Square Kilometre Array telescope (SKA) – Strategic Infrastructure Project 16 (SIP16), but it will also act as a stimulus for job creation, local economic and tourism development, enterprise development, greater access to the worldwide information society and a conducive hands-on science learning environment.

The proposed Carnarvon Science Visitor Centre (Carnarvon SVC) will significantly benefit the Carnarvon community and the surrounding towns of Vanwyksvlei and Vosburg. Some broad impacts that may arise from the development of the proposed Science Visitor Centre in Carnarvon are:

- Personal impact, which is defined as the change in an individual as a result of his/hers contact with a science visitor centre. It includes factors such as science learning; changed attitudes to science, social experience, and career direction formed; increased professional expertise; access to an information society; and personal enjoyment.
- Social impact of a science visitor centre, which is defined as the effect that such a centre generally has on groups of people, organizations, and on the built and natural environment. Examples of this area are local/regional/international tourism; community leisure activities; youth employment; stimulate a culture of entrepreneurship (tours, events, arts, crafts, service providing to the facility); community partnerships; volunteer schemes; local clubs and societies; urban redevelopment; environmental restoration; infrastructure roads, parking, and transport. In addition, the adjoining Schietfontein Township will receive a direct benefit as a result of the establishment of the Carnarvon SVC as a stargazing platform will be constructed in area and a walking trail will be developed to connect the township and the Carnarvon SVC.
- The political impact of a science visitor centre is its influence on governmental policies and priorities. It is the impact on all levels of Government. Relevant examples of this pertain to the delivering on job creation, rural development, skills development, spatial development and tourism development mandates.
- The economic impact of such science visitor centres is generally the direct and indirect effect it has on employment and the local economy. It includes measures such as income brought into the science centre from visitors; income brought into the community and business environment especially retail by visitors; science centre expenditure; new enterprises being created; job creation for staff and outside providers.

- Stimulate science tourism in South Africa. Science tourism is travelling to a location to experience science such as visiting a science visitor centre or science museum and related sites of scientific interest.

The establishment of the Carnarvon Science Visitor Centre will contribute significantly to education, training, skills development and social transformation in Carnarvon and the Kareeberg Local Municipality as a whole. Furthermore, the science visitor centre will be a big tourism and heritage feature in the region while at the same time generating considerable own income to become self-sustainable so that it is not a constant drain on the public sector financial resources.

A basic analysis reveals that the Carnarvon Science Visitor Centre would be viable under the following conditions:

- It is part of the multi stakeholder relationship in the Northern Cape Province.
- It is strategically linked to the SKA Project.
- It benefits financially from the major tourism activities and opportunities that are clustered and linked to it.
- It offers a critical mass of innovative educational and training products and services at opening, and builds on these products and services once fully operational.
- It is developed and operated strictly in accordance with high financial best practices and good corporate governance. All CAPEX and at least 3 years OPEX must be covered by public sector, sponsors and donors.
- It attains the necessary credibility to host science and technology education events and sponsors.
- It is staffed by well-motivated people who operate it in an entrepreneurial and proactive way.
- It operates in close collaboration with other science centres in South Africa and abroad.
- It places strong emphasis on partnership development, and operates as a collaborative and co-ordinator 'innovation hub' with other related and relevant stakeholders.
- It focuses on developing successful in-house and outreach educational and training programmes that have a wide footprint in the Northern Cape.
- Enterprise development plays a big role and is interlinked with SMME development for Carnarvon.

All the above-mentioned conditions are achievable, and the science visitor centre has the potential to contribute significantly to education, training, job creation, local SMMEs and the empowerment of young people in the Kareeberg Local Municipality and the Northern Cape.

The potential exists that the science visitor centre will become a key anchor node for the development of a wide range of education, edutainment, recreational and tourism that will help to rejuvenate the Carnarvon as a town as a whole and provide constructive and transformational activities for the community of the Carnarvon and surrounding towns.

The opportunity also exists that the educational development programmes that will be on offer of the science visitor centre will reach into all corners of the Northern Cape and lead a revolution in the quality of science and technology teaching, and a strengthening of the science culture, throughout the province, especially because of the strong strategic link to SKA.

As many sources of funding are available to successful science centres in South Africa, from both the public and private sector, the Carnarvon Science Visitor Centre could attract increasingly generous donations other national and international donors. This will however be dependent on the key stakeholders on this project successfully launching the Carnarvon Science Visitor Centre over its formative first two to three years.

Interactive/virtual science centres have successfully demonstrated their ability to cost-effectively contribute to science and technology education, and the strengthening of the science culture, in cities, provinces and countries worldwide.

An interactive/virtual science centre is the ideal facility to anchor the Carnarvon Science Visitor Centre as it will provide valuable product and service offerings while at the same time generating considerable own income so that it is not a perpetual dependent on public financial resources, in that it needs to become self-sustainable within at least 3 years.

Furthermore, a science centre is a flexible, dynamic development that can constantly respond to new challenges and opportunities; it will therefore remain relevant to the region's needs well into the future.

The proposed science visitor centre will create an attraction in Carnarvon that is unique in to the Kareeberg Local Municipality and in the Northern Cape, and will from a tourism perspective attract both domestic and international tourist and investment to Carnarvon. It will also encourage Carnarvon residents, and especially the youth, to remain in Carnarvon over weekends and holidays, with further benefits to the local economy.

The science visitor centre during both CAPEX and OPEX phase will create \pm 157 direct and indirect jobs and will in additional also provide short-term opportunities for part-time workers and volunteers. In addition, the development of the buildings and site, the design and manufacture of furnishings, exhibitions and displays, the outsourcing of the restaurant, internet café, coffee shop, science shop, craft and souvenir shop, tourist guides etc. will all create additional jobs. Furthermore, long-term contracts

could be offered for the transport of learners to and from the science visitors centre, and for the transport of travelling displays from the science centre to all parts of the Northern Cape.

Further income generating potential and job creation will also be possible through the establishment of a small accommodation facility to cater for group visitors and other travellers on the Carnarvon Science Visitor Centre plot.

Additional employment opportunities can be created through the enterprise development model that can be run through the Carnarvon Science Visitor Centre for SMMEs, this is especially critical as Carnarvon does not have enough black owned enterprise participating in the local economy.

There are few types of edutainment destinations (especially in the Northern Cape) that promise so much to a town that does not have enough to offer its community. If the science visitor centre is operated as a Non-Profit Company but along strict business lines, it has the opportunity to become a very strong economic and socio-economic driver for Carnarvon and the Kareeberg Local Municipality.

2. Purpose of this report

The aim of this report is to first review the concept of the Carnarvon Science Visitor Centre and then to recommend the optimal way in which the science visitor centre should be established in Carnarvon. Only once the concept is agreed upon the financial viability is done, it is important to understand various operational principles of a science visitors centre first before financial decisions are made. It is envisaged that Carnarvon Science Visitors Centre would have the following components:

- Links with indigenous peoples within the immediate region.
- Digital links with other similar centres around the world.
- Lecture rooms with computers and digital link-up.
- Auditorium for small meetings and seminars.
- Astronomy links to other scientific interests.
- Exhibition space for temporary exhibitions.
- Visitor information office / reception desk.
- SKA Tier 3 Big Data Storage facility.
- Working space for SKA scientists.
- Outdoor space for small events.
- Walking trail to Schietfontein.

- Craft and souvenir shop.
- Maintenance workshop.
- Conference facilities.
- Virtual museum.
- 3D planetarium.
- Tourism kiosk.
- Tourist guides.
- Science shop.
- Internet café.
- Coffee shop.
- Additional Tourism activities.
- Additional Heritage activities.

3. Science centres in South Africa

3.1. The challenge of SMT education in South Africa and abroad

A strong science and technology culture is pivotal to South Africa and the Northern Cape's economic growth, social development and an improved quality of life for all. The development of this stronger science culture in the long term is dependent on the extent to which the youth engages in science, technology, engineering and mathematics. This engagement could take the form of developing an interest in science and science-related disciplines and activities, enrolling in science and maths courses at school, and following tertiary studies and careers in science and maths.

The Department of Science & Technology has developed various programmes to address the challenges of developing a stronger science culture, in particular the 'Youth into Science' strategy (DST, 2005a). This campaign aims to identify, recruit and nurture youth with talent and potential and develop them into a new generation of excellent and representative researchers. Key institutions, organizations, associations and government departments have been invited to support the implementation of the strategy.

The DST has recognized that "Science centres provide an important infrastructure to enthuse and facilitate public participation in science" (p.13, DST 2005a). The DST approved a Norms and Standards

document for science centres in February 2005 to normalize their operations as they had been found, in prior surveys, to operate at different levels of efficiency. The DST now considers that the developing science centre network has "... great potential to contribute towards improved participation and performance in mathematics, science and technology" (p.14, DST 2005a).

The Norms and Standards document requires science centres belonging to the DST-supported network to be:

- accredited so that they meet certain minimum standards
- appropriately positioned and equitably distributed
- of different types, i.e. stationary and mobile, generic and specialized, full service and limited service
- accessible to learners from different backgrounds
- well managed
- monitored in terms of their performance.

Other declarations and initiatives that promote science and technology awareness, and have relevance to science centres, include:

- White Paper on Science and Technology (1996)
- National Youth Policy (1996)
- Year of Science & Technology (1998)
- Public Understanding of Science, Engineering and Technology (PUSET) (1998)
- National Research and Development Strategy (2002)
- Human Resources Development Strategy
- National System of Innovation (NSI)
- National Skills Development Strategy
- National Strategy for Mathematics, Science and Technology Education (2001)
- National Science Week (since 2003)
- Collaboration Agreement between the Department of Education and the Department of Science & Technology (2004)
- National Norms and Standards for Science Centres (2005)
- e-Education programme (2005)
- NEPAD e-Schools Initiative.

The Collaboration Agreement signed by the DST and the DOE identified the network of science centres as a key infrastructure to deliver the interventions of both the 'Youth into Science' strategy and the National Strategy for Mathematics, Science and Technology Education (DST, 2005a).

3.2. The importance of interactive teaching and learning

Science centres have a greater capacity to contribute to interactive teaching and learning than any other educational institutions, such as schools, colleges, universities, museums, aquaria, zoos and botanical gardens. Their key roles are:

- changing the mindset of learners in the direction of more positive attitudes towards, science, maths and technology
- empowering teachers
- celebrating South Africa's achievements in science and technology
- serving as forums for debate on SMT topics (technical as well as social, moral and ethical issues).

3.3. Origin of science centres

Interactive methods of teaching and learning can be traced back over 2 000 years to Greek and Roman scholars. In the modern era, the practical demonstrations of scientific principles by Sir Humphrey Davy and his protégé, Michael Faraday, at the Royal Institution in London, England, in the middle and late 19th century, lead to a widespread appreciation of the value and importance of science and technology.

The first interactive science shows and demonstrations in a museum have been traced to the Deutches Museum in Munich, Germany, in the 1920s and the Franklin Institute in Philadelphia, USA, in the 1940s.

The era of customized interactive science centres started in the mid-1960s with the establishment of the Exploratorium in San Francisco, California, USA, and the Ontario Science Center in Toronto, Ontario, Canada. Both of these founding science centres have played a significant role in the development of the science centre network worldwide. In particular, the Exploratorium cookbooks and snackbooks (manuals on the design and manufacture of interactive displays) have been widely used.

The originator of the Exploratorium, Frank Oppenheimer, emphasized from the outset that science teaching should dominate the design and operation of a science centre, rather than spectacular capital works or opulent décor. The Exploratorium has remained true to his vision and is, in my opinion, still the most inspirational and innovative science centre in the world today, notwithstanding the fact that it occupies a simple building (from the 1908 World Fair), has basic décor and a bare, cement floor.

A measure of the importance of science centres in different countries is reflected by the following statistics:

- Thailand established a new National Science Centre in 2002 at a cost of R726 million.

- The new CosmoCaixa science centre in Barcelona, Spain, was built at a cost of over R1.4 billion
- A new science centre is under construction in China that will cover an area of over 102 000 m²
- China announced in early 2005 that it would build 1 000 new science centres and museums by 2012.

3.4. Concept and definition of an interactive science centre

A widely accepted definition of a science centre is: “A customized educational facility that uses the most effective ways of teaching mathematics, science and technology, i.e. through hands-on, interactive, experiential, learner-driven educational methods”.

This definition emphasizes:

- that science centres are characterized primarily by their teaching method, and not by their physical facility, size, visitor base or managerial structure.
- that the most importance characteristic of a science centre is the efficiency of its teaching methodology.
- that its teaching methodology requires direct involvement by the visiting public, rather than passive learning.
- that learning in a science centre is primarily under the control of the learner, who interacts directly with the displays, without the need for a human intermediary.

The strength of science centres is that they focus on teaching efficiency, but that does not mean that they have to be exact clones of one another. In fact, the best science centres respond to the opportunities provided by their unique environments while learning as much as possible from the experience of other science centres.

Although science centres focus on teaching efficiency, they should not be regarded solely as ‘super classrooms’, i.e. very well- resourced facilities that train learners how to pass examinations. They should rather be regarded as complementing the formal classroom by providing educational products and services that typical science classrooms cannot offer, e.g. laboratories, computer centres, hands-on, practical experience, exposure to cutting edge technology, opportunities to participate in national and international science and technology events.

Science centres should therefore be regarded as an essential component of the educational network, together with schools, universities, colleges, as well as museums, art galleries, aquaria, zoos and career centres.

Science centres, therefore, typically have the following characteristics:

- wholly or mainly interactive
- responsive to new needs and therefore remain relevant
- offer products and services to a wide range of public
- relatively language free
- cater for all cultures
- collaborative and well networked internationally
- forward looking and proactive
- relatively cost effective compared to most other edutainment destinations
- multiple use facilities
- have wide stakeholder bases.

In order to understand the concept of a science centre, it is useful to compare and contrast it with a traditional museum.

Science centres and traditional museums differ in several important aspects. Museums play a very important role in society by curating, displaying and making available for study and research in the long term, cultural history artifacts and natural history specimens. This is an expensive, public service activity that should only be undertaken by State-aided museums. Because of their core business, museums tend to be primarily focused on the past, rather than the future, and tend to have a slow reaction time to new needs. They are typically capital-intensive projects, and their presentation style (look-but-don't-touch) is dominated by the need to preserve the integrity of their valuable, and often irreplaceable, collections. The artifacts and specimens in museums often require a detailed description in order for the visiting public to understand their significance. Their displays and exhibitions are, as a consequence, often burdened with heavily worded labels written by experts who have little appreciation of the needs of the visiting public.

In contrast, science centres are populated with displays that are designed to be educational and require little explanation. Furthermore, the displays can be constantly changed, and discarded if necessary, as they have no intrinsic historical value. They can also be interpreted with simple labels. Most importantly, the displays are designed to be interactive, to be directly handled by the visiting public, and are not confined behind glass in cabinets.

As the goal of science centres is to demystify science and technology, they tend to be focused on the changing future, rather than the unchanging past, and constantly seek new ways of presenting their

subject matter in exciting and provocative ways. For this reason, science centres should not be regarded as new-age museums – they are educational facilities in their own right with their own, unique methods of teaching, although some of their techniques developed originally in museums.

There is now a strong trend for the best characteristics of science centres as well as traditional museums, libraries, resource centres, career centres, teacher training centres, theatre complexes, conference venues, and even aquaria and music conservatoires, to be combined into one, large, multi-functional facility. This is evident, for instance, in the Cité des Sciences et de l'Industrie in Paris, France, the Powerhouse Museum in Sydney, Australia, the Liberty Science Center in Jersey City, USA, and CosmoCaixa in Barcelona, Spain.

Furthermore, many modern museums have introduced interactive galleries into their facilities in order to encourage visitors to engage directly with some of their displays, e.g. the Launch Pad at the Science Museum in London, England, and All Hands on Deck at the Maritime Museum in Greenwich, England.

The concept of a science centre is continuously being re-invented in response to new technological innovations and display techniques. Virtual reality techniques have been introduced into many modern science centres, and the IBM TryScience Kiosk allows visitors to make virtual visits to science centres in other continents. There is talk of virtual science centres that will only exist on the internet, but their validity is questioned as they would not allow hands-on interaction with in-the-round displays, the hallmark of a successful science centre.

3.5. Goals of a science centre

The broad goals of a science centre are:

- to demystify science and technology and make it more accessible to the general public
- to change the mindset of learners so that they are more responsive to science and technology teaching in the formal environment
- to introduce interactive methods of teaching and learning
- to strengthen the science culture
- to create a public domain platform for debates on science and technology
- to showcase science and technology innovation, including indigenous knowledge systems.

3.6. Science centre development internationally

From humble beginnings in the USA and Canada in the mid-1960s, science centres have grown into a worldwide phenomenon that is having a major impact on public understanding of, and engagement in,

science, mathematics and technology. In many countries, science centres are now the leading institutions through which the public and the private sectors expose the general public to new scientific and technological advances, and in which debates take place on the value and ethics of scientific advances. Science centres have, furthermore, taken the lead in making science and technology accessible to the youth, especially in developing countries, and play a major role in encouraging young people to follow careers in science, technology and engineering.

3.7. Science centre development in Africa

No continent, other than Antarctica, has fewer science centres than Africa, yet Africa is the continent that stands to benefit most from the teachings of science centres.

Four countries in Africa that have well established science centres are: Egypt, Tunisia, Botswana and South Africa. Previous research showed that there are not many other interactive science centres in central, east or west Africa, although initiatives are currently underway to establish science centres in Nigeria, Cameroon, Kenya, Swaziland, Namibia and Angola.

3.8. DST policy towards science centres in South Africa

The White Paper on Science & Technology (1996) recognized the role of public understanding of science, engineering and technology (PUSET) in the development of South Africa's National System of Innovation (NSI). The NSI, in turn, recognizes the importance of science centres in PUSET.

The DST has described the goals of the envisaged network of science centres as follows (DST, 2005b):

- to promote science literacy among the youth and the population in general
- to identify and nurture talent and potential in science, technology, engineering and mathematics (STEM)
- to enhance learner participation in STEM, and
- to provide career education in general and STEM in particular among the youth.

In order to support the development of the science centre network, the DST has undertaken to do the following (DST, 2005b):

- improve access to science centre services by the target audience (mainly underprivileged children)
- upgrading existing science centre infrastructures
- developing the capacity of science centre staff to manage and develop their facilities

- providing financial support for specific Puset programmes determined by the DST, such as National Science Week, theme months, World Space Week, PUB
- establishing an accreditation process for science centres
- operational support in the form of internship and learnership programmes, fixed rate subsidy for every learner visiting a science centre, negotiation of funded provincial posts in science centres.
- developing an evaluation and monitoring system for science centres, through the Science and Youth Unit of the DST.

The Carnarvon Science Visitor Centre will be well positioned to benefit from DST support which is critical to its establishment and existence.

The DST has furthermore defined two broad development models for science centres (DST, 2005b):

- Redress model: This model focuses on improving access to science centre services by establishing small science centres in rural areas. These would mainly be 'Limited Service' science centres, i.e. they would provide a limited range of services.
- Public Private Partnership (PPP) model: A PPP is a contract between a public sector institution and a private party, in which the private party assumes substantial financial, technical and operational risks in the design, financing, building and operation of a project. This model is intended to afford South Africa the opportunity to develop large science centres of international stature, and to provide the DST with the opportunity to fairly value all the proposals that it receives from private organizations to develop science centres.

These would mainly be 'Full Service' science centres, i.e. they would provide a wide range of services. One 'Full Service' science centre would be established per province, and they would be developed and operated in terms of Treasury Regulation 16 of the Public Finance Management Act (PFMA) of 1999.

The DST has undertaken to implement these models of science centre development by 2008 (DST, 2005b). The Carnarvon Science Visitor Centre at best is aligned to the 'Full Service' science centre for the Northern Cape.

3.9. Science centres in South Africa

The table below lists all the science centres that have been established in South Africa:

Province	Science Centre	Telephone Number
Eastern Cape	FOSST Discovery Centre Nelson Mandela Bay Science Centre Sasol Inzalo Foundation	040 602 2160 041 978 8070 011 3 443 636
Free State	BOYDEN Observatory	051 401 3507
Gauteng	ArcelorMittal Science Centre Vanderbijlpark Hartebeesthoek Radio Astronomy Observatory Johannesburg City Parks The South African Nuclear Energy Corporation National Zoological Gardens Sci-Enza Science Centre Sci-Bono Discovery Centre University of JHB Soweto Science Centre Moipone Academy	016 988 0509 012 326 0742 011 712 6758 012 305 5310 012 328 3265 012 420 2865 011 639 8400 011 559 5756 082 979 8898
KZN	ArcelorMittal Science Centre Newcastle Isibusiso Esihle Science Discovery Centre Olwazini Science Centre STEC-UKZN Science Centre The KZN Science Centre Unizulu Science Centre	034 314 1247 072 737 5522 033 395 8230 031 260 2524 031 830 5380 035 797 3204
Limpopo	Bokamoso Science and Technology Centre Giyani Science Centre University of Limpopo Science Centre Vuwani Science Centre	083 471 3414 015 812 3782 015 268 3099 015 962 8000
Mpumalanga	Anglo-American Science Centre Mondi Science, Career Guidance and FET Skills Centre Osizweni Education Development Centre Penreach Shalamuka Science Centre	013 691 9353 017 265 703 017 689 2005 013 758 9092
Northern Cape	Mothibistad Science Centre	082 937 3826
North West	NWU Mafikeng Science Centre NWU Potchefstroom Science Centre	018 389 2606 018 299 4236
Western Cape	ArcelorMittal Science Centre Saldanha Bay Cape Town Science Centre iThemba Labs South African Astronomical Observatory South African National Space Agency	022 719 1479 021 300 3200 021 843 1000 021 469 9319 028 312 1196

South Africa Agency for Science and Technology Advancement (SAASTA)

4. Northern Cape Schools Analysis

According to the Northern Cape Department of Education (Annual Performance Plan 2016/17), the Northern Cape had a total of 544 public ordinary schools, 11 special schools and 30 private/independent schools. The learner educator ratio for the province in public schools was 29,8 learners per educator and on average there were 494 learners per school for public schools. This number had decreased from the 2013 Snap Survey (506). Frances Baard District Municipality has the most (90 498) learners but John Taolo Gaetsewe District Municipality has the largest number of schools (170). Schools in Frances Baard tend to be larger schools with an average of 732 learners per school. Namakwa District Municipality consist of a total of 21 926 learners in 72 schools which results in an average of 281 learners per school with 26,7 learners per educator.

In 2016 the average learner growth over the last five years was 1.17%. The growth from 2015 to 2016 was 0.5%, and projections for the next following 5 years suggest that the Northern Cape Province will have well over 300,000 learners in 2019. The table below gives a summary of the Northern Cape provincial schools statistics for 2016.

Table 1: Northern Cape provincial schools' summary 2016

District Municipality	No. of Learners	Learners as % of provincial total	No. of Schools	Learners as % of provincial total
Frances Baard	92 754	32%	127	22%
John Taolo Gaetsewe	73 819	25%	175	30%
ZF Mgcawu	56 568	19%	102	18%
Pixley Ka Seme	46 120	16%	92	16%
Namakwa	22 229	8%	78	14%
	291 490		574	

Source: Northern Cape Department of Education Annual Performance Plan 2016/17

5. Tourism Sector Analysis

The Northern Cape comprises of one of the most unique landscapes in the country, and it also comprises of exceptional natural and cultural attributes offering potential for the development of tourism. The provincial tourism vision and mission is stated in the Northern Cape Tourism Master Plan (Revised 2015) which captures the objective of the Carnarvon Science Visitor Centre:

- **Northern Cape Tourism Master Plan Vision:** “By 2020, the Northern Cape will be on track to be known as South Africa’s most authentic adventure destination known for its unique variety of nature, adventure, cultural, extreme and special interest tourism offerings through the responsible development of natural and cultural resources.”
- **Northern Cape Tourism Master Plan Mission:** “We strive to increasing tourist visitation and expenditure to maximising employment and economic opportunities for the citizens while ensuring the responsible and sustainable development of the tourism industry through stakeholder collaboration, good governance and accountability.”

According to the SA Tourism 2016 Annual Tourism Report, International Tourism Performance, in 2016 the market size of tourism in SA reached 34.3 million (Mn) trips (24.3Mn domestic trips and 10.0Mn international arrivals). This resulted in a 2.8% growth compared to the 33.4Mn trips in 2015 for the country.

The volume size of domestic trips has been on a steady decline since 2014. Trips are mainly affected by two factors; number of people travelling and how often they chose to travel. In 2016 fewer people (11.7Mn) decided to travel than usual however the positive is that those who have travelled increased their frequency of travelling from 2.0 to 2.1 trips.

The decline in domestic trips was driven by declines in Holiday and Visits to Friends and Relatives (VFR) trips, which both had decreases of -3.1% and -1.0% respectively. Business trips and tourist travelling for other purposes grew by 21.8% and 18.4%. However, the double-digit growth in business and other trips had a minimal impact on overall trips as they only account for a smaller share (SA Tourism 2016 Annual Tourism Report, International Tourism Performance).

The SA Tourism 2016 Annual Tourism Report, International Tourism Performance, further reports that international tourist arrivals fully recovered from the 2015 decline and grew by 12.8% to reach a record high of 10.0Mn arrivals in 2016. This meant that an additional 1.1Mn tourists have chosen to visit South Africa compared to other destinations. The growth in international tourist arrivals to South Africa were driven by the increase in arrivals across all regions with Central & South America, Middle East and Asia growing by over 30% (albeit from small base) while other regions grew in double-digit.

International tourist who came to South Africa for the purpose of visiting friends and relatives was mentioned as the main reason why tourist visited in 2016. It grew by 24.1% to reach 3.3Mn tourists. Holiday tourist grew by 9.3% while MICE contracted by -7.3%. Religious and medical tourism recorded strong growth although from a very small base. In MICE segment there was a decline specifically in tourist coming for conventions (-18.6%) and Exhibitions (-3.1%) while Meetings and Incentive groups recorded an increase.

In 2016 the tourism market value size of tourism reached R 102 billion (Bn) (domestic R 26.5Bn, international R 75.5Bn) and this is 11.1% increase than the R 91.8 Bn in 2015 (SA Tourism 2016 Annual Tourism Report, International Tourism Performance).

Domestic tourist's revenue: increased by 12.3% from R 23.6 billion in 2015. This increase in domestic revenue was driven by tourists spending R 20 more per day than usual and this resulted to additional R 2.7 billion. Tourist increased the length of their holiday by 1.6% and this resulted to R 0.4 billion in 2016. The domestic tourists who took a trip in this period spent more per trip and stayed longer than previous years.

International tourist revenue: increased by 10.8% to record R 75.5 billion. The growth in spent was driven by change in volume resulting in R 8.7 billion; spend per day increased by 1.5% resulting to additional R 1 billion rand, average length of stay dipped by -2.9% and resulted to a loss of close to R 2 billion. The Rand strengthened against most currencies across the world; the currencies that weakened the most in 2016 were the Mozambican Metical, Nigerian Naira, Angolan Kwanza and the British Pound. Despite the weaker currencies the tourists spend grew in each of the regions.

Tourist spend most of their money on shopping for personal items, this category was estimated at R 26 billion in 2016 and it grew by 16.4%. The tourism sector benefited from the increase in international tourist arrivals as money spend on food, transport and leisure related actives all grew. The only sector that remained stable was accommodation. Holiday tourists drove the increase in spend both among domestic (24.4%) and international tourists (10.3%). Among domestic tourist's business, medical and religious tourists saw double digit growth in spend while VFR tourist spend grew by 5.6%. Among international tourists only VFR and medical tourists spend grew while business and religious tourists spent less in 2016. The table below gives a summary of the Northern Cape provincial foreign tourism statistics for 2016.

Table 2: Northern Cape Foreign Tourist 2016

Northern Cape Foreign Tourist (2016)	Arrivals	Spend	Length of stay	Bednights	% visiting other provinces
	98 214	R 635 000 000	8	768 000	26

Source: SA Tourism 2016 Annual Tourism Report: International Tourism Performance

Table 3 below gives a summary of the Top 10 Attractions in the Northern Cape for the fourth quarter of 2016. The table clearly indicates that there is a dedicated interest and spend for stargazing thus further supporting the business case for the Carnarvon SVC.

Table 3: 2016 Top 10 Attractions: Northern Cape

2016 Top 10 Attractions: Northern Cape	
Kimberley Big Hole	36.8%
Diamond Mall	31.6%
Kimberley Museum	26.2%
Mokala National Park	22.8%
Augrabies Falls	22.1%
Namaqualand Flowers	16.3%
Kgalagadi Transfrontier Park	16.1%
Blue flag beach at Mcdougal Bay	8.7%
San Cultural Villages (e.g. Khomani San Village etc) (Specify)	5.4%
Sutherland and Carnarvon - Stargazing (Salt and SKA)	4.6%

Source: SA Tourism Index Q4 2016: International Tourism Performance

The Karoo region and the Karoo National Park was listed number 19 on the Top 40 attractions or land marks visited by tourist in South Africa for 2016. A total of 193 000 tourist visited the Karoo region and the Karoo National Park in 2016 (SA Tourism 2016 Annual Tourism Report, International Tourism Performance).

Table 4: Tourism related events that take place in and around Carnarvon.

EVENT	2016/17	2015/16	2014/15	2013/14	2012/13	2011/12	2010/11	REGION
Carnavon Fly-in	No event	No event	No event	900	500	150	-	Carnavon - Pixley ka Seme District Municipality
Williston Winter Festival	8 269	4 400	4 500	1 860	800	800	362	Williston - Namakwa District
Carnavon Kreeberg Festival	No event	No event	No event	5 000	900	700	600	Carnavon - Pixley ka Seme District Municipality
AfrikaBurn	13 000	9 264	9 000	-	-	-	-	Hantam Karoo - Namakwa District
Karoo Cooking & Culture Festival	No event	5 000	600	-	-	-	-	Calvinia - Namakwa District

5.1. Tourism Benefits of Science Visitor Centres

Science tourism is targeted both to scientists traveling to specific places and sites for research purposes and to tourists with specialized interests in cultural and natural heritage. This has given rise to the development of science visitor centres and science museums.

Science centres and science museums have a significant impact on destination visitation figures with the top ten such facilities in the world attracting visitor figures of between 1 400 000 to 5 000 000 people in 2010 while the top 10 centres in the USA generated annual numbers ranging from 600 000 to 1 605 020 visitors.¹

According to the Singapore tourism website, the Science Centre in Singapore (S.C.S) is “an engaging venture of the Science Council of Singapore to promote scientific and technological knowhow in the country.” More importantly it is reported that it attracts more than a million visitors a year and is popular with families too.²

Furthermore, the Canadian Association of Science centres unambiguously states that science centres and similar organisations engage 8 million Canadians annually with innovative learning opportunities. These organisations are a fundamental part of the culture of innovation in Canada.³

In addition, the Multilateral Investment Fund (MIF), a member of the Inter-American Development Bank (IDB) Group, assisted the Chilean government to develop its Aysen region as an international science tourism destination on the basis that it had significant benefits for the local economy and tourism enterprises in the region. It is argued that the project would lead to improving the delivery of quality tourism services, and promoting the establishment of a participatory management model for the development of science tourism products. ⁴

Finally since 2007, The Chilean Center for Research on the Patagonian Ecosystem (CIEP) has generated tourism research, innovation, and technology transfer projects through the creation and implementation of a “Science Tourism Center”. This initiative objective is to bring scientific knowledge to the tourist experience, promote participatory strategies for the generation of new knowledge and ensure knowledge and skills transfer to promote the conservation of the region’s cultural and natural heritage.⁵ Admittedly, even though the planned Carnarvon SVC will be a relatively small facility compared to its world counterparts, the dynamics will largely be the same.

¹ (Source: <http://museumplanner.org/worlds-top-10-science-centers/>).

² (See www.remarkablesingapore.com)

³ (Source: www.canadiansciencecentres.ca).

⁴ (Source: <http://www.fomin.org/PORTADA/Noticias/Comunicadosdeprensa/TabId/511/ArtMID/3819/ArticleID/52/The-MIF-Works-to-Enhance-Scientific-Tourism-in-Chilean-Patagonia.aspx>).

⁵ (Source: <http://www.fomin.org/PORTADA/Noticias/Comunicadosdeprensa/TabId/511/ArtMID/3819/ArticleID/52/The-MIF-Works-to-Enhance-Scientific-Tourism-in-Chilean-Patagonia.aspx>).

As a result, the information on the impact of science centres and science museums on tourism as outlined above, it would be a reasonable assumption to make that the planned facility development would positively impact through, amongst others, its tourism industry on the local and regional economy.

Furthermore, the Carnarvon SVC will derive synergies for sustainability from the science visitor centres in Sutherland (Northern Cape), Hartebeestpoort Dam (Gauteng) and others in South Africa. At the same time, it will present South Africa with an opportunity to put on special displays on the work of South African radio telescope astronomers thus further stimulating and increasing visitor interest in the facility.

The Carnarvon SVC will also act as the official tourist information centre to the area and this will be offered alongside all the other features of the facility. This is an important development as Karoo is becoming an ever more popular destination in the Northern Cape and will continue in this manner as the provincial government developed Karoo Highlands Route come on stream in 2015. (The Karoo Highlands Route spans the southern areas of the Northern Cape, otherwise known as the Karoo, from Victoria West in the east to Calvinia and Niewoudtville in the west. Carnarvon is expected to be an important staging post on this route.)

The role of visitor information centres within the tourism industry is increasingly perceived as both integral to travel patterns and strategic in tourism planning. Fallon and Kriwoken (2002) in their comprehensive study of the Strahan SVC (Tasmania), suggest that the place of the SVC in tourism has been raised because of the complexity of government and community needs.

The key aim of visitor information centres, however, is to provide knowledge to visitors, although there is little standardisation of the ways and means of providing this information (Lee 1998). Further to this, various writers such as Moscardo (1993; 1998; 1999), Pearce (1991) and Wylde (1996) suggest that there are other key functions of visitor information centres. These include marketing an area and then promoting access to this area; enhancing the visitor experience through the provision of information on the area; controlling and filtering the number of visitors to reduce visitor pressures on resources, and providing an actual substitute for the visitor experience. For example, many visitor information centres have displays and interpretive centres associated with them that become an attraction in their own right.

The role of the visitor information centres is significant in that, if done well, it can help increase visitor stay and visitor expenditure in the region (Tierney 1993). In undertaking this role of providing tourist information, two main determinants will increase the yield from the visitor information – effective communication skills and the capacity to handle large numbers of visitors (Hansen & Eringa 1998).

5.2. Visitation at edutainment destinations

Research has found that black South Africans are not regular visitors to edutainment destinations, such as museums, science centres, and aquaria in South Africa, in relation to their proportion in the total population, although few accurate statistics are available in this regard. However, this is proven in the Western Cape where black people constitute about 76% of the population, but they represent less than 5% of the self-initiated visits to the MTN Sciencentre (and to the Two Oceans Aquarium on the V&A Waterfront); the great majority of their visits take place through sponsored school group arrangements. This therefore means that a similar trend could be relevant for the Northern Cape.

This is a pattern however that could be broken in Carnarvon, as the Carnarvon SVC will be in walking distance of the townships and suburbs that are mainly populated by PDIs. A very concerted effort needs to be made to make the Carnarvon SVC attractive, hospitable and relevant to all races. The displays, exhibitions and educational services should not only support curriculum-based teaching, but should also showcase the latest scientific and technological innovations and act as a showcase for the SKA Project situated approximately 80km from the site of the Carnarvon Science Visitor Centre.

The Carnarvon SVC also has considerable potential to act as a major tourist destination in the Kareeberg Local Municipality as the region lacks cutting edge attractions. The Carnarvon SVC will be perfectly located to provide an interactive and participative experience that will allow visitors to obtain an understanding of the scientific and technological principles behind the development of the SKA.

5.2.1. Visitation

Attracting large numbers of visitors is a primary goal of a science centre, but this should not be achieved at the expense of the quality of the individual visit. A fine balance needs to be achieved, therefore, between maximizing visitation (and gate income) and providing a meaningful experience for every visitor. While it is tempting to maximize income by driving visitor numbers, it is more prudent to depend less on gate income and to give higher priority to other sources of income.

It is recommended that dependence on gate income, as a percentage of total income, should not exceed 50%. While this figure may be difficult to achieve initially, it should stand as a long-term goal. In the case of the MTN Sciencentre, gate income represented >80% of total income in Year 1, and has gradually reduced to <45% total income in Year 5.

5.2.2. Typical visitation trends for an edutainment destination

Worldwide, a typical pattern of visitation for an edutainment destination (new museum, science centre, aquarium, zoo) is as follows:

- High first year attendance due to novelty value
- 40-50% drop in attendance in Year 2
- Build up to 60-80% of Year 1 attendance over a period of 5-10 years.

Many science centres in South Africa have jumped this trend and experienced steadily increasing VPAs throughout their first 5-10 years of existence, due to a retained novelty value and constant changing of displays and exhibitions.

The typical ways of increasing VPAs are:

- Increase new visitations by offering a quality visitor experience that is well publicized
- Increase return visitations by constantly changing displays, exhibitions and special events
- Establish a 'Society of Friends' to reward your most valued clients
- Organize a variety of events that encourage people, who would not otherwise visit the science centre, to experience it for the first time, e.g. product launches, corporate events, life skill training programmes, media events, videocasts, competitions, film festivals, debates, talks and celebrity appearances.

5.2.3. Visits by people from historically disadvantaged communities

In South Africa, and particularly in the Northern Cape, one of the primary goals of science centres is to maximize visitation by PDIs. This can be achieved by:

- Keeping entrance fees low
- Arranging sponsored transport and entrance fees
- Lobbying the provincial Department of Education to classify science centre visits as a compulsory part of the school curriculum (as is the case in Mexico)
- Offering programmes that are of interest and relevance to PDIs.
- Catering for the language and any other special requirements of PDIs, including differently-abled visitors.

The actual VPA will depend on a number of factors:

- Ticket prices, and overall cost of a visit to the Carnarvon SVC

- The novelty and relevance of the edutainment attraction offered by the Carnarvon SVC
- The quality of the formal and informal education programmes that are offered
- The mix of entertainment, recreation and leisure offered at the overall site (the more entertainment and recreation, the higher the VPA to the Carnarvon SVC)
- The quality and impact of the partnership development, public relations and marketing campaigns
- The levels of sponsorship acquired for sponsored school group visits
- The frequency with which the Carnarvon SVC offers new displays, programmes and events for the visitor (to encourage return visitation)
- The strength of the 'Society of Friends' and the electronic database of external stakeholders.

Year-on-year growth of VPA could increase by 8-10% through natural increase, but could be substantially higher if substantial sponsorship is raised from the regional or national government, or from corporates, for substantially increased sponsored school group visits.

6. Context of a science visitors centre in Carnarvon, Kareeberg LM

Carnarvon is situated on the R63 – 140km from Williston and 63km from Loxton – falling under the jurisdiction of the Kareeberg Local Municipality, and more broadly within the Pixley ka Seme District Municipality of the Northern Cape. Within the Kareeberg Municipality, the nearest towns are Vanwyksvlei and Vosburg, as well as the township of Schietfontein.

In its Master Plan, the Northern Cape Government identified key attractions and gateways to stimulate its tourism initiative. With the futuristic development of the Karoo Array Telescope (MeerKAT) and the Square Kilometre Array Radio Telescope (SKA), the Northern Cape Province can expect an even greater number of visitors, especially in the town of Carnarvon.

The largest chunk of the SKA infrastructure will be built in Africa, with the core and highest concentration of receivers being constructed about 80km from the town of Carnarvon.

According to the Northern Cape's Provincial Spatial Development Framework (PSDF 2012), the SKA core near Carnarvon will be supported by satellite stations in Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia. Together, the combined collecting area of these antennas will be roughly one square kilometre.

Furthermore, as one of the largest scientific research facilities in the world, it is envisaged that the SKA radio telescope (and MeerKAT) will consolidate the Southern African region as a major international hub for astronomy and cutting-edge technology. The planned development area for the Astronomy Reserve and identified SKA Corridor in the Northern Cape largely covers the Pixley ka Seme District Municipality.

As a good demonstration of its science, technology and engineering skills, South Africa has already designed and started construction on the MeerKAT telescopes, which will act as a pathfinder to the SKA project. The first seven dishes of the MeerKAT project– referred to as KAT-7 – were completed in December 2010 and have already produced their first pictures converted from radio waves. KAT-7 is the world’s first radio telescope array. By 2016, 64 MeerKAT dishes will be constructed in the Karoo. This will be followed the construction of 190 dishes forming Phase 1 of the SKA development.

According to SKA Africa, the technology being developed for MeerKAT is cutting-edge and the project is helping to create a large group of young engineers and scientists with world-class expertise in the technologies. As part of an e-Schools initiative, the SKA South Africa Project, the Department of Science & Technology and the Northern Cape Department of Education launched two new computer laboratories at Carnarvon High School. In addition, it also launched two e-School initiatives in Carnarvon.

The concept behind the establishment of a unique SVC in Carnarvon is to benefit the following:

- the Northern Cape tourism industry and tourists to the region;
- the astronomy community;
- the local business community;
- the local communities, particularly learners in and around the Carnarvon area and in both surround local and district municipalities; and
- the stakeholders and interested parties involved in MeerKAT.

As a service industry, tourism has tangible and intangible elements, which continues to contribute towards job creation. As a result of the SVC these elements will be, amongst others, stimulated by enriching the experience of the visitor. Given that Government aims to increase tourism’s contribution, both direct and indirectly, to the economy to R499 billion by 2020 (National Department of Tourism, 2012), the Carnarvon SVC will significantly contribute toward this target. More particularly, as a further project-related benefit and outcome, this development will benefit rural tourism, which is another strategic objective of the Province.

A successful interactive science visitors centre has the potential to become a major visitor attraction and educational facility in Carnarvon, which would establish this historical town as the hub for SMT education in the Northern Cape. If Carnarvon takes the initiative in this regard, other developments will follow that will firmly establish the Carnarvon Science Visitor Centre as the flagship project for the province, and the possible location to host National Science Week and other important local, district, provincial, national and international events.

The Kareeberg Local Municipality is mainly driven by the agriculture industry (primarily on sheep farming) and some tourism, whilst SKA has now also become a significant feature of the region. The region’s economy is not well diversified. Small stock and game farming dominate the semi-arid areas of the

region, with few other opportunities for employment outside of agriculture and government. The region is thus very vulnerable to fluctuations in the agricultural market.

It is clear that with the appropriate funding, the development of a SVC in Carnarvon will economically enhance the ability of local communities of the Kareeberg Local Municipality – especially those residing in the town of Carnarvon. The areas will also be boosted by an increase in international and local tourists resulting in an increase in foreign direct investment.

The SVC will also create potential job opportunities for locals and probably boost the growth opportunities of small enterprises.

Through this proposed SVC there will also be a spill-over into other local tourist attractions in and around the town of Carnarvon and within the wider Kareeberg Local Municipality. These other attractions provide the opportunity for tourists to benefit from a more varied experience given the diversity of natural and historical attractions such. This should lead to local tourist-focused businesses benefiting from developments linked to the SKA and MeerKAT projects and developments.

In an effort to aid in the improvement of spatial integration of poor areas surrounding Carnarvon, the project aims to include the neighbouring township of Skietfontein by means of a walking trail between the towns, together with the development of a stargazing point in Skietfontein with guided tours for small groups.

It is a further objective of this aspect of the project to contribute toward SMME development and job creation in the poor surrounding areas.

The main factors that distinguish the Kareeberg Local Municipality as an investment destination are:

- Availability of land
- transport network
- Political stability
- Sustainable development.

Two obvious shortcomings in this list are:

- Lack of tourist destinations in spite of the tourism potential
- Lack of publicly accessible science and technology education and training facilities
- Lack of edutainment facilities for young people.

The establishment of science visitors centre in Carnarvon would help to overcome these disadvantages, and further strengthen the Kareeberg Local Municipality's case as an optimal investment environment.

The Carnarvon SVC would not only serve the population of Carnarvon and Kareeberg Local Municipality, but also the greater Pixley ka Seme District, and the Northern Cape. If a substantial facility with first class products and services is established, it will be visited by adults and children from throughout South Africa by local and foreign tourist.

There will be no overlap between the similar facilities closets to Carnarvon, such as the Sutherland Visitors Centre, instead the objective will be to establish linkages and partnerships between similar facilities. No other science centres are currently planned for or being established in the Northern Cape and thus further rationale for the establishment for the Carnarvon Science Visitor Centre.

7. Policy Contextualisation

There are a number of different policy and development perspectives from which the broader SKA and MeerKAT developments are identified and approached in strategic policy and planning documents at national, provincial and local levels of government.

7.1. National Policy

The National Infrastructure Plan of 2012, which aims to, amongst others, transform the economic landscape of South Africa while simultaneously creating significant numbers of new jobs, the National Government has identified 18 Strategic Integrated Projects (SIPs). Government has identified SKA and MeerKAT as SIP 16, a Knowledge SIP. In this way, Government has recognised the development and growth potential of SKA and MeerKAT from a Science & Technology perspective as a global mega-science project. Furthermore, at a national level, and also from a Science & Technology perspective, the National Development Plan (NDP 2030) highlights and acknowledges South Africa's potential to develop its capability in astronomy through SKA and MeerKAT developments.

7.2. Provincial Policy

The Northern Cape Provincial Development and Resource Management Plan/Provincial Spatial Development Framework (PSDF 2012) recognises SKA and MeerKAT's potential to serve as an example of how the Northern Cape Province has become an international economic, scientific and environmental focal area. This is of particular relevance given National Government highlighting the Northern Cape as one of the lagging provinces in terms of economic growth and development.

Over and above Science & Technology Development goals, the PSDF also highlights the Tourism perspective. In particular, the document suggests that in line with the objective of Responsible Tourism, the tourism potential presented by SKA and MeerKAT and other Science & Technology components should be utilised and developed.

7.3. Local Policy

From a Local Government Perspective, the municipal's Integrated Development Plan (IDP 2011-2016) highlights SKA and MeerKAT as important developmental issues.

In terms of the SWOT Development Analysis done for the District as a part of its IDP, the SKA and MeerKAT projects were identified as a major opportunity for development in the region. Ultimately, with the priorities of local economic development, increased tourism, poverty alleviation, education, youth development and job creation, the intended benefits of the SKA and MeerKAT projects and their identification as development opportunities imply that the SKA and MeerKAT projects will inform the development strategies which will be adopted by the Council for the region.

Furthermore, within the Kareeberg Local Municipality's IDP (2011-2016), local economic development is a key issue. According to the IDP, local economic opportunities are sadly lacking within the Kareeberg Local Municipality. It is characterised by high levels of migrant labour, yielding negative effects on service delivery and infrastructure in the Municipality. There are high levels of unemployment and low levels of education, with few opportunities for either to improve.

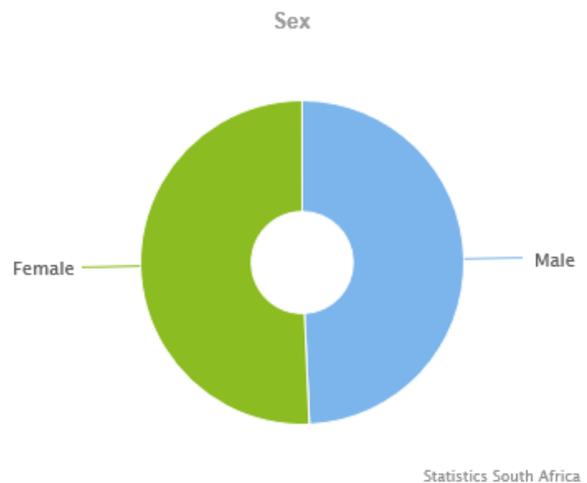
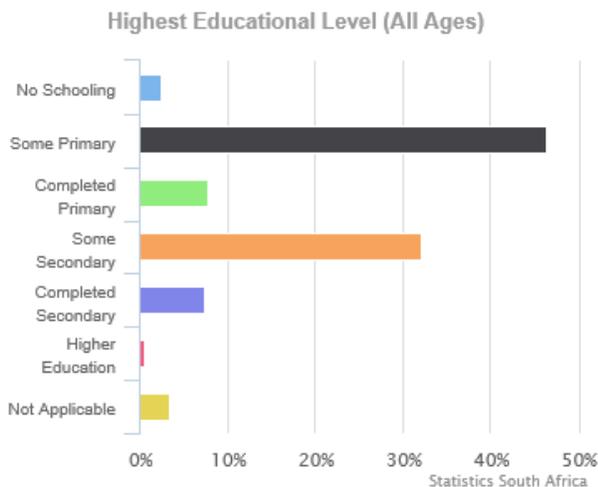
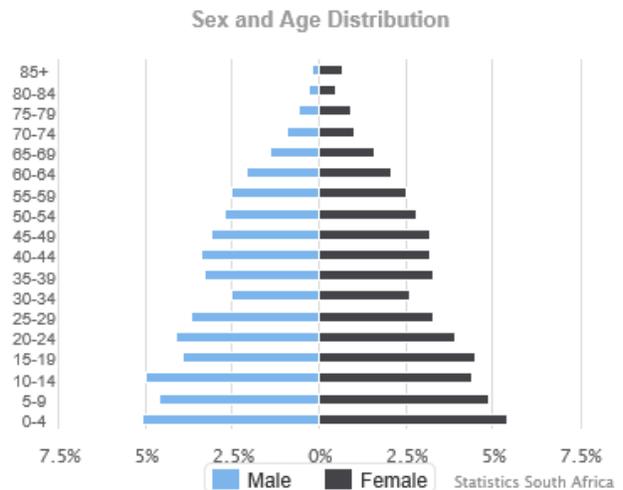
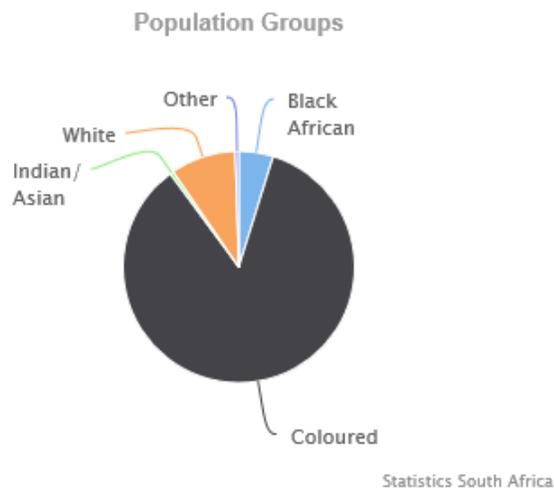
8. Demographics of Kareeberg Local Municipality

The Kareeberg Local Municipality is characterised by a high degree of poverty and a low degree of education. Due to the high rate of unemployment in the area, most locals are economically inactive in a declining economy that is based primarily on sheep farming. Poverty and indigent people are a major problem for the Municipality, with growth and economic development opportunities sadly lacking in the area. Often, large numbers of the population leave the Municipality to seek employment in other towns and provinces. The Kareeberg Local Municipality is situated in the western part of the Pixley ka Seme District Municipality of the Northern Cape Province. The District is made up of nine local municipalities, of which Kareeberg is the second smallest. The Kareeberg Local Municipality was established through the amalgamation of the towns of Carnarvon, Vosburg, Vanwyksvlei and a large area made up of rural farmland. Carnarvon is the administrative centre of the Kareeberg Local Municipality, and is located on the main route from Kimberley/Bloemfontein to the Southern part of Namakwaland and the West Coast.

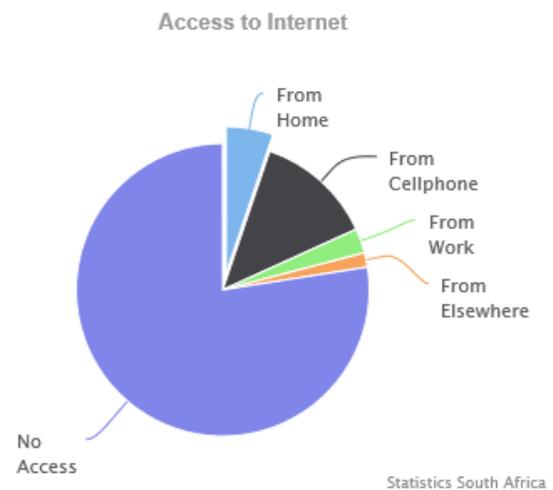
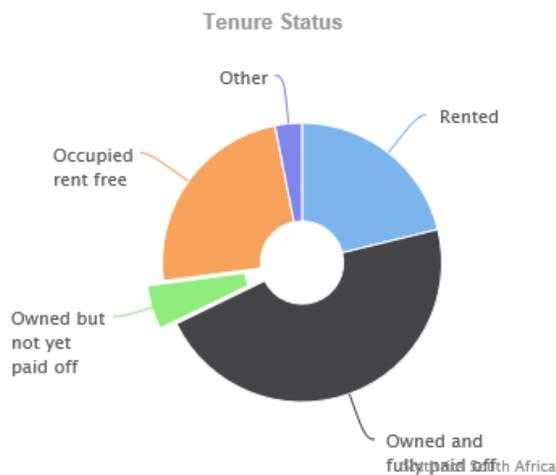
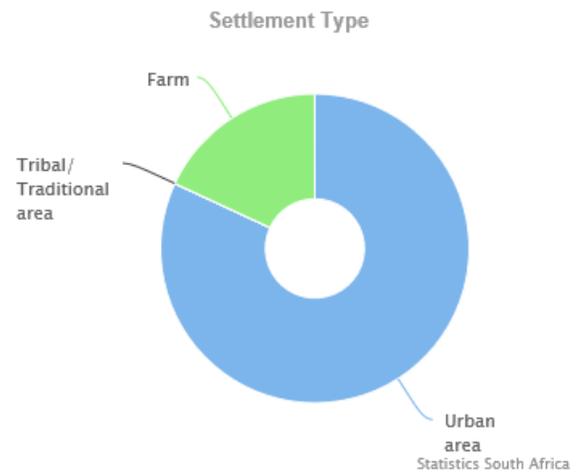
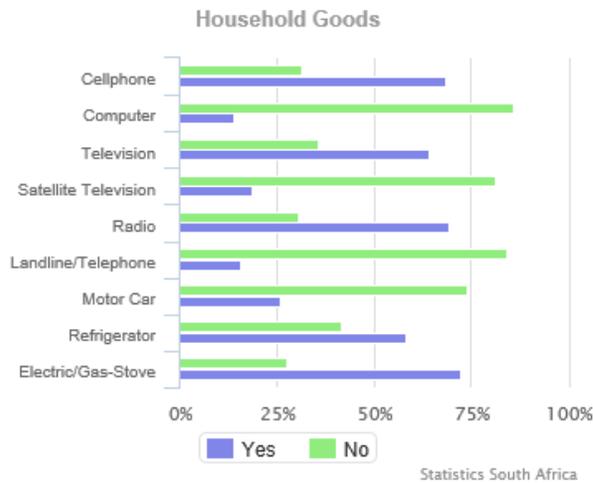
In terms of the spatial overview of the Kareeberg Local Municipality, Carnarvon is considered to be an urban centre, while Vosburg and Vanwyksvlei are identified as rural service centres. Most of the settlements in the Kareeberg Local Municipality are very small and far apart, making it difficult for regional services schemes to be economically viable.

Kareeberg Local Municipality

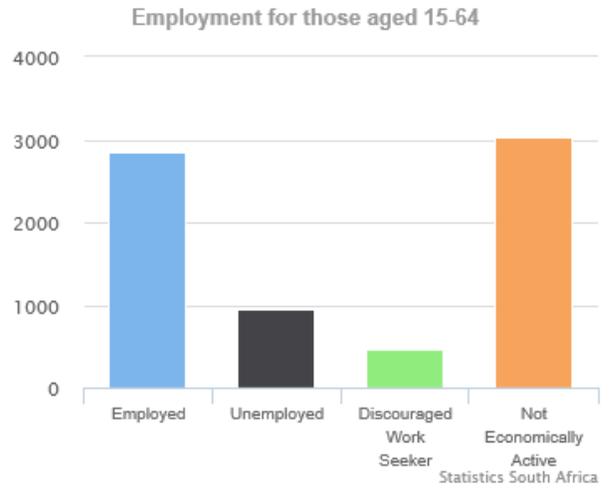
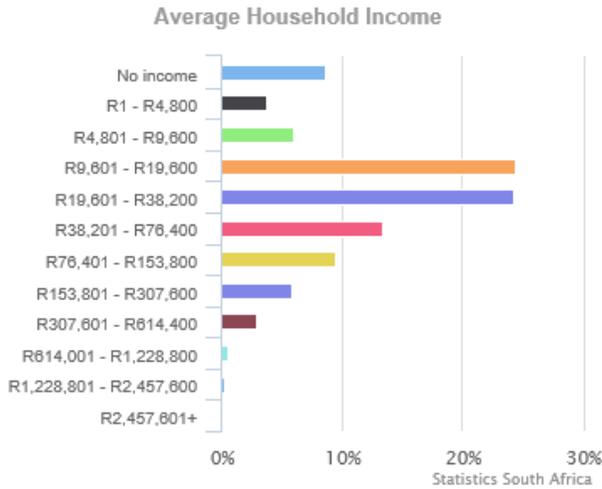
People: According to the 2011 Census, Kareeberg Local Municipality has a total population of 11 673 people. Of the households in the area, 33,60% are headed by females. The majority of the population in the municipality are coloured at 85,1%, 4,8% are black African, 9,1% are white, with the other population groups making up the remaining 1%. Of those aged 20 years and older, 7,2% have completed primary school, 32,1% have some secondary education, 17,5% have completed matric and 5,7% have some form of higher education. Of the mentioned age group, 18,0% have no form of schooling.



Living Conditions: There are 11 673 households in the municipality, with an average household size of 3,4 persons per household. Of the households, 41,5% have access to piped water either in their dwelling or in the yard, while 73,6% of households have access to electricity for lighting.



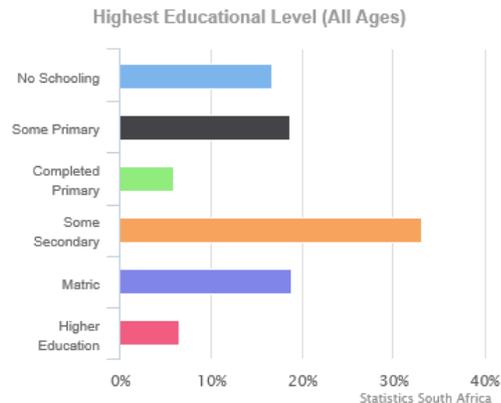
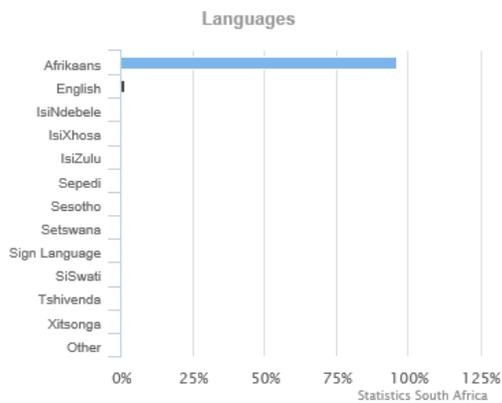
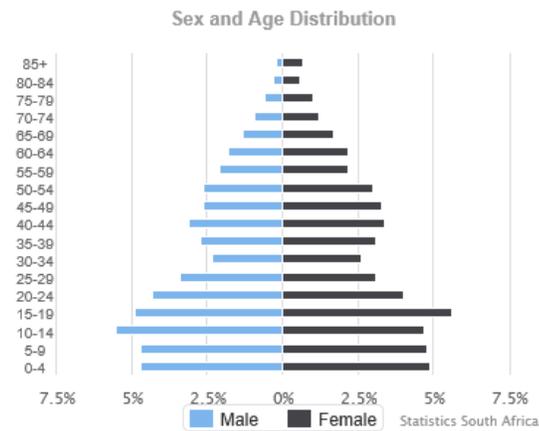
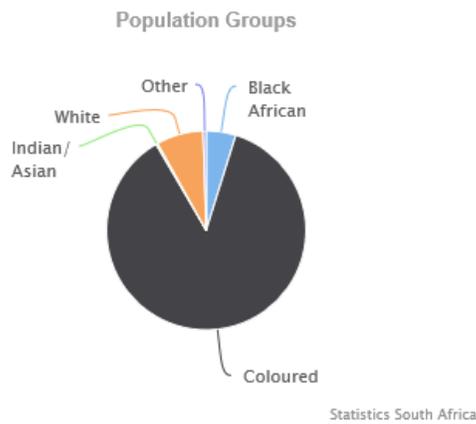
Economy: There are 3 810 people that are economically active (employed or unemployed but looking for work), and of these, 25% are unemployed. Of the 1 631 economically active youth (15–34 years) in the area, 32,1% are unemployed. The region’s economy is not well diversified. Small stock and game farming dominate the semi-arid areas of the region, with few other opportunities for employment outside of agriculture and government. The region is thus very vulnerable to fluctuations in the agricultural market. As a result, many young people leave the area in search of work elsewhere.



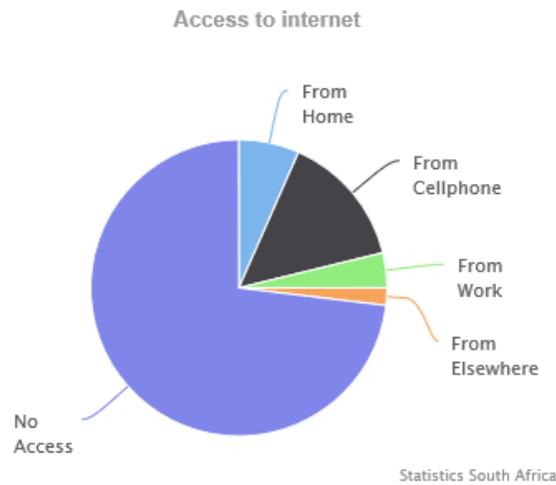
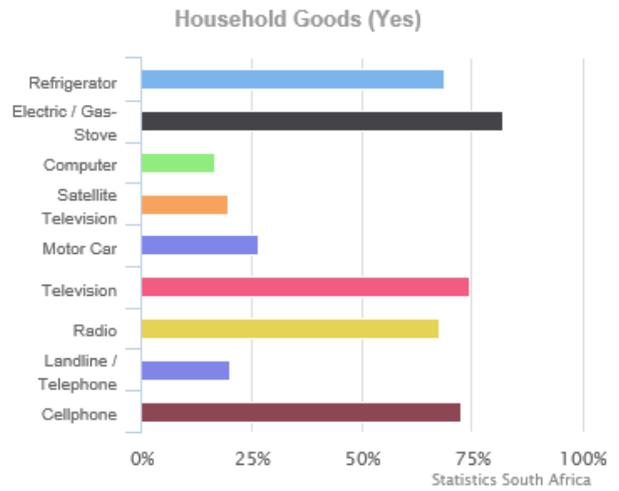
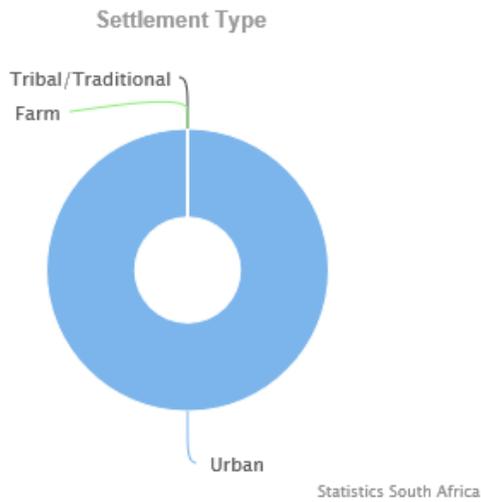
Carnarvon

Focusing now more specifically on the town of Carnarvon where the SVC will be located, according to Census 2011 results, the population of the ward is approximately 6,612 people. Approximately 6.4% of the population of the ward is unemployed, while only 27.0% of the population is employed and 31.1% of the population is not economically active. Carnarvon has 1, 552 households 1,552 with and average household size 4 people per household.

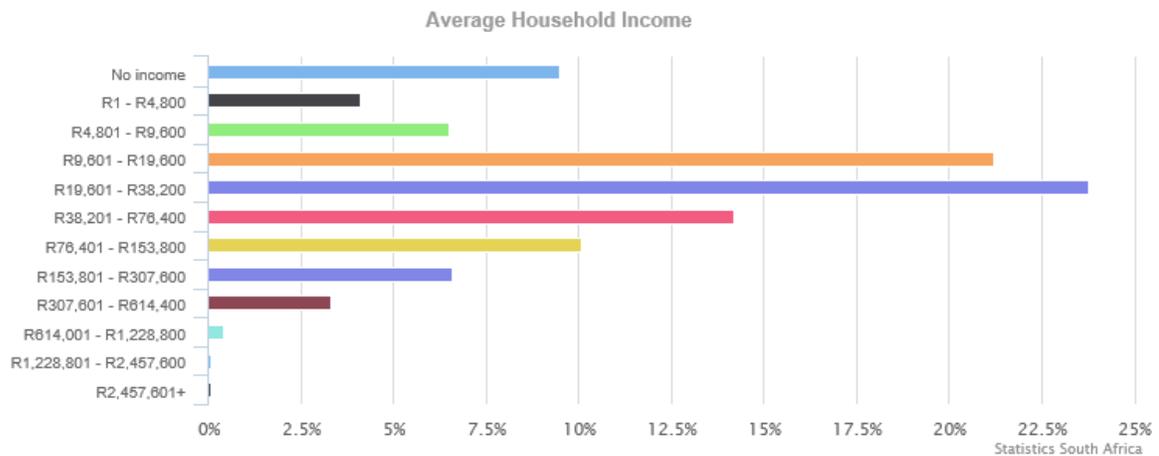
People:



Living Conditions:



Economy:



Vanwyksvlei and Vosburg

The ward results for Vanwyksvlei according to Census 2011 findings indicate a population of approximately 1,721 people. Approximately 6.6% of the population of the ward is unemployed, while only 22.2% of the population is employed and 26.3% of the population is not economically active. The ward results for Vosburg according to Census 2011 findings indicate a population of approximately 1,259 people. Approximately 5.1% of the population of the ward is unemployed, while only 39.6% of the population is employed and 20.6% of the population is not economically active.

In terms of public facilities in the Municipality, only Carnarvon possesses formal sport and recreation centres that are properly equipped and maintained. There are two libraries located in Carnarvon. While there are primary schools in all three major towns in the Municipality, the only high school is located in Carnarvon, with the nearest tertiary facilities in De Aar or Kimberley. Unfortunately, due to the socio-economic situation in the Municipality, public transport facilities and services are limited and do not match the travel needs of those living in the Municipality.

9. Concept of a science centre in Carnarvon

The following factors should be taken into account when conceptualizing the Carnarvon SVC:

- its primary focus should be to achieve both educational and tourism goals
- it should be a safe and secure environment for young people, day and night
- it should have an open plan design to maximize future opportunities and to keep open options for the future
- it should be designed so as to maximize income-earning opportunities, other than gate takings
- it should have an appropriate size for the local demography and predicted tourist numbers
- it should have the right mix of general displays galleries, exhibitions halls and specialized facilities
- it should have robust, low-maintenance fittings and furnishings.

The personality of the Carnarvon SVC, i.e. how it presents itself to the visiting public, is very important to define, and should include the following elements:

- Dynamic, progressive and topical;
- Trend-setting, relevant and challenging;
- Colourful ('perky') industrial and intelligent;
- Curious and controversial;
- Friendly and cool;
- Ambitious and seriously educational; and

- Embrace the culture and heritage of the region.

Key decisions that need to be made for the science visitor centre in Carnarvon are:

- What is the visitor catchment? Initially 60% Northern Cape, 40% Western and Northern Cape and tourists; after three years: 40% Northern Cape, 60% South Africa and tourists.
- What age group/s should be targeted? 8+ years to adults, with the emphasis on 8-25 year olds.
- Should it be multi-disciplinary or specialized? While it should be focused primarily on the main theme tourism and science, it should offer multi-disciplinary services.
- Should it be a science centre or tourism attraction or both? It should primarily be both an interactive science visitors centre.

9.1. Name and corporate identity

Once the name has been finalized, the overall corporate identity of the Carnarvon SVC needs to be defined; this should preferably be done by a professional advertising agency in collaboration with key stakeholders.

The corporate identity would include the following:

- Name
- Byline
- Logo (perhaps a colourful, simple and bold indigenous design incorporating the theme of the Carnarvon SVC)
- Corporate colour scheme (typically with one predominant colour, and two or three other colours; the predominant colours could be used)
- Typeface used in all promotional and advertising material and signage (a modern, 'scientific' typeface)
- Design of letterheads, business cards, compliments slips and other stationery
- Pitch of the advertising campaign (innovation, thinking, cutting edge, can do)
- Staff and volunteer uniforms
- Stationery, T-shirts and promotional material
- Web page
- Graphic email invitations.

9.2. Theme and storyline

As the predominant characteristics of the Carnarvon area is the tourism industry and the town's heritage, as well as the SKA Project, the most appropriate theme for the science visitors centre would be 'astronomy and heritage' related. This theme is not only topical but also covers a wide range of science and technology disciplines and tourism potential.

9.3. Legal status

It is imperative that the science centre should operate through a non-profit company in order to qualify for government funds, National Lottery funds and donations from various corporate funds and other CSI opportunities.

As a non-profit company the Carnarvon SVC should be concerned solely with the business of the SVC and its own entrepreneurial activities, and not with the operations of any other facilities or projects potentially linked to the SVC.

As a non-profit company surplus profits cannot be distributed to individuals and must be used solely to achieve the mission of the non-profit company. The company has Members, some of whom are elected as Directors; its affairs are overseen by a Board of Directors that must meet quarterly and convene an AGM once a year.

The composition and independence of the Board of Directors is of vital importance to the viability of the Carnarvon SVC. It is strongly recommended that Directors are appointed on the basis of the contribution that they can make as individuals to the development of the Carnarvon SVC; the Board should not be comprised of individuals appointed solely to represent various public and private bodies who have no personal interest in the concept or development of the Carnarvon SVC.

It is important that the Board has a range of expertise, including financial management, human resource management, legal expertise, educational expertise, and entrepreneurial acumen. Subcommittees of the Board, which could include co-opted Members who are not Directors, should also be formed; these could include subcommittees on Human Resources, Financial Management and Fundraising, Legal Affairs, Education, and Community Relations.

It is also recommended that a Science & Technology Advisory Committee (STAC) should be formed outside the structure of the non-profit company. This informal, non-executive group should comprise science, mathematics and technology experts from industry, universities, the Department of Education and other relevant bodies who advise on the content of the educational programmes at the Carnarvon SVC.

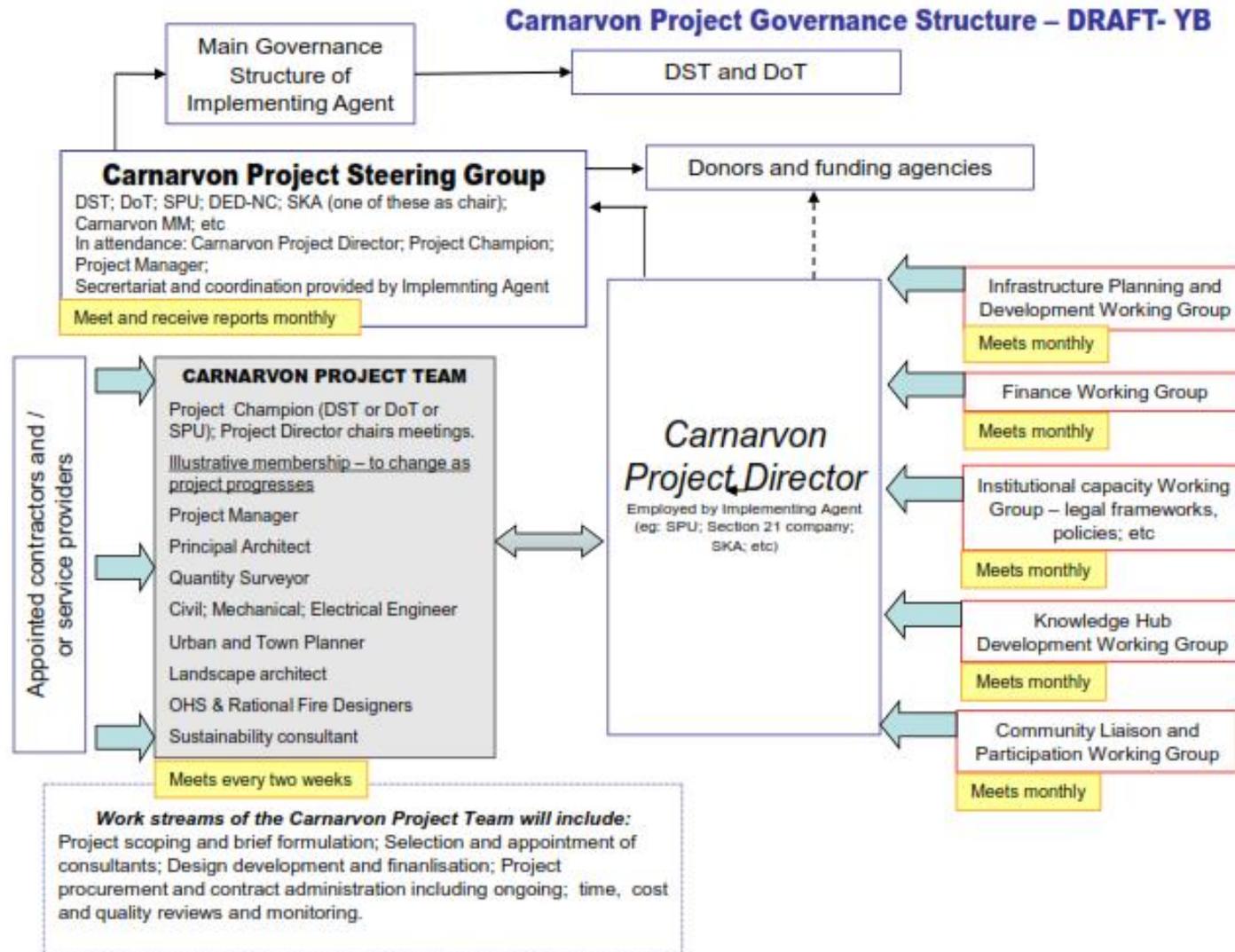
The appointment of the Chairperson of the Board is an important decision. This person should have a genuine interest in the business of the Carnarvon SVC, appropriate expertise, should be locally based in Carnarvon, and should have sufficient time on his/her hands to play a full role in the development of the facility. This is not a passive, 'status' post that delegates all tasks to underlings – the Chairperson should have an active involvement in the promotion and development of the Carnarvon SVC, especially in its formative years.

It is essential that the Board has the authority to make decisions within the limits of its constitution and using the funds at its disposal. If decisions of the Board need to be ratified by one or more higher authorities, the Carnarvon SVC will fail as it will not have a quick reaction time to new needs and will not be able to be entrepreneurial and proactive. In every respect, the Carnarvon SVC needs to be run like a competitive business except that the profits are not distributed to individuals.

If the Carnarvon SVC is to establish itself as the leading such facility in the Northern Cape, and a leader in South Africa, it needs a strong, decisive, enterprising and committed Board of Directors. If this can be achieved, the Carnarvon SVC has the potential to be a major development driver in the Kareeberg Local Municipality.

9.4. Proposed governance structure

The diagram below provides a proposed governance structure for establishment of the Carnarvon Science Visitors Centre:



10. SWOT analysis of a science visitors centre in Carnarvon

This SWOT analysis is conducted on the basis that Strengths and Weaknesses are internal properties of the science visitors centre, whereas Opportunities and Threats are properties of the outside environment. When strength can be combined with an opportunity, growth will result. Where a weakness is combined with a threat, there is no growth, or failure.

Strengths

- First science visitors centre of this nature (astronomy and tourism) in the Northern Cape, and therefore has a good chance of being recognized as a 'flagship' (DACST terminology) or 'full service' (DST terminology) science centre in the Northern Cape.
- Strong support from the local, district, provincial and national government.
- Strong support from the SKA Project.
- Enthusiastic support from high-ranking individuals in local industry
- Opportunity to develop the science visitors centre in a multi-destination facility and location
- Strong likelihood of good private sector sponsor support
- Excellent, central and very strategic location in Carnarvon
- Availability of existing bulk infrastructure
- Close proximity to relatively large communities of disadvantaged youths
- Opportunity to develop revenue-generating auxiliary tourism, entertainment and edutainment activities.

Weaknesses

- No science centre infrastructure and experience locally
- Carnarvon is not known as a science education hub
- Carnarvon is a small town with few visitor attractions, and is therefore not an established visitor destination
- Relatively low visitor numbers can therefore be expected, at least initially
- Possible difficulty of attracting suitable staff and volunteers
- Consequent non-innovative, bureaucratic management style of appointed staff
- Uncertainties about revenue earning potential of site.

Opportunities

- Science centres are a novel and successful international concept

- Strong growth and development potential of the tourism industry in Carnarvon
- Outcomes-based learning is at the cutting edge of education
- Strong national need to strengthen a science and technology culture, especially in the 'rural' regions such as the Kareeberg Local Municipality
- High level political support for the Carnarvon SVC
- Strong potential for support from relevant government lead institutions
- The science centre community is well-organized through the Southern African Association of Science & Technology Centres (SAASTEC)
- The science centre community internationally is well-organized through a series of umbrella bodies on all continents
- Lack of edutainment competitors in the Northern Cape.

Threats

- Possible inadequate understanding of the benefits of a science visitors centre among the general public and key decision makers
- Delays in the implementation of the Carnarvon SVC in both CAPEX and OPEX phases.
- Consequent delays in funding
- Donor fatigue in South Africa

SWOT analysis:

- Strength + Opportunity: Strong, relevant theme + good public and private sector support + entrepreneurial management style = good quality facility with good potential for growth.
- Weakness + Threat: Inadequately trained staff + non-innovative, bureaucratic management style + poor visitation in Carnarvon = poor quality facility with poor potential for growth.

SWOT strategy:

- Positive formula: World-class vision + aggressive, competitive and positive management style + bold fund-raising and partnership development campaign + close attention to the needs of clients = a winning science centre, and a winning city.
- Negative formula: Colloquial vision + apologetic and defeatist management style + modest and unsuccessful fund-raising and partnership development campaign + definition of goals without consultation with clients = an unsuccessful science visitors centre, and a lost opportunity.

11. Staffing the Carnarvon SVC

It is anticipated that difficulty will be experienced in appointing suitable staff for the Carnarvon SVC, partly because staff with the appropriate expertise are rare in South Africa, and partly because Carnarvon may be considered a suboptimal place to live. The SVC will rise or fall on the quality and enterprise of its staff. It is absolutely pointless appointing staff who are not innovative, energetic, visionary and proactive, as the science centre, at least in its early years, will require a great deal of competitiveness in order to succeed.

While it is important to support employment-creation programmes in the Northern Cape, it is essential that the search for staff, especially management staff, be conducted countrywide through a professional recruitment agency. The appointment of the Director and the Marketing Manager are particularly crucial; the Financial Manager and Exhibitory and Technical Manager posts are also important, but their skills are more widely available.

When the staff are appointed, it is essential that it is made clear to them from the outside that they will be working in the tourism sector, i.e. they will be busiest when others are off-work or on holiday. Staff with a service-orientation and a passion for the mission of the Carnarvon SVC need to be recruited.

It is also imperative that the staff is representative of the cultural demography of the Kareeberg Local Municipality and Pixley ka Seme District Municipality region as far as possible, trilingual in Afrikaans, English and Xhosa. While it is not imperative that all the staff have a tourism, science and technology background, they should have an interest in these fields, and be prepared to increase their understanding in these industries.

11.1. Staffing levels

After careful consideration of the mission, goals and location of the Carnarvon SVC, the predicted visitor numbers, and the special features of the science visitors centre's location and operations, the following staff establishment is recommended initially:

Staff establishment of the Carnarvon SVC, and role of the staff

Management Committee

Director	Overall strategic management and financial control, leads the partnership development programme, member of Board, represents the Carnarvon SVC to external stakeholders
Financial Manager	Financial management and control
Exhibitory/Technical Manager	Development and operation of displays, exhibitions, capital works and vehicles

Education Manager	Overall development of the formal, informal and outreach education programmes, liaison with the Department of Education, also an active Teacher
<u>Middle management</u>	
Senior Educationist	co-ordinate and implement in-house and outreach education programmes
Floor Manager	Management and control of informal education staff in the science centre, i.e. Facilitators, temporary Facilitators and Volunteers
IT Technician	Overall installation and maintenance of IT equipment, computers and computerized displays
Public Relations Officer	Public relations programmes, organization of special events
Events Manager	Implementation of events, venue hire, development of venues
Bookkeeper	Assist the Financial Manager with a range of financial management and control tasks
<u>Other staff</u>	
General Technician	Overall maintenance of displays, exhibitions, capital works and vehicles
Cashiers	Selling tickets, 'Friends' memberships and other services at the cash office
Information desk staff	Check ticket receipts, answer public and telephone enquiries, confirm bookings, etc. at Information Desk

Security and cleaning duties, as well as graphic design duties, would be outsourced, as would the operations of the restaurant, internet café, coffee shop, science shop, craft and souvenir shop, tourist guides etc.

This staff establishment would be adjusted and increased after Year 1 in response to the Carnarvon SVC's needs. Every effort should be made to persuade the regional Department of Education to second Teachers to the science centre; regional Department of Education's usually have a small number of Teacher's posts that are available for secondment to non-formal educational institutions. Teachers have been seconded to several science centres in South Africa, including the MTN Sciencentre in the Western Cape and the Sci-Bono Discovery Centre and Sci-Enza Discovery Centre in Gauteng.

Corporate sponsors may also be persuaded to sponsor/second posts to the Carnarvon SVC.

11.2. Staff training

In SA the operation of a science centres is a new field of endeavour, it will therefore be essential that staff training is initiated immediately after appointment and continues every year. The DST and SAASTA offer capacity-development courses for science centre staff.

11.3. Volunteers

The development of a motivated and effective volunteer corps is essential, for the following reasons:

- It makes available to the science centre staff who can be called on at short notice in response to increased visitor demand
- It provides an opportunity to train potential new staff members, and to develop the skills of local people, without being a financial drain on the science visitors centre
- People from a wide range of backgrounds, and with different technical, personnel and language skills, can be become engaged in the Carnarvon SVC work.

Experience in other science centres in South Africa, reveals that volunteers may be drawn from the following sectors of society:

- Students and other unemployed trainees
- Unemployed teachers and other educationists
- Unemployed technologists
- Housewives with relevant qualification in science and/or education
- Retired scientists, engineers, teachers and other professionally qualified people.

Volunteers may carry out the following functions in the Carnarvon SVC:

- Primarily as Educational Assistants in the display galleries
- Assistance with technical and displays maintenance
- Assistance with marketing, public relations and event implementation
- Assistance with the implementation of major events, themed months and excursions.

In order for the volunteer force to function efficiently, it is essential that:

- They are handled with courtesy and respect
- Their schedules are meticulously organized, and they are fully aware of their rights and responsibilities
- Their transport and entrance fee costs are paid, but they are not paid a salary
- Special events, excursions, end-of-year parties and recognition events are held on their behalf.

An effective volunteer force can contribute significantly to the efficient and cost-effective operation of the science centre, as well as to skills development in Carnarvon and the Kareeberg Local Municipality and Pixley ka Seme District Municipality region.

11.4. Temporary staff

It will occasionally be necessary to take on additional staff, such as Cashiers, Information Desk staff and Facilitators, with the required skills, during intensive events and busy periods. Additional temporary technical and IT staff may have to be appointed when large exhibitions are being developed.

11.5. Expert demonstrators

It will occasionally be necessary to employ volunteer or temporary Expert Demonstrators when high tech equipment is on display.

11.6. Society of Friends

The development of a 'Society of Friends' is essential to the long-term viability of the Carnarvon SVC. The advantages of a 'Society of Friends' are:

- it provides the science visitors centre with an opportunity to offer special privileges to its most faithful visitors
- it generates a steady revenue stream
- it creates a captive market for science centre events and programmes
- the 'Friends' act as ambassadors for the science centre's programmes and events
- the 'Friends' regularly bring visitors to the science centres
- the activities of the 'Friends' often generate media interest in the science centre
- the 'Friends' buy branded science centre products.

The management of the 'Society of Friends' is a time-consuming and exacting task, and involves the following:

- issuing new membership certificates and cards
- maintaining the membership database
- sending out annual membership reminders
- publishing a hardcopy and electronic newsletter
- organizing special events for the 'Friends'
- informing 'Friends' of their special privileges.

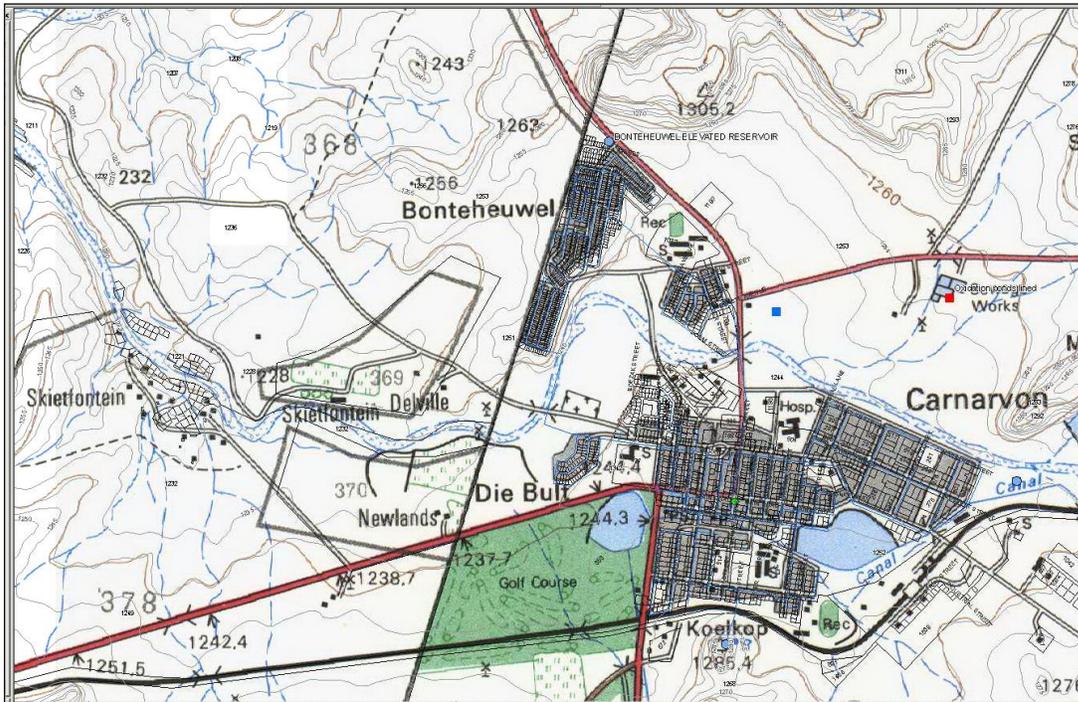
12. Location of the Carnarvon SVC

Carnarvon is situated on the R63 – 140km from Williston and 63km from Loxton – falling under the jurisdiction of the Kareeberg Local Municipality, and more broadly within the Pixley ka Seme District Municipality of the Northern Cape. Within the Kareeberg Municipality, the nearest towns are Vanwyksvlei and Vosburg, as well as the township of Schietfontein. When travelling from Johannesburg, travel along the N12 towards Britstown, take the R384 turn-off in the direction of Vosburg and continue towards Carnarvon. The GPS coordinates for the site in the town of Carnarvon are: 30° 58' 0" S and 22° 7' 60" E. See Figure 2 below.



Map of Carnarvon and SKA/MeerKAT site

The site is known as erf 431 is approximately 4.5 hectares in size. The site is located at the Western entrance to Carnarvon and is bounded by End Street and the town centre to the East, the R63 to the South, large open space with a small housing development to the West and Mark Street to the North. The site is therefore easily accessible from the R63 and from Carnarvon itself. Water and electricity services are available at the site, which is also large enough to accommodate future expansion of Carnarvon SVC development.



Proposed location for Carnarvon SVC

12.1. Land Usage

The site identified for the development of the Carnarvon SVC is owned by the Northern Cape Department of Roads and Public Works with the provincial Department of Education registered as the user of the land. The site was the old grounds of a school in Carnarvon which had burned down many years ago. The school was rebuilt at another site in the town and the grounds have thus remained vacant for many years, with no foreseeable plans for development by the Department in the near future.

In light of the fact that the land will be used for a development which will offer educational benefits to the community, the Department of Tourism has received permission from the Department of Education to utilise the land for the development of the Carnarvon SVC. This agreement has been key in making this development possible.

12.2. Importance of a multi-destination facility and location

South Africa has a weak science culture; as a result, few people choose to visit stand-alone science and technology destinations as part of their discretionary leisure activities. Science centre managers therefore need to use a variety of devices to attract visitors to their facilities. One of the most common devices is to 'soften' (dilute) the scientific attraction and offer more recreational/leisure options to the

visitor. While this may solve short-term problems, it is definitely not a long-term solution as it undermines the centre's reputation as a genuine educational facility at the science centre, and eventually leads to a loss of identity and loss of credibility among educational functions. The strategic location of the Carnarvon SVC as a multi-destination location, will have the following benefits:

- Benefits from the exposure, marketing and public relations campaigns. Joint marketing campaigns, discount offers, promotional campaigns, radio advertisements, email shots etc, all help to promote the SVC with little budget
- Benefits from bypass trade through Carnarvon (during school holidays bypass trade represents ca 80% of the visitation to the MTN Sciencentre at Canal Walk). This bypass trade ensures that the science centre continues to generate revenue throughout the year, including school holidays, and ultimately guarantees the financial viability of the facility.
- Benefits from the many other services provided by the facility, e.g. parking, security, ICT connectivity, building, grounds and garden maintenance, joint access to emergency first aid and medical treatment, joint staff and visiting public transport arrangements, etc.
- The SVC can generate auxiliary revenue from visitors through the shops, the restaurant, internet café, coffee shop, science shop, craft and souvenir shop etc.

12.3. Plans and Conceptual Drawings

Below are the plans and conceptual drawings/artists impression and conceptual layout of the proposed Carnarvon SVC.



Perspective of Science Centre travelling west on the R63 from Carnarvon



Perspective of Science Centre travelling from Williston towards Carnarvon

The initial artist's impression and layout of the Science Centre was based on visits to the area and the proposed initial location at Klerefontein. The overall architectural theme of the Science Centre has not changed substantially from the initial theme namely to include elements of local architecture most notably elements of Korbeel Huis, use of stone, colours that fit with the Karoo and integrating radio telescopes into the design.

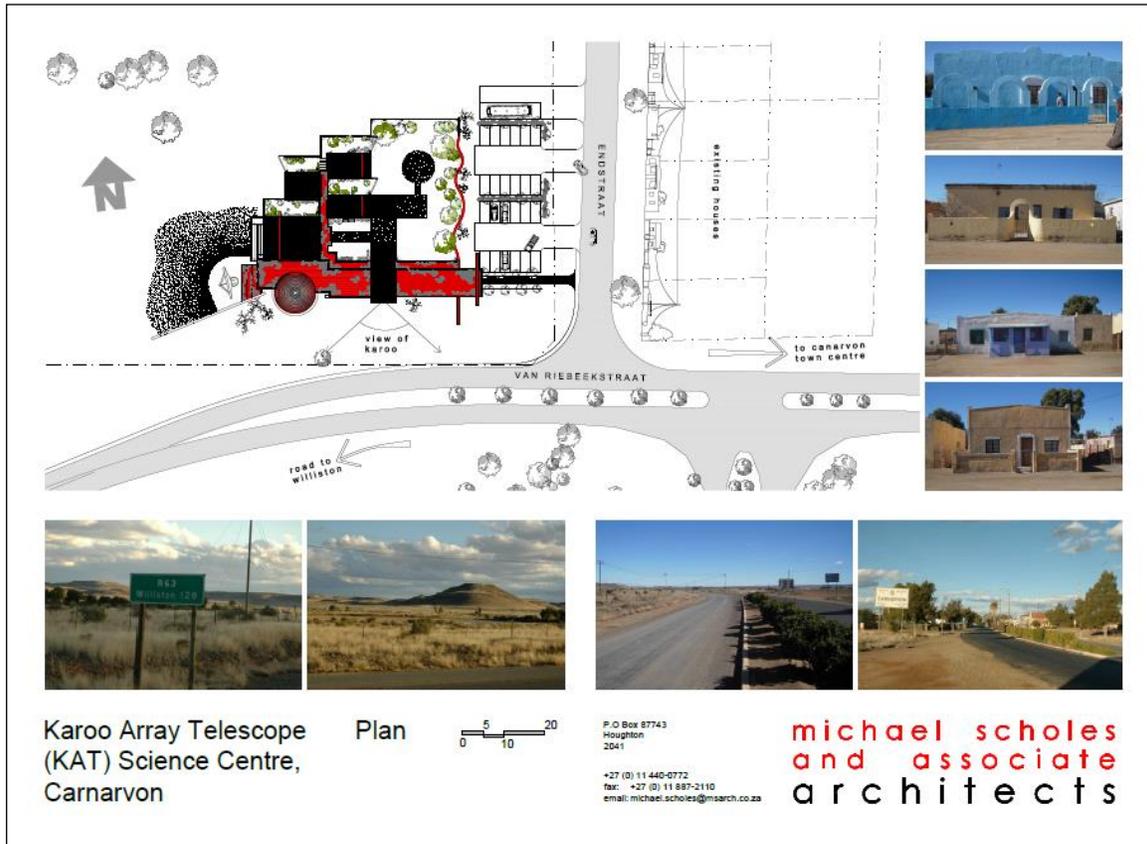
A number of changes have occurred and certain additional facilities to include have been identified since the original study into the establishment of a Science Centre was completed in 2009. The orientation and layout of the building has been totally redesigned to suit the site that was finally selected and the user requirements that have expanded and become better defined over the last two years.

In addition to being an artist's impression, the revised Science Centre conceptual design floor plan also shows the access and parking more clearly, makes allowance for a disabled bathroom and disabled access as well as providing additional space for offices, a larger hall /auditorium, a resource centre, a braai area and a platform for star gazing.

The revision of the layout and facilities within the Science Centre has been done to enable it to fulfill a meaningful role in science outreach whilst also maximizing its appeal to tourists and catering for the needs of a variety of users. This has resulted in the overall floor area increasing by over 50% from the original conceptual design of a facility of $\pm 600\text{m}^2$ under roof to just over 939m^2 under roof.

The most prominent features of the Science Centre are the Korbeel Huis design of the display area from the exterior and the telescope adjacent to the South Western Corner building. The concept is that a full-

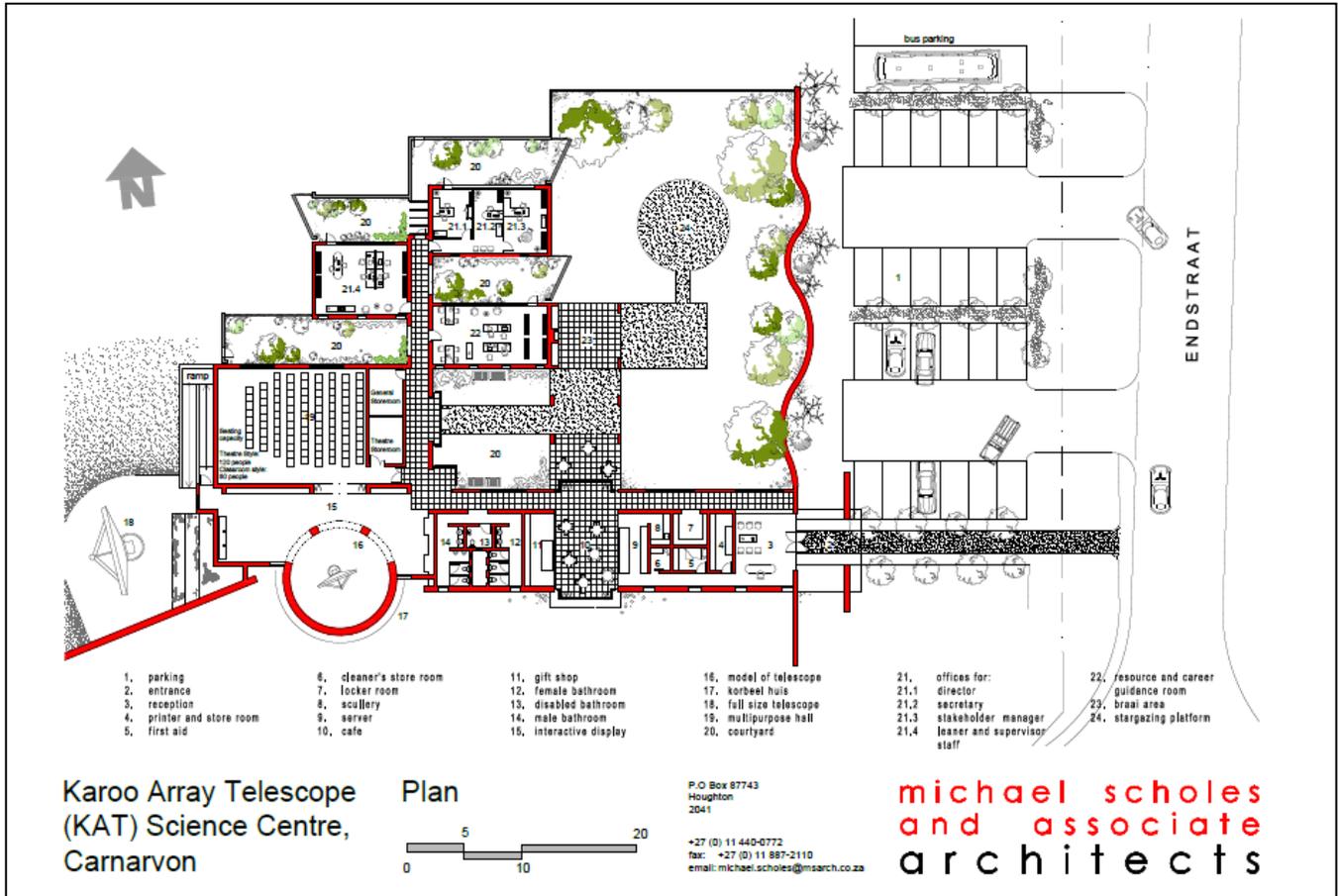
sized radio telescope be erected on a banked (raised) area adjacent to the Science Centre. This will help to associate the building with the MeerKAT project and provide an “Iconic Structure” that is easy for visitors to identify and that will define the entrance to the town en route from the site complex.



Science Centre General Site Plan

The orientation of the Science Centre on the site has been chosen to maximize visibility from the R63, to facilitate easy access from End Street, to leave room for future expansion on the site behind the Science Centre amongst other reasons.

The houses photographed are located along End Street and are excellent examples of Karoo Architecture.



MeerKAT Science Centre Conceptual Floor Plan

The Conceptual Plan of the Science Centre has been developed taking the user requirements as well as the characteristics of the site itself into consideration. The layout considers circulation of visitors and has also been designed to cater for the needs of disabled visitors.



Section through Exhibition and Hall

This section shows what it will look like inside the Science Centre and how the interactive display area is connected to the multi-purpose hall. Note the use of Korbeel Huis design elements, the inclusion of Karoo gardens at the entrance and in the courtyard areas and plantings on sections of the roof.

The radio telescope located adjacent to the Science Centre will be the most prominent feature as it is large and positioned on a raised area.



View of MeerKAT Visitors Centre at Night

The Science Centre will be a fantastic facility for star gazing and star parties. The courtyard will contain a braai area and platform for optical telescopes to be set up during star parties and to show visitors the difference between optical and radio telescopes.

7. MeerKAT Lookout Point

One of the key findings that emerged during visits to other similar establishments around the country as well as the review of various case studies of similar centers around the world is that visitors particularly tourists and schoolchildren would like to experience the particular subject of the visitors centre first hand.

This presents a challenge as one of the reasons that the site was selected was due to its remoteness. To overcome this challenge and to enable visitors to experience the telescopes first hand an actual telescope and a functional scale model have been included in the Science Centre. Images of the telescope and data obtained from the telescopes will also be showcased in the Science Centre.

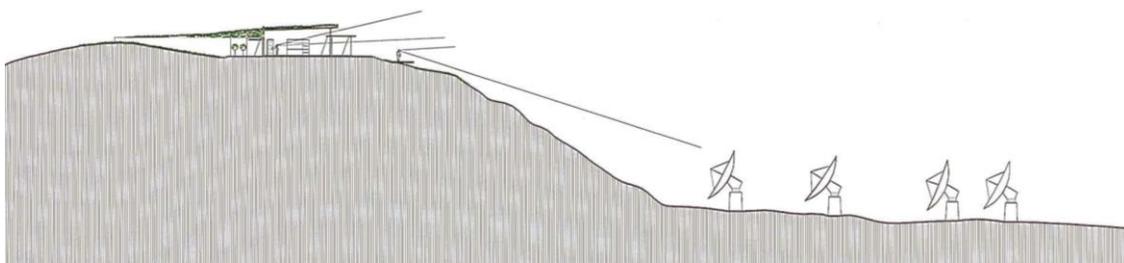
The above-mentioned facilities and displays could be located anywhere in the world and the key that will attract many visitors especially tourists to travel to a remote area is the opportunity to actually see the MeerKAT array.

To enable this, a viewing bunker strategically located overlooking the MeerKAT Telescope Array is proposed as part of the Science Centre package. The approach to and exact location of the viewing

bunker will need to be constructed in such a way that it does not result in radio interference and compromise the quality of the data being received by MeerKAT and the other telescopes in the area.



Viewing Bunker Location



Viewing Bunker Conceptual Image

The viewing bunker can be seen as phase 2 of the proposed development and would involve the construction of a simple viewing bunker overlooking the MeerKAT array.

13. Operational methodologies

In general, science centres operate in a similar way to museums and aquaria, but savings and efficiencies can be achieved, which make the facility more competitive, if certain commonsense guidelines are followed.

13.1. Ticketing system

It is recommended that single or multiple tickets should be issued from one central Cashier's Office (situated in the Entrance Hall) for all destinations associated with the Carnarvon SVC. The receipt for the purchase of a ticket/tickets, on which the cash amount, date and time of purchase is printed, should be used as an entrance ticket by the customer. This receipt should automatically be printed by a computerized till that records and analyses information about the ticket and the visitor.

Alternative ticketing systems use printed tickets or re-usable plastic disks with magnetized or electronic strips that automatically open the gate. These systems are more complex and far more expensive to operate, but they do not require a dedicated staff member at the gate to monitor entries. Electronic tickets also do not have the details of the actual purchase printed on them (which needs to be verified by the attendant at the gate in order to confirm that the ticket is valid ticket).

The 'receipt' system requires simple turnstiles that are remotely released by the staff member checking the tickets, whereas the magnetic/electronic ticket system requires more sophisticated (and expensive) magnetic- or electronic strip-reading gates that open automatically.

As it seems likely that there will be at least two, possibly more, entrance gates into the Main Exhibition Gallery, and additional entrance gates to the other facilities, the cost of the ticketing system and the gates is an important consideration.

13.2. Cash transfer

Cash collected at the Cashier's Office and Information Desk should be deposited into a drop safe after each working shift. The keys to the drop are not held by Carnarvon SVC staff but by a cash security company. Cash transfers from the drop safe to a bank must be carried out by a professional cash security company.

13.3. Venue hire

The hiring of venues in the Carnarvon SVC is an important activity, for the following reasons:

- It generates considerable revenue (R 30 000 – R 50 000 per month at the MTN Sciencecentre at Canal Walk)
- It helps to establish partnerships with the corporate sector
- It raises awareness of the SVC and its services in the local community and among attendees at functions
- It helps to achieve the SVC's mission of engaging constructively with the community.

The following venues can be hired out:

- Auditorium
- Computer rooms
- Classrooms
- Office spaces
- Laboratories
- Restaurant
- Exhibition Hall
- Party Room
- Entire science centre
- Outdoor venues.

The facility that will be hired out most frequently is the auditorium. In order to encourage use of the auditorium as a hired venue, the following conditions will need to be met:

- The venue should be well designed with tiered seating, good lines-of-sight from all seats, good acoustics, a stage, lectern, curtains and appropriately sited entrance and exits.
- The venue needs to seat at least min 100 people in comfortable, upholstered chairs
- The audio-visual equipment (digital projector, videocasting equipment, large screen, satellite dish, sound and acoustics systems, lighting systems, laptop and remote control) needs to be top-of-the-range, better than equipment at any other venue in Carnarvon or the Kareeberg Local Municipality and Pixley ka Seme District Municipality.
- The venue needs to have standby power and a spare digital projector bulb.
- A small change room should be available for performing arts productions.
- At least two staff members need to be trained to operate the venue faultlessly, of whom one should be in charge of the venue.

- A brochure and publicity material on the venue needs to be produced, and it needs to be actively marketed as one of the services offered by the Carnarvon SVC. The local, district and provincial government should be encouraged to set the example by hosting regular functions at the Carnarvon SVC. An annual calendar must already be booked out for the year as far as possible by local, district and provincial government.

The auditorium could be hired for a wide variety of functions (all those listed below take place in the Ericsson Auditorium in the MTN Sciencentre):

- Corporate product and intellectual property launches
- Videocasting of corporate financial results, locally and internationally
- Talks, presentations and film shows
- Graduate events
- Staff and franchisee training
- Team building events
- Performing arts productions
- Music and dance events.

In addition, the Carnarvon SVC itself would use the auditorium, inter alia, for the following events:

- Science shows
- Staff training
- Performing arts
- Film festivals
- School group tours
- Addresses by dignitaries from both public and private sector events
- Exhibition launches.

13.4. Building maintenance

It is imperative that the Carnarvon SVC makes use of a low maintenance building. As the SVC would expect to be open to the public for at least 360 days pa, and building maintenance would normally be confined to the period in the early morning between 08h00 and 09h30, the management cannot afford to use a building that requires constant repair.

The maintenance of the fabric of the building should ideally be carried out by the local authority, who should also take charge of the initial installation of electrical cabling, sockets and distribution board, as

well as plumbing, fire protection devices, general lighting systems, clean power, air conditioning (if any), toilets and waste removal systems.

13.5. Security

Usually it's a norm that facilities like a science centre are vulnerable to robbery (of cash and equipment), abduction of young visitors, and vandalism of the building and displays. Items that are particularly attractive to thieves are computers, audio-visual equipment and private possessions, such as wallets, cell phones and handbags.

It is recommended that there should be 24/7 manned security at the Carnarvon SVC, which should establish itself, immediately upon opening, as a strongly secure, impregnable environment. Three, eight hour shifts of grade 2 or 3 security guards should be used.

13.6. Security in a science centre is concerned with four issues

Security of young visitors: Unless an alternate arrangement has been made with the parents or guardians, young visitors (<12 years) should not be allowed to leave the SVC until they are collected. Parents or guardians should be asked to sign a register that records their names and cell phone number/s, and the time of their proposed collection of the children. A plastic armband can also be placed around the child's wrist that records these details. As child abduction is a serious issue in South Africa, and the Carnarvon SVC needs to have a reputation as a safe haven for children, these rules need to be strictly observed.

Children aged 6 years and under should only be allowed into the Carnarvon SVC accompanied by an adult. In the case of school groups, the accompanying adults should be teachers and parents or guardians.

Security of access and entrances/exits: Security guards will be required to check that everyone entering the Carnarvon SVC has paid, or has permission to do so. They also need to ensure that no visitors enter through the exit turnstiles.

Security of cash: Cash collected at the tills should be deposited in a drop safe after each cashier's shift; the fact that this cash is not acceptable to anyone except bank officials should be clearly advertised. Arrangements should be made with the bank, or with a cash security company, to transport the cash to the bank on a daily basis. The cashier's offices should be protected by sheets of bulletproof glass against robbery.

Security of the displays and exhibitions: From their posts at the entrances and exits, security guards can also play a role in protecting displays, installations and exhibitions from abuse by bringing any incidents that they observe to the attention of the floor staff. They should not, however, be detracted from their line function when carrying out this task.

13.7. Safety

The safety of visitors and staff in the Carnarvon SVC is of paramount importance. If the SVC acquires a reputation as a place in which children are often injured, this will seriously detract from its viability.

Safety measures start with the design of the building, installations and displays. Government safety regulations in terms of the capital works need to be adhered to, if not exceeded. Particular attention needs to be paid to mezzanine levels, stairways, overhead displays, electrical sockets, railings, turnstiles and any sharp corners, protrusions or overhead racks. At the Old Mutual/MTN Sciencecentre in Umhlanga, horizontal-rung railings that were approved by a government inspector were deemed unsafe by the science centre staff and were replaced, at considerable cost.

Safety should be a major consideration when designing, manufacturing and presenting displays and exhibitions. Lead-free paints should be used, and sharp corners should be reduced to a minimum. Visitors should not be able to access electrical sockets. Care should be taken that young children do not have access to displays that include parts that are small enough to swallow.

If an accident does occur in the Carnarvon SVC, the circumstances of the incident should be reviewed and the duty officer should present a report to management. Steps should then be taken by management to ensure that the accident does not recur.

All the Carnarvon SVC staff, including temporary staff and volunteers, should undergo basic First Aid training. A medical doctor should be easily reachable from the SVC, and on standby, throughout opening hours. Whenever an accident occurs, a member of the management staff should be informed whether or not he/she is on duty.

Science shows are an essential component of a science centre's activities, but they need to be performed with utmost care by well-trained professionals, especially when chemicals, rockets, other propulsion systems, gases and heat are used in the demonstrations. Safety glasses should be worn at all times, and fume cupboards, fume extraction equipment, Perspex barriers and metal-topped tables should be used whenever appropriate. A fire extinguisher should be readily at hand during any science show.

Science centres have a moderate risk of fire and should be equipped to deal with electrical, wood and inflammable liquid fires. Regular fire and evacuation drills should be carried. A member of the technical

staff should be appointed as the Fire and Safety Officer, and should attend appropriate training courses on a regular basis. When this Officer is not on duty, another trained-up staff member should be allocated his/her responsibilities. Safety issues should be discussed regularly at staff meetings. The name and contact details of the Fire and Safety Officer on duty at any time should be clearly indicated on a board in the science centre.

13.8. Cleaning

Cleaning services need to be outsourced. Cleaning duties should have commenced at least two hours before the Carnarvon SVC opens each morning and should be continued throughout opening hours. Cleaning activity should be intensified on weekends and during holidays. Emergency plans should be put in place for major spillages, or for accidents that occur during science shows.

Care should be taken that the cleaners do not use abrasive detergents that damage displays and signage.

13.9. Interactive displays and exhibitions

The beauty of science centres is that their main attraction is the multiplicity of different displays and exhibits that are available for interaction with the public. This is in contrast to aquaria and many museums, which require massive capital works in order to offer a worthwhile attraction to the public.

As a result, the displays in a science centre can be built up over time as funds permit. Adding additional displays constantly adds variety to the teaching programmes and encourages return visitation.

13.10. Different kinds of displays, installations and exhibitions

There are nine different kinds of displays in a science centre:

Permanent displays: These are relatively large, long-term displays that have enduring value. They could include a giant, 2-m diameter GeoSphere Globe, an 'exploded' motor car, an exhibition on the history of the bicycle, a steam engine, a small airplane, a space satellite or manned re-entry module, a mini submarine, or an unusual boat.

Permanent installations: It is proposed that a few major, permanent installations should be purchased before opening day. Examples of permanent installations used in other science centres are:

- Audio-Kinetic Sculpture
- Audio-visual display
- Virtual Reality Grand Prix Car: A first-class and exciting virtual reality driving experience, around the most famous Grand prix tracks in the world.

Travelling displays: It is essential that the Carnarvon SVC has a Travelling Exhibition Hall measuring at least 300 m² (preferably 400 m²) for receiving the variety of travelling exhibitions that are on offer from science centres, museums and governments departments in South Africa and abroad. The hosting of major traveling exhibitions will be a major characteristic that distinguishes the Carnarvon SVC from other edutainment destinations in the Northern Cape, and will ensure that it becomes part of the worldwide network of facilities that hosts such displays.

Travelling exhibitions that are currently available in South Africa include:

- MTN Sciencentre: 'Puzzling Things', 'Maths 2000', 'Science of the Bicycle', 'Science of Cricket', 'A Walk through Time' (geological and biological evolution), 'Great South African Inventions', 'Play2Learn' (educational value of toys and games).
- SAASTA: 'StarLab' (inflatable planetarium), 'SciTech on the Move' (physics), 'It's a Biotech World' (GM foods and bioforensics), 'DNA 50' (DNA research).

Travelling exhibitions: In order to receive travelling exhibitions, and also achieve its mandate of developing an outreach programme to serve satellite science centres, the Carnarvon SVC needs to develop its own travelling exhibitions. These could be on the following themes:

- Astronomy
- Heritage

The diversity and success of these travelling exhibitions will depend on the ingenuity of the Carnarvon SVC staff.

Activity zones: Activity zones are major, multi-functional displays that typically cover 200-400 m² of floor area. They offer a wide range of activities for young visitors aged 6-12 years (the age group that is learning how to role play in groups) within a given sub-theme.

The highly successful Activity Zone in the MTN Sciencentres in Cape Town and Umhlanga is the Murray & Roberts 'Building Africa' site, which was designed and made by MTE Studios in Cape Town.

Temporary displays: Temporary displays are constructed and exhibited in response to a topical event that has limited staying power, for instance an anniversary related to the 'SKA' theme, these displays are typically exhibited for three months, and then recycled.

Outdoor displays: The Carnarvon SVC site has considerable potential for significant outdoor displays, which will greatly enhance the quality of the visitor experience. These outdoor displays could not only be installed in the immediate vicinity of the SVC but throughout the Carnarvon SVC site development. Each outdoor display will have a weatherproof label that will explain clearly how the display should be used; most of these displays do not therefore require supervision.

The outdoor displays should add to the science centre attraction rather than compete with it; some means of deriving income from the outdoor displays may have to be developed.

Outdoor displays have the following characteristics:

- They must be very robust and weatherproof
- They should have simple outdoor signage that should be easy to understand
- They should be medium to large, bold displays
- They should be mechanical displays without need for electricity
- They should encourage group participation.

14. Display and exhibition manufacture

The manufacture of robust and safe interactive displays for use in science centres is a specialized discipline that requires special skills and experience. Inexperienced display makers tend to make the displays that are too complex (convey too many messages simultaneously) and too fragile, for use in an interactive teaching environment. The design and manufacture of displays needs to be carried out in close consultation with professional science centre staff in order to avoid the many pitfalls.

In general, science centres worldwide collaborate closely in the development of new displays. In particular, the famous Exploratorium in San Francisco has published three 'Exploratorium Cookbooks', and several 'Snackbooks' and 'Cookbooks', which provide ideas and technical diagrams for complex, simple and very simple interactive displays, respectively. Many of the initial displays in the MTN Sciencecentre in Cape Town were based on the Exploratorium designs.

When the MTN Sciencecentre was initiated in Cape Town, there was no local exhibit-making capacity and most of its opening day displays had to be imported. Now a strong consortium of interactive display and exhibition makers has been developed in Cape Town. One of these displays makers, MTE Studios, has developed a strong export market in interactive displays and has established a very successful office in Dubai; displays to the value of over R40 million have been sold to Dubai by MTE Studios in the past. Other display makers have been developed by the Sci-Bono Discovery Centre in Johannesburg.

A list of the leading display makers in South Africa, with their area of specialization, is given below:

Interactive display makers in South Africa, and their areas of specialization

Western Cape

MTE Studios	Mechanical, electric, electronic, especially large, iconic displays and activity zones, themed environments, in wood, metal, composite, fiberglass, internationally respected contractor
Corewijn & Associates	Mechanical, electrical, wood and metal, including artistic works
Seipone	Mechanical, electrical, especially with ethnic connotations, wood and metal
Graeme Murray & Associates	Mechanical, electrical, electronic, high precision steel work, composites, fibre-glass, specializes in displays on boats and bicycles
IDS	General furnishings, simple interactive displays in wood and metal
Bailey Bros.	Complex, large-scale metal interactives
Cape Town Society of Experimental and Model Engineers	Group of retired engineers who make high precision models and interactives in metal
Etienne de Kock	Large-scale interactives in wood and metal

Gauteng

Richard Waller & Associates	Stand-alone interactives, metal, wood
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KwaZulu-Natal

UniZulu Science Centre	Simple, tabletop travelling exhibits.
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The MTN Sciencentre imported 80% of its opening day displays from outside the Western Cape (mainly New Zealand) but now makes over 90% of its displays locally.

It is important that some of the opening day displays for the Carnarvon SVC are imported from abroad.

The international display makers are recommended, with their recommended displays, below:

International display makers recommended to the Carnarvon Science Centre

Southern Hemisphere

Science Exhibits, New Zealand	High quality permanent and travelling displays, metal, fibre-glass
Science Alive! New Zealand	Wide range of world class multiple displays
Raul de Soroa, Brazil	Complex, metal audio-kinetic sculptures

Northern Hemisphere

Exploratorium, USA	Classic interactive displays from their famous range
Minnesota Museum of Science, USA	Off-the-shelf array of classic interactive displays
Jack Rouse Associates, USA	Complex, themed, interactive environments
Premier Exhibitions, Inc., USA	Complex, themed, interactive environments
Hüttinger, Germany	Major interactives in all materials
Xperiment Huset, Sweden	Simple but effective stand-alone displays
Tom Tits Experiment, Sweden	Simple, robust outdoor displays
Northern Light CoDesign, Holland	Complex, themed, interactive environments

Broadly speaking, displays made in the southern hemisphere are 3 to 4 times more expensive than those made in South Africa, and displays made in the northern hemisphere are 4 to six times more expensive to purchase, including shipping and importation costs.

There are many advantages associated with manufacturing displays in South Africa:

- builds local capacity
- saves foreign exchange
- cheaper
- quicker delivery (from some suppliers)
- fewer transport and no import problems
- repair of displays by local manufacturers is more practical and cheaper
- local manufacturers use locally available components
- proudly South African.

The downside of ordering locally is:

- variable quality
- limited experience
- limited capacity
- few manufacturers with international experience and reputation
- most manufacturers are concentrated in the Western Cape.

14.1. Display and exhibition maintenance

Each display should be delivered with a maintenance manual, and the technical staff employed by the science centre should undergo specialized, in-service training at other science centres in South Africa.

A characteristic of science centres is that displays, no matter how robustly they are built, will break as a result of regular public interaction with them. Furthermore, the public is utterly intolerant of broken displays. As a result, display and exhibition maintenance are very high priorities in a science centre, and must be carried out seven days a week.

The Carnarvon SVC workshop should take the form of an 'emergency care hospital' for broken displays, and procedures need to be put in place for the rapid repair of all kinds of displays, during the week and weekend. Comprehensive collections of components, spares and small hardware need to be available at all times.

It is also very important that preventative maintenance is carried out on all displays to reduce the risk of damage. It is well known that the public abuses displays' that are slightly broken, with the result that they then become very broken, and sometimes unsafe. It is the responsibility of all staff to bring defective displays to the attention of the technical staff.

It is further recommended that the science centre should be closed one or two days a month, or one afternoon a week, for exhibit maintenance. The closed days should not fall on a weekend or public or school holiday.

14.2. Opening day zonation and lay-out of displays

While it is important that the opening day displays should be laid out in accordance with the subthemes of the Carnarvon SVC it is not recommended that this lay-out should be formal and inflexible. It is more important to make optimal use of the spaces available, and to create a living 'palace of discovery' that visitors, young and old, will find irresistible.

The most important point about the initial lay-out is that it should be temporary so that displays can be moved around, sometimes on a daily basis, to accommodate new ideas, changed teaching methods or added displays. It is further recommended that no permanent or temporary partitions should be erected within the main science centre space in order to demarcate the subthemes – these will become irrelevant, and will be a waste of resources, within weeks.

14.3. Display and exhibition signage and presentation

The signage on the displays and exhibitions needs to have the following characteristics:

- It should reflect the corporate identity of the science centre
- It should be standardized in presentation, type face, colour scheme, lay-out, graphics and size (A4, A3 or A2)
- The logo of the Carnarvon SVC, and of the sponsor of that display, should be displayed
- The text on the signage should be carefully written, extremely concise, and presented under standard subheadings, such as: “What is it? What do I do? What’s going on? Other things to try”.
- Optimal use should be made of simple diagrams and cartoons to explain the workings of the display.
- Where practical, a secondary, computer-based sign should be added to provide extra depth for the keen visitor.

Signage can be attached to the display or be self-standing. Self-standing signs take up extra floor space but can be read by participants on all sides of the display, and do not use up display space.

As far as possible, the presentation of the displays should reflect the corporate ID of the Carnarvon SVC, and the displays should, in general be made from the same materials, i.e. mostly wood, metal, fibre-glass or other composites. The main colour/s of the displays should mirror the corporate colours of the Carnarvon SVC.

15. Education Programmes

While it is sometimes tempting to consider that science centres projects are primarily about entertainment, display and building maintenance, people management and marketing, it is important to bear in mind that their line function is education, both formal and informal.

For this reason, it is imperative that all planning associated with the Carnarvon SVC should be directed at improving the quality and scope of the educational programmes on offer.

The education programmes are divided into five categories:

- curriculum-based education
- public understanding of science, engineering and technology
- specialized training
- career mentoring
- life skill development.

It is important that the Carnarvon SVC collaborates with other organizations involved in these different facets of education in order to ensure that it delivers the most effective and relevant services to its visiting public.

15.1. Unique role of a science centre

When designing the education programmes, it is important to take into account the unique role of a science centre:

- it is a 'super-classroom' in the public domain that offers a far more comprehensive range of educational products and services than any individual school could offer
- it focuses primarily on the most efficient methods of teaching and learning, i.e. hands-on, minds-on, learner-driven, and at the pace of the learner
- it is a dynamic, proactive, ever-changing environment that responds quickly to new needs
- it is not limited in its subject matter by the classical definitions of science, maths and technology – science centres can teach whatever they like, whatever is relevant
- they operate both in-house, through their indoor displays, as well as through outreach programmes that reach into remote urban and rural areas
- they provide a democratic forum for debates on the merits and demerits of scientific and technological advances
- they teach teachers as well as learners, parents, grandparents and the general public about Mathematics, Science, Engineering and Technology (MSET)
- they are ideal platforms for different educational organizations to present their programmes collaboratively
- they are globally connected.

15.2. Integration into the regional education strategy

The most important partner in a science centre venture is the provincial Department of Education; it is thus essential that a good working relationship is established with this Department even before the science centre opens. This collaboration will/may facilitate the following:

- Ensure that the education programmes in the science centre support curriculum-based teaching as it is carried out in that province
- The Department of Education is more likely to grant permission for school group visits to the science centre during school hours
- The provincial Department of Education may second teachers to the science centre

- The Department of Education is more likely to use the science centre for functions and events, which further cement the relationship
- Senior Education officials are more likely to open new exhibitions and programmes at the science centre, which provides credibility for these projects
- The Department of Education may agree to subsidize school visits to the science centre, and also to sponsor new displays and programmes
- The Department of Education may agree to endorse applications for sponsorship to regional and national government departments, funding agencies, and the National Lottery
- The receipt of donations from the private sector may be contingent on support from the provincial Department of Education.

15.3. Teacher empowerment

One of the most important tasks that a science centre can perform is to empower teachers, especially science, maths and technology teachers. This service has the maximum cascading benefit through the education system, and also addresses one of the top priorities in educational redress in South Africa, i.e. the lack of capacity among teachers.

It is strongly recommended that teacher empowerment courses should be initiated even before the science centre opens, and that they should be a regular and strong component of the science centre's life in the long term. Teacher empowerment courses would offer the following services to teachers:

- Improve their understanding of the theory of science, maths and technology, and related fields
- Improve their understanding of the practice of science, maths and technology, and related fields
- Improve their skills in using interactive and 'science show' techniques to teach MSET in a livelier, and more effective way, in the classroom
- Instruct teachers how to make simple teaching aids in the classroom
- Expose teachers to interesting science and technology environments through excursions and site visits
- Ring teachers into contact with top science teachers and demonstrators
- Formal classes on better classroom teaching technique
- Specialized training courses, e.g. on computeracy, software programming, robotics, project management
- Provide teachers with the opportunity to participate, with their learners, in a variety of inspiring MSET events, e.g. National Science Week, World Space Week, the DST Themed Months, robotics competitions, science camps, sleep-overs, popular science talks, science film festivals, quizzes and debates.

15.4. Worksheets and teaching manuals

It is essential that the educational staff of the science centre, in collaboration with Curriculum Advisors, should develop worksheets and teaching manuals for all the displays, exhibitions and programmes hosted by the science centre. These documents should be aimed at specific grades and specific components of the curriculum, and should not have a 'shotgun' approach.

The worksheets should be provided free to teachers who bring classes to the science centre, and should also be sold in the shop and through the Carnarvon SVC website.

15.5. School visits

Pre-booked school visits are the 'bread-and-butter' of a South African science centre's, and will constitute a substantial component of the visitor base during the school term. As teachers lead busy and complicated lives, it is essential that the school booking system should be as efficient and simple as possible. The components of this school booking system are:

- A well-informed, well-spoken and articulate Receptionist or Schools Booking Officer who receives the initial call and explains the conditions of a visit and visit procedure to the teacher
- The offer of a free visit to the teacher (if practical) in order to view the teaching facilities, collect teaching aids and meet the staff
- A faxed or emailed School Booking Form, which must be completed by the teacher and returned to the science centre
- An efficient, computerized method of recording all school bookings, including the need to prevent clashes of facilities and overbooking
- An efficient system of recording cancellations and changed bookings
- Efficient method of arranging transport for the school group, if necessary
- Communication of all school bookings to floor staff through the intranet
- Meeting the arriving group and ensuring that they link up with their science centre educationist
- Providing an effective educational programme
- Follow up after the visit to ensure that the visit met all expectations.

15.6. Facilitated tours

Although science centres specialize in ‘free choice’ learning under the control of the learner, it is often useful to provide facilitated tours for visiting school groups to particular displays and exhibitions in the science centre. These tours provide structure to a visit, especially for first-timers, and ensure that the maximum value is obtained from the visit. Facilitators should take care that they do not ‘spoon feed’ the visitors too much, otherwise the value of the visit will be lost.

15.7. Science shows

Live science shows by skilled demonstrators are the lifeblood of a science centre, and a major distinguishing feature from other edutainment destinations. Science shows are very adaptable and effective way of teaching, but also of arousing awareness of the ‘magic’ and beauty of science and technology. They appeal to children and adults of all ages and may play a major role in demystifying science.

It is strongly recommended that every school group that visits the Carnarvon SVC should witness a science show, and that regular science shows are offered on weekend and during the holidays.

Science shows can either be offered formally in an auditorium, or informally as short, ‘busking’ science shows from a mobile laboratory in the heart of the science centre. They can also be offered as a travelling service to schools and science festivals.

15.8. Demonstrations

Demonstrations of cutting edge technology are an important part of a science centre’s life. Examples of such demonstrations done at other science centres are:

- Hybrid motor car engine
- Latest biotechnology products
- Bioforensics by the South African Police
- 3G technology on a cell phone
- Latest car safety features
- Blood analysis equipment
- Brain scanning.

Science centres are uniquely equipped to showcase the latest scientific and technological advances to the general public.

15.9. Workshops

Regular workshops for learners and adults should be held at the Carnarvon SVC. These workshops would be on subjects as diverse as: computeracy, computer programming, robotics, photography, crafts, bicycle maintenance, energy conservation, making simple optical instruments (telescope, solarscope, binoculars, microscope), how to balance your diet, how to do a PowerPoint presentation, educational value of toys, science of sailing, how airplanes fly.

In addition to adding value and substance to the science centre's education programmes, workshops can also be an important source of revenue. They can either be operated by the science centre staff or outsourced to other education and training organizations. SETA funding can be used to cover the costs of workshops related to life skill development and in-service training.

15.10. Popular science talks and debates

The Carnarvon SVC will be the ideal environment to host popular science talks and debates for the general public. These events should be low-key, informal and well presented so as to encourage engagement with the public, rather than alienation from them. They offer an excellent opportunity to bring science and technology into the lives of people and to develop a passion for these subjects among the youth.

Speakers could be recruited from universities (Sol Plaatje University), colleges, science and technology societies, museums, professional societies as well as from commerce and industry. The opportunity to host international speakers, who are in South Africa on speaking tours or to conduct research, should also be explored.

Ideally, a particular evening in the month should be scheduled for a regular popular science talk, and more talks should be offered during special events, such as National Science Week. Talks should be arranged to support commemorative events, e.g. events related to the SKA Project, or the advent of scientific phenomena, e.g. solar eclipse, Mars or lunar landing, cloning of a lamb.

15.11. Interschool competitions

An extremely efficient way of engaging schools in the operations of the Carnarvon SVC is to arrange interschool competitions in various disciplines. These could include:

- Robotics competitions, organized through the First Lego League, with the possibility of sending winners on to the national and international finals
- Science, mathematics and computer Olympiads, with the possibility of sending winners on to the national and international finals.
- Chess, as well as traditional games, such as marabaraba and mankala
- Interschool debates on scientific topics
- Design competitions
- 'Greening the school campus' competitions'
- Water-saving competitions in schools.

The hosting of competitions for schools from throughout the Northern Cape would establish the Carnarvon SVC as a focus for creative and competitive activity in MSET, and would also stimulate activities in schools.

15.12. Excursions

The Carnarvon SVC should take the lead in organizing school group and public excursions to destinations of science and technology interest, such as the SKA Project, meerKAT and the Southern African Large Telescope (SALT) project etc. These excursions can be life-changing experiences for young people, and are an essential component of the non-formal educational programmes of the science centre.

Once the Carnarvon SVC has become well established, formal tours for paying tourists could also be organized with trained tour guides.

15.13. Science festivals

It is essential that the Carnarvon SVC should participate actively in the three main science festivals that occur in South Africa: Sasol SciFest (Grahamstown, early March), ScienceUnlimited (Pretoria, late March) and Sasol TechnoX (Sasolburg, late August).

Every effort should also be made to arrange for guest speakers, science show demonstrators, and other invited guests to Sasol SciFest to also visit and perform at the Carnarvon SVC.

15.14. Participation in government-funded Puset activities

The DST is the lead agency for Puset programmes in South Africa, and implements many of its programmes through SAASTA in Pretoria. As the DST and SAASTA have a national responsibility but no regional capacity, they regularly use science centres to implement their programmes in provinces. It is imperative that the Carnarvon SVC quickly establishes itself as a reliable and efficient partner of the DST and SAASTA in the delivery of government-funded Puset activities in the Northern Cape. The most important programmes are:

15.15. National Science Week

National Science Week (NSW) is held simultaneously in all nine provinces in the second week of May each year. One or more organizations in each province are chosen to host NSW there, on a merit-application basis.

NSW is an intense, week-long celebration of the achievements of science and technology, and represents the most intense week in a science centre's life. Typically, visitation figures increase 3 or 4-fold during this period, and substantial additional staff need to be hired. Funding is usually available to bring learners from far afield (the most remote parts of the province) to the event.

If the Carnarvon SVC is established as the first 'full service' science centre in the Northern Cape, and it has adequate physical and human resources to run the event, there is an excellent chance that DST/SAASTA would choose the Carnarvon SVC to host the event in the Northern Cape. This would not only add substance to the Carnarvon SVC's education programmes, but would also lend credibility to its operations and generate valuable income (a percentage project management fee).

15.16. Themed months

DST has declared that four science and technology themed months would be celebrated each year. The themes chosen reflect areas of scientific endeavour in which South Africa has geographical or expertise advantage on an international scale, and include:

- Antarctica (June)
- Biodiversity (July)
- African origins (September)
- Astronomy (October).

It is essential that the Carnarvon SVC should submit applications to participate in these themed months, as funding is allocated by the DST through SAASTA to host a number of educational programmes, and sponsor school group visits to participate in them, which would normally be beyond the reach of the science centre.

15.17. World Space Week

World Space Week (WSW) is an international event that is held in the first week of October each year (and therefore coincides partly with the themed month on astronomy). Separate funding is available through SAASTA to host events relevant to space science and astronomy during WSW.

15.18. INSITE exhibition

The DST, in collaboration with other government departments, hosts an international science and technology exhibition in Midrand in October/November each year called INSITE. Science centres are invited to participate in this event, which provides an opportunity to showcase their MSET education programmes. Once the Carnarvon SVC has become established, it is strongly recommended that it participate in INSITE.

15.19. PUB programme

The DST has launched, through SAASTA, a Public Understanding of Biotechnology (PUB) programme that serves to highlight advances in biotech research internationally and locally. PUB has funded the development of travelling exhibitions on bioforensics, cloning, GM foods and DNA technology, and also hosts talks, debates and competitions on biotech.

16. Identified key features of the Carnarvon SVC from previous study

Based on the previous study done by Anix Consulting in 2014, consultations with tourism officials, tourist product providers, local municipal officials, national and provincial departments, representatives of the SKA SA project team as well as desktop research and a series of visits to other similar establishments, the following facilities and services were identified and refined for inclusion in the Carnarvon SVC:

a) Entry

The entrance to the Carnarvon SVC will be designed to be inviting and welcoming. The entrance will be provided with a cover porch scaled to the building whilst maintaining a human scaled base. Opportunities will be created for visitor seating. The main entrance to the building will be provided with an entry vestibule reflecting the particular unique characteristics of the Carnarvon SVC and the town of Carnarvon. A help desk will be centrally located to the entrance area to ensure human contact at the point of entry.

b) Lobby

Designed to be spacious with an unobstructed view of the information/reception desk area and view access to the rest of the facilities/services on offer at the Carnarvon SVC. Provision will be made for the lobby and entrance area to be sealed off with interactive display terminals (even if only supplied/fitted in future) to allow for this portion of the facility to be used after hours without staff assistance. Furthermore, banking facilities in the form of an ATM will also be placed in the lobby area for ease of access for visitors wishing to withdraw money to purchase tickets for a tour of the Centre, as well as to purchase goods within the café/souvenir shop inside the Centre. The proposed banking service will be outsourced.

c) Information/Reception desk

The reception area, including seating and a reception counter, will be strategically located in relation to the lobby and entrance area to allow for human contact at the point of entry. Service personnel can monitor and control the reception area, store room, computer server, café and souvenir shop from the location. The reception desk area will be designed to accommodate three computer stations for tourism staff with a sales register (on one end of the counter) for trade sales.

Two additional staff stations will have internet access with reference materials for trip planning in vertical files behind staff in a manner that will make them accessible to all staff members. Clear overhead signage will be provided. There will also be brochures, posters and information about the Carnarvon SVC and other items that could be of interest to visitors such as information about other attractions in the area, information about the SALT project and other astronomy projects.

d) Booking area

Three dedicated stations (for ticket sales for tours of the centre) will be provided at the information/reception desk area. Furthermore, two separate dedicated stations will also be provided at the information/reception desk (one for accommodation and tours and a second for a dedicated destination/experience for the Carnarvon area) with internet connection. Both of these booking areas will be screened from the main counter because they are dedicated activities for individual staff members. It

is proposed that the booking systems to be used at the Carnarvon SVC will be outsourced. Clear overhead signage will be provided.

e) Informational brochure and map area

Information stands with brochures and tourism planning materials will be provided in the information desk/booking area as well as in the trip planning/visitors' lounge area. These will be arranged so as to be space efficient and to reduce the need to walk between areas.

f) Trip planning/Visitors' lounge area

This area will be designed to create a restful and relaxed atmosphere. The area will be deliberately screened from the main thoroughfare of the facility to minimise disruptive activities. Provision will be made for two self-serve public interactive display terminals (even if only supplied/fitted in future) off to each side of the area. These terminals will provide access to information such as local weather conditions, events, etc.

g) Café and souvenir shop

The café and souvenir shop will be located adjacent to the entrance of the Carnarvon SVC whilst visitors will need to register at the reception counter if they are to embark on a tour of the facility and or a guided tour to the actual telescope site. The café area will have large sliding glass doors that allow the visitor to sit either inside or outside, weather permitting. This also enables visitors to access the courtyard from the café without necessarily walking through the entire Centre.

A coffee shop/café will be provided to provide for 30 seated patrons. This operation will be outsourced. The interior design of the coffee shop area will closely follow the theme design for the multi-purpose/interpretive/exhibit area. Ease of movement between the foyer, trading area and information/bookings area will be created. A dedicated sales point will be located on the foyer side of the coffee shop as this operation is likely to be outsourced.

h) Locker room

A locker room has been specifically included to enable visitors to deposit their cell phones and other devices that may cause radio frequency interference in a safe location. This will be particularly important if the proposed viewing bunker is included as part of the overall Carnarvon SVC package.

i) Ablution facilities

Adequate facilities will be provided for the Centre. Three bathrooms will be provided: one male, one female and one disabled bathroom with wheelchair access. These facilities will be strategically located

adjacent to the café en route to the interactive display, to allow for ease of access when entering or leaving the facility.

j) Multipurpose/interpretive/exhibit area

The interactive/interpretive display area will be located adjacent to the multi-purpose hall. Within the interactive display area, there will be enough space to accommodate at least 50-100 visitors and visitors can either walk around the interactive display area themselves or a guided tour can be given. This depends on the nature of the displays that will change from time to time to keep the Carnarvon SVC fresh and interesting.

The display area could include displays related to MeerKAT itself such as a functional scale model of a MeerKAT radio telescope if an agreement is reached with SKA South Africa, but also displays related to SKA, SALT and other local and international astronomy projects that would be of interest to visitors. Primarily, however, the display area will showcase the archaeological, cultural and historical attractions of Carnarvon and surrounds, which of course includes the SKA/MeerKAT development.

This area will be designed for high-tech media. Ceiling mounted fixtures (lighting, etc.) will be visible and theme-orientated. Floor space will be used primarily for exhibitions both of a permanent and temporary nature and a helpdesk will be located at the end of the area facing the entrance. Floor space will be utilised in a manner that allows for elements of the exhibit/interactive display to be cleared easily in the event of large displays/cultural activities/seminars.

Apart from high-tech visual display units, the space will also allow for high quality book, poster, painting and exhibits of other art forms. Relatively convenient linkage with the trade area is essential as items on display/exhibit may be offered for sale in the trading area. In addition, the exhibit area will be continuous with entrance from the lobby and trade area flowing into the trip planning/visitors lounge area.

k) Functional scale model of a MeerKAT radio telescope

The focal point or central feature of the Science Visitor Centre, and located within the interpretive/interpretive display area, is the proposed functional scale model of a MeerKAT radio telescope strategically located in a round section of the building joined to the interactive display area. This section will be in the style of a Corbelled House “Korbeelhuis”, a unique style of building found only in the Karoo. There are a number of examples of Corbelled Houses in the area including an excellent example located next to the museum in Carnarvon as well as a number of other examples in varying conditions.

The scale model of the MeerKAT radio telescope is valued at an estimated R1,000,000.00 and can potentially be obtained from SKA South Africa for said price.

The rationale for including a functional scale model of a radio telescope is so that visitors can experience how a radio telescope works. The Carnarvon SVC is separated from the actual telescope arrays and therefore including a scale model telescope that is still fairly large in the building will create a sense of connection between the building and the MeerKAT project.

The circular roof above the scale model of the Centre can be used as a planetarium and this could be used to demonstrate how the telescope can be set to focus on a specific point of interest in the sky.

l) Full-sized MeerKAT radio telescope

Central to the design of the Carnarvon SVC is the inclusion of a full-sized radio telescope to be located outside the building on a banked (raised) area adjacent and accessible from the interactive display area. This may be a prototype radio telescope that is not being used or could be purpose built depending on the cost and logistics involved.

SKA South Africa has indicated that a full-sized MeerKAT radio telescope can be made available to the Carnarvon SVC at no cost as it has been proposed that an existing unused dish will be relocated from the site to the SVC.

At a later date and depending on the final design, a SKA telescope could replace the MeerKAT telescope to showcase the latest design at the time. The “old” telescopes could be a) removed b) moved to the courtyard which could be expanded to accommodate the telescopes, or c) located next to the telescope on the banked area to show the evolution of radio telescopes in recent years.

m) Display of the SALT telescope and live link to Sutherland

To tie in with the SALT telescope project in Sutherland, a SALT display area will be set up in the Carnarvon SVC that has static displays and information about SALT. This will also include a fibre optic link showing images from the SALT project on screens in the Carnarvon SVC, dependent on the availability of funds.

n) Multipurpose hall

The multi-purpose hall is located adjacent to the interactive display area and has been designed to accommodate ± 100 people. The hall is flat and will include a stage area and screen located along the wall furthest from the entrance. The multi-purpose hall also has a general store-room and theatre store-room attached.

It is envisioned that tourists will start with a visit to the café for coffee followed by a briefing session and short video in the multi-purpose hall before being shown the fully functional scale model telescope and experiencing the interactive displays. A visitor would spend up to 2-3 hours within the SVC. The group

could then leave the Carnarvon SVC, commence with a tour to the telescope array or undertake a walking tour to Skietfontein or of Carnarvon.

The café and terrace can also be used by casual visitors, local residents and learners, visiting scientists, students working on the MeerKAT and other related projects, operational staff and resident scientist alike.

The multi-purpose hall will cater for visitors; provide a venue for visiting scientists to present papers, for operational and scientific working groups as a briefing room before or after travelling to the site complex and for school groups to watch astronomy related videos amongst numerous other possible uses.

o) Resource and career guidance room/Internet stations

The Carnarvon SVC will also have a resource and career guidance room that will contain astronomy and science reference material, computers acting as internet stations, desks and chairs for learners.

The design of the stations and the area will be of a similar nature to that of the coffee shop so as not to create a disjointed effect.

p) Administrative offices

Depending on the requirements of the Centre, the administrative offices could take on the form of private offices and a multipurpose boardroom. Specific provision has been made for three individual offices for the Centre Director, secretary and stakeholder manager. Provision has also been made for a larger open plan office to be used by the supervisory staff and learners working part-time at the Centre.

q) Fibre Optic Cable

In addition to the traditional bulk services, SKA South Africa has indicated that they will supply a connection to the fibre optic network from the Carnarvon Point of Presence (POP) for the Carnarvon SVC. Tapping into this fibre optic network will greatly enhance the facilities of the SVC, giving almost unlimited scope for the virtual experience that a number of the proposed interactive displays and other SVC facilities could offer visitors, not to mention the resource and career guidance room and internet stations.

r) Courtyards and outdoor facilities

There are also four smaller courtyard areas strategically located next to the café, multi-purpose hall, offices and learner and resource centre.

Provision has been made for a braai area as well as a stargazing platform both located in a large courtyard suitable for star parties and other functions.

s) Bulk Services

Erf 431 – the site selected for the Carnarvon SVC – lies within the town of Carnarvon on the site of a school that burned down and has been vacant for many years. Due to its location within the town is important to take cognisance of the impact that the development of the Carnarvon SVC will have on the provision of bulk services to other residential, social and commercial facilities in the town.

A 2011 bulk services availability report was compiled by Worley Parsons, indicating that taking into consideration the size and purpose of the development that the overall conclusion is that existing bulk engineering services i.e. water, sewer, streets and electricity are in place and planned for. Furthermore, the impact of the Carnarvon SVC on the existing services was determined to be limited and negligible.

t) Signage

The location for the Carnarvon SVC is at one of the key entrances to the town of Carnarvon, making the Centre easily visible to tourists and passers-by from the R63. Signage will be required to enable visitors to find their way to and from the SVC easily. There is a general need for improvements to signage in and around the town of Carnarvon to cater for increased tourist traffic to and through the town and surrounding areas, which becomes even more necessary with the development of the SVC. Signage will be related to the Carnarvon SVC and possibly other tourism attractions in and around the town itself.

u) Parking

The parking lot located along End Street is large enough to accommodate over 20 vehicles as well as tour busses and an area for overflow parking.

v) Cleaning of Tourism Nodes in Vanwyksvlei and Vosburg

Cleaning will consist of street sweeping, litter picking, emptying of dustbins, and other areas identified by the Municipality.

w) Beautification of Vanwyksvlei and Vosburg

Welcome signs will be erected at the entrances of Vanwyksvlei and Vosburg. These signs will include the directions and distance to the Carnarvon SVC subject to the relevant legislations. For example, the welcome signs within the road environment will be provided for the benefit of tourists and will not be construed as advertisements for the facilities concerned. Furthermore, the exact location and design of the signs will be implemented in co-operation with significant role players in a structured way through a consultative committee.

In addition, Indigenous trees and plants will also be planted to beautify the entrances of the towns.

x) **Walking trail to Schietfontein**

In light of the historical and cultural significance of the township of Schietfontein, an 8km historical walking trail through the town of Carnarvon to the informal settlement of Schietfontein will be upgraded for tourists to take guided or self-guided walking tours to the area. In addition, a stargazing point will be developed in Schietfontein with a seating area and telescope where local guides will explain the night skies to tourists.

17. **Marketing and Public Relations**

Educational NGOs are notorious for the poor quality of their marketing and public relations (MPR) campaigns. It is essential that the Carnarvon SVC has an innovative, high profile and well-funded Marketing and Public Relations campaign that reaches all the publics that have been identified as potential visitors.

17.1. **Marketing**

The first task is to identify the different target market segments that the Carnarvon SVC is targeting, as it is well known that 'shotgun' approaches to a broad public do not work. The different market segments are likely to be:

- Pre-booked school groups of learners (Grades R to 12)
- Other youth groups, including sports teams
- University and college students
- Teachers and other educationists
- Families
- Casual individual youths (afternoons, weekends, holidays)
- Casual individual adults (including grandparents)
- Young mothers and children
- Specialist groups (members of science and technology societies, attendees at workshops and training sessions)
- Politicians, top decision makers and celebrities
- Tourists (local and foreign).

Different marketing strategies need to be developed for each target public.

17.2. Public relations

An increasingly large group of internal and external stakeholders needs to be cultivated by the PR team.

Internal stakeholders include all person directly involved in the Carnarvon SVC's operations.

External stakeholders include visitors, potential sponsors and donors, regional government officials, the media, service organizations, and staff of competing or collaborating educational stakeholders.

A balanced MPR campaign using the following mechanisms needs to be developed:

- Press releases and advertorials
- Published monthly and holiday programmes
- Programmes for special events, e.g. NSW and WSW
- Radio and TV interviews and adverts
- Publication of articles in magazines
- Press launches and special media events associated with new exhibitions and programmes
- Hip, up-to-date website that is easy to use
- Graphic email invites to special events
- Regular communiqués to the Society of Friends of the Carnarvon SVC, and to the Carnarvon SVC's email database
- Publication of a quarterly hardcopy newsletter
- Hosting of MPR banquets, excursions and other special events.

17.3. Media relations

The development of symbiotic media relations is essential to the success of the Carnarvon SVC. Science and technology reports from the printed media, radio and TV should be engaged in the project from the outset, i.e. during the planning stage, through the launch and into the operational phase.

The Carnarvon SVC should establish a reputation that it is a regular and reliable source of relevant stories, not only about its own programmes, but also about the world of science and technology in general. Eventually this will lead to invitations to participate in regular radio slots, to write columns for local newspapers and magazines, and to appear on TV.

The media has to culture a very special stakeholder in the science centre initiative; they should be seen as partners who can help the science centre to achieve its mission.

Special press kits and press launches need to be organized for each new exhibition and programme, the media need to be acknowledged at special events for the important role that they are playing, and they should be invited on special excursions and to sponsor's dinners.

17.4. Importance of community radio

Community radio is greatly underutilized resource in Puset in South Africa, yet it is one of the most effective methods of demystifying MSET and making it accessible to the general public. It is strongly recommended that the Carnarvon SVC should make early contact with community radio stations so that regular talk shows, interviews and statements can be made through this medium.

The Carnarvon SVC will be able to substantially increase its external stakeholder base through the medium of community radio stations, which are well developed in the South Africa.

17.5. Interface with politicians

It is important that the Carnarvon SVC engages with regional and national politicians and other top decision makers, early in its development to ensure that they are made aware of the pivotal role that the science centre will play in Puset in the province in future. Ideally, politicians who are sympathetic to the science centre's cause should be identified and brought on board as spokespeople for the project.

Relevant politicians should be placed on the invite list for all important Carnarvon SVC events, and should also receive the quarterly newsletter. Newsletters should also be placed in the library of the local, district and provincial government.

17.6. Celebrity appearances

The youth identify strongly with role models who are prominent in sports, politics, music (especially radio DJs), TV, radio or cultural activities, as well as with young scientists and technologists. Appropriate celebrities who might support the Carnarvon SVC cause should be identified and approached to act as ambassadors. Their duties would include attending Carnarvon SVC events, spearheading outreach programmes, talking to the media about the importance of the Carnarvon SVC's work, and inspiring visitors during occasional visits to the science centre.

18. Partnership development

Today all successful businesses operate in partnerships, and this is even more important in the non-profit company sector. The development of mutually beneficial partnerships is therefore absolutely vital to the success of the Carnarvon SVC. These partnerships will be formed with a surprising variety of organizations, well outside the comfort ones of traditional educational institutions such as schools and colleges.

For example, the MTN Sciencentre has formed working partnerships with the South African Police Forensic Unit, the Brain Research Unit of the UCT Medical School, the South African Industrial Leadership Initiative, the South African Bureau of standards, the Cape Town Society of Experimental & Model Engineers, the Astronomical Society of South Africa, the South African Institute of Electrical Engineers and Magnetech (a magnet manufacturer and importer).

For the Carnarvon SVC following are key partners, amongst others: SKA Project; National Department of Tourism; National Department of Science and Technology; Kareeberg Local Municipality; Pixley Ka Seme District Municipality; Northern Cape Tourism Authority; Sol Plaatje University; the Northern Cape Department of Education; the Northern Cape Department of Sports, Arts and Culture; Private sector; other SVCs; Parastatals and national facilities; and various big private/corporate companies. Formal relationships through MoUs/SLAs need to be formed with These potential institutions/organisation.

18.1. Universities

Links with the Sol Plaatje University and other relevant universities are vital as they offer speakers for talks and debates, technical expertise, access to the latest literature, and sometimes funding for outreach programmes and interschool competitions. Universities gain from the partnership with a science centre as they may recruit the best science students, and the pool of potential science students may be increased by the Carnarvon SVC's activities.

18.2. Linkages to other edutainment destinations

Strategic linkages need to be established with various other edutainment destinations, both locally and internationally, these would include museums, science festivals, game parks and tourist destinations.

18.3. Linkages to SALT, MeerKAT and SKA Project

Strategic linkages need to be established with various other edutainment destinations, both locally and internationally, these would include museums, science festivals, game parks and tourist destinations.

Link to Salt: According to the Worley Parsons 2011 feasibility study for the establishment of a science centre for the Karoo Array Telescope in Carnarvon, done on behalf of the Northern Cape Department of Economic Development and Tourism, it was suggested that there is scope for the development of a link for the proposed Carnarvon Science Visitor Centre with the Science Education/Visitor Centre in Sutherland for the Southern African Large Telescope (SALT) project.

SALT is the largest single optical telescope in the Southern Hemisphere and is also located in the Northern Cape just outside the town of Sutherland, 250km from Carnarvon. The positive impact of the SALT project on the town of Sutherland has been significant. Large numbers of people visit Sutherland from all over the country and world to see the SALT telescope and to hear about the project and how it operates. It is proposed that the same benefits and impact will be experienced in Carnarvon with the development of the Science Visitor Centre, including a boost for the local economy.

There is an opportunity to promote the Carnarvon Science Visitor Centre at SALT and vice versa. SALT already has displays related to the MeerKAT and SKA projects, however these can be improved. Once the Carnarvon Science Visitor Centre is open, there can be a more direct link between the two facilities. The idea is that the Carnarvon Science Visitor Centre has static displays and information about SALT and that there is a fibre optic link to SALT showing images from the SALT project on screens in the Carnarvon Science Visitor Centre.

A scale model of SALT should be included alongside the scale model of the MeerKAT telescope in the Carnarvon Science Visitor Centre so that astronomy tour guides can explain the difference between an optical telescope (SALT) and a radio telescope (MeerKAT). The main misconception that the general public has about telescopes is that all telescopes are basically single lens binoculars that one looks through with one's eye. Scale models of the two different types of telescopes and an explanation of the basic differences between various telescopes will go a long way towards promoting a better understanding of astronomy amongst the general population.

The linkages between SALT and MeerKAT can also extend to promoting tours that involve a visit to both facilities that would need to take place over at least 2 days to be enjoyable and meaningful.

18.4. Stakeholder Matrix

Strategic Partners	Characteristics and possible objectives for involvement	Potential stakeholders
Tertiary Academic Institutions	<ul style="list-style-type: none"> • Stable organisations with track records • Limited funding to invest in R & D • Access to Research Facilities • Access to Knowledge Base • Knowledge transfer • Technology transfer 	<ul style="list-style-type: none"> • Sol Plaatje University
Research Centres/Institutions	<ul style="list-style-type: none"> • Government established research institutions • Technology transfer through government funded institutions • Utilisation of human capital capacity and linkages 	<ul style="list-style-type: none"> • The South Africa Agency for Science and Technology Advancement (SAASTA)
Local, Provincial or National Government	<ul style="list-style-type: none"> • Allocation of land or buildings • Could be a partner in planning the Science Visitor Centre • Low funding possibility • Could assist in aligning the Science Visitor Centre to strategic objectives relevant to national, province and local government • Economic development and local and district municipal levels • Achieving sustainable development • Integration of the Science Visitor Centre into Education, Tourism, SMME, LED Plan, and IDP strategies • Utilisation of human capital capacity and linkages 	<ul style="list-style-type: none"> • National Department of Tourism • National Department of Science and Technology • Northern Cape Department of Economic Development and Tourism • Northern Cape Department of Education • Kareeberg Local Municipality • Pixley Ka Seme District Municipality • Northern Cape Tourism Authority • Northern Cape Department of Sports, Arts and Culture • SOEs
SMME Development Organisations	<ul style="list-style-type: none"> • In the form of a SMME Hub located in the Science Visitor Centre, could be a key role-player in partnership formation and the delivery of business support programs/services and interventions which currently don't exist in the Kareeberg Local Municipality • A SMME Hub could be a key economic development tool for the Kareeberg Local Municipality 	<ul style="list-style-type: none"> • SEDA • SEFA • NYDA • Local organised business • LED Unit
Private Sector	<ul style="list-style-type: none"> • Could provide subsidised funding and operational capacity for the Science Visitor Centre • Were risks of development are low and sustainability and impact can be proven, private sector may either participate in either CAPEX or OPEX phases • Profitable development, either from returns from tenant rentals or from investment in the infrastructure yielding passive returns over a longer term 	<ul style="list-style-type: none"> • SKA Project

19. Fund-raising

Science centres are attractive targets for private and public sector funders for the following reasons:

- They are cost-effective and relatively self-funded organizations, compared to museums and many other educational NGOs/ non-profit companies, and therefore do not have a dependence mentality. Whereas museums in South Africa typically require ca 80-90% subsidization in order to survive, science centres only require 20-30% OPEX subsidization.
- They are addressing a national priority (strengthening the science culture)
- They are innovative, 'new age' educational institutions with the potential to make a real difference
- They are not burdened by massive operational overheads, unlike museums which have the costly responsibility of archiving heritage collections
- They are partners in internationally collaborative initiatives to promote PUSET and therefore have access to some of the most advanced teaching tools.
- They offer, for sponsorship, clearly circumscribed programmes with tangible and measurable outcomes and benefits.

The key to successful fund raising is not to regard it as a cheque book exercise, i.e. the relationship with the sponsor should be far more than just the receipt of a donation. Sponsors should be brought on board as full partners in the science centre venture, and they should be given prominent credit for their all-round support.

In order to achieve this symbiotic relationship, it is very important that any project selects the right sponsors. It is critical to select sponsors/partners whose own goals will be achieved through the project's work; their support of a project therefore helps them to achieve their own objectives. Careful work must be done to identify sponsors who have a similar CSI mission to that of the Carnarvon SVC.

19.1. Fund-raising patterns worldwide

The main differences in fund-raising patterns worldwide are determined by the tax laws in different countries. In the USA and Canada, for instance, where generous tax incentives are available to donors to the arts and sciences, there is a generous culture of corporate giving to science centres, museums and music conservatoria.

In South Africa, science centres and museums that are not State-aided cannot offer any tax relief to donors, unless they are registered as a Section 18A Trust (a very difficult status to attain). As a result, non-State-aided NGOs compete on an unfair basis with State-aided, as well as university-based, NGOs.

19.2. Lessons learned in South Africa

South Africa has one of the highest ratios of empowerment NGOs and CBOs in the world, and they make enormous demands on the small core of potential funders in the country. Fund-raising campaigns therefore have to be extremely well planned and executed.

Funders in South Africa tend to ask the following questions when making a funding decision:

- Does the proposed project help us to achieve our objectives?
- Have we supported this organization before, and, if so, was the investment worthwhile?
- Do we trust the project leader?
- Is the organization a registered NGO?
- Does the organization have a good track record?
- Do they have strict financial management procedures and audited financial statements?
- Are they equipped to deliver on their objectives, or are they being too ambitious?
- Will we be able to measure the impact of our donation?

The Carnarvon SVC needs to ensure that it answers each of these questions in its applications for financial support.

19.3. Use of consultants

Fund-raising consultants tend to be utilized as an option with careful consideration in South Africa, especially those who are paid as a percentage of the total amount awarded, as their commission.

19.4. Fund-raising from the private sector

Most major commercial companies have formed foundations, trust funds or Chairman's Funds to manage their CSI vote; in some cases, these organizations are independent of the company or may be outsourced. These funding organizations all have different conditions of grant, and it is imperative that the fund-raising staff of the Carnarvon SVC are familiar with these conditions before the applications are made. In most cases the size of the grant is dictated by the conditions of grant.

19.5. Fund-raising from the public sector

Fund-raising from the public sector (including parastatals/SOEs) tends to be more formal and less flexible than from the private sector. Most of the grants made available to science centres are administered by SAASTA on behalf of the DST. Detailed questionnaires have to be completed and submitted by certain deadlines, and the success of the outcome, even for well-established science centres, cannot be guaranteed. The efficiency of the National Lottery varies from time to time.

19.6. Sustainable financial models for science centres

The Carnarvon SVC is likely to be sustainable in the long term if the following conditions are adhered to:

- The SVC pathologies are avoided
- The estimates of major incomes and expenditure are accurate
- The SVC is operated in a proactive, entrepreneurial way that optimizes income and minimizes expenditure
- Satellite developments associated with, and partly dependent on, the SVC generate revenue on an ongoing basis for the SVC.
- The Carnarvon SVC develops sufficient credibility as a genuine educational and tourism facility that it receives regular grants from the DST and the National Lottery and other major funders of science centres in South Africa.

19.7. International best practice

The funding model for science centres differs widely from one country to the next. The one consistent pattern, and even this does not apply to all countries, is that the value of science centres has been appreciated to such an extent that most receive 30-80% (sometimes 100%) subsidization of their operating costs (OPEX) from government sources, either local, provincial or national. In many cases, the cost of the entire initial capital works is covered by government funding, and a non-profit Trust Fund or other cost centre is then established to manage income and expenditure, and cover the operating costs of the science centre.

Most large science centres worldwide are State-owned and/or -funded, although they may have started as relatively modest private enterprises, e.g. Techniquest in Wales. In many cases, the major ongoing expenses, such as rentals, rates, vehicle purchase and operating costs, water and electricity, and taxes, and sometimes senior staff salaries, have been institutionalized, i.e. they are paid by a public entity, whereas the ongoing operational costs have to be covered by the science centre's own entrepreneurial

activities and fund-raising campaigns. This is an optimal model as it takes away the burden of raising funds for fixed costs but allows the science centre to have a measure of financial and operational independence from the public sector. In rare cases, the entire cost of developing and operating a science centre has been covered by a single private sector donor (CosmoCaixa in Barcelona). It is very rare that science centres in the world survives with no public sector support; the MTN Sciencecentres in Cape Town and Durban probably come closest to this situation.

19.8. Key success factors of science centres internationally

The following key success factors have been identified for science centres internationally:

- They occupy a unique niche in the edutainment market
- They demonstrably contribute to the strengthening of a county or state's science culture
- They use the most effective methods of teaching and learning
- They are financially viable as they are able to earn substantial own-income, like theme parks but unlike most museums, aquaria, libraries, art galleries and similar edutainment destinations.
- They are responsive to change, and often lead in terms of finding new ways in which to engage the public in science and technology
- They have established themselves as a vital link in the 'social contract' of science, i.e. the responsibility of science to deliver useful products to society.
- They are able to efficiently address the needs of disadvantaged communities, and therefore to help bridge the 'digital divide'
- They are effective in multi-lingual, multi-cultural countries as their displays are relatively language-free. They are therefore very successful in developing countries, states and provinces.
- They address a very wide age groups
- Their displays and exhibitions are socially neutral and do not carry 'social baggage', unlike many traditional museum displays
- They focus on the future rather than the past
- They are fast-moving, proactive and quickly responsive to new needs
- They work in efficient collaborative networks

19.9. What works in South Africa

In its simplest form, the following works best in South Africa:

- All capital costs prior to opening day should be sponsored
- All operating costs, including staff recruitment, uniforms and training, salaries, consultancy fees, marketing and public relations activities, development of teaching programmes and aids, installation

of financial management systems, commissioning of computers and the inter- and intranets, etc., prior to opening day should be sponsored

- The science centre should open in a debt-free environment
- All new acquisitions after opening day, i.e. new displays, exhibitions, programmes, vehicles, installations, infrastructure, should be sponsored, and branded to the sponsor
- The operating costs should be 50% subsidized for at least the first 12 months of operation
- The OPEX of the science centre should be at least 30% subsidized after 12 months
- Income generated by the science centre should be used solely to cover the other 70% of OPEX, including the remuneration of new staff. Permanent staff should preferably not be employed on short-term, 'soft' money obtained from sponsors. The secondment of teachers from the Department of Education should be strongly encouraged.
- Branding on educational products and services should be offered on a carefully considered, hierarchical basis, i.e. the largest sponsors receive the most exposure, but only on the products and services that they sponsor, and only for a limited time period.
- An entrepreneurial, non-dependant ethos
- Keeping a maximum number of income-earning options open for the future
- Developing a multi-purpose facility that serves the needs of many stakeholders
- Making optimal use of limited human and financial resources
- Maximizing the benefits of partnerships
- Planning for a long-term, unpredictable future.

It should be borne in mind, during the planning of the Carnarvon SVC, that a substantial amount of income to the science centre could derive, not from paying customers, but from sponsors who subsidize visits from disadvantaged communities. This however is not a normal economic model as it means that it is not 'actual consumer demand' that is driving gate income, but 'created consumer demand'. This consumer demand is 'created' by the sponsors, who make it possible for an individual to visit the facility that he/she had no intention (or means) of visiting previously. If this will be an important income category of the Carnarvon SVC, it means that the supply can be shaped to meet the demand, i.e. the SVC and its sponsors largely dictate how many visitors there are, and therefore how much it costs to operate the science centre.

In the case of the MTN Sciencentre in Cape Town, substantial funding has been obtained from the National Lottery, Anglo American Chairman's Fund, MTN, Ericsson and MTN to sponsor visits by learners from disadvantaged communities to the science centre; this constituted a major source of income and a major source of visitation.

19.10. Some initial proposed variables for the financial model for the Carnarvon SVC

- Reduced water and electricity rates, sewerage removal rates, rates and regional service levies should be negotiated.
- Additional funds should be raised from both public and private sector post establishment and operation of the Carnarvon SVC.
- It is essential that the science centre benefits financially from the retail, edutainment and entertainment activities that are clustered around it, such as the restaurant, internet café, coffee shop, science shop, craft and souvenir shop, tourist guides etc.
- Income should be generated by the SVC from gate fees, 'Friends' memberships, sale of merchandise, hire of travelling displays, venue hire, children's parties, revenue share and rental recovery, workshops, movie evenings, special events, project management fees, outreach programmes, outdoor displays, government subsidies, sponsor income, and interest on investments.
- All new exhibitions, projects and programmes should be carefully costed out and run as separate cost centres; new money needs to be raised for each cost centre.
- Careful control needs to be exercised over expenditure, and the staff should strive to achieve savings on all budgeted expenditure items. Once a contract for a particularly project has been negotiated, every effort should be made to achieve that project within budget.
- Insurance costs should be carefully reviewed. For instance, it is wasteful to insure against theft items that cannot be stolen (which many museums do). On the other hand, third party and health insurance coverage should be generous.
- Preventative maintenance, and intelligent management of staff and displays, will significantly reduce the risks of accidents and breakages, and the cost of maintaining the displays and exhibitions.
- Non-line function services, such as security, cleaning, catering, transport of learners and displays, and high-tech maintenance, should be outsourced.
- The SVC should have a rolling three-year business plan that is constantly updated in accordance with changing circumstances.
- Staff should constantly be on the lookout for new opportunities to earn revenue.
- The staff should stay in touch with science centre best practice internationally by attending national and international conferences and remain in close touch with key science centre players worldwide.

19.11. Financial management practices

NGOs and non-profit companies in South Africa sometimes face intense scrutiny by government departments and corporates because of the high incidence of financial mismanagement, and even fraud, largely because many NGOs do not have the financial management skills to run their organizations efficiently. It goes without saying that the financial management of the Carnarvon SVC needs to be beyond reproach, and that strict financial controls need to be put in place, from the Board down, without interfering with the ability of the Director and his Management staff to act entrepreneurially and proactively.

The Board needs to have at least one member with financial expertise, and the Director needs to have a good understanding of financial management and control. A senior staff member should be appointed as Financial Manager, and the financial records of the Carnarvon SVC need to be independently audited. Independently audited books are an essential requirement for many potential sponsors, including the National Lottery. The requirements of the PFMA also need to be met, if not exceeded, by the Carnarvon SVC staff.

Programmatic grants from corporate and public-sector sponsors usually need to be independently audited, or at least reported on, so a detailed set of books needs to be kept that itemizes every expenditure against a given programme account.

20. Financial Plan

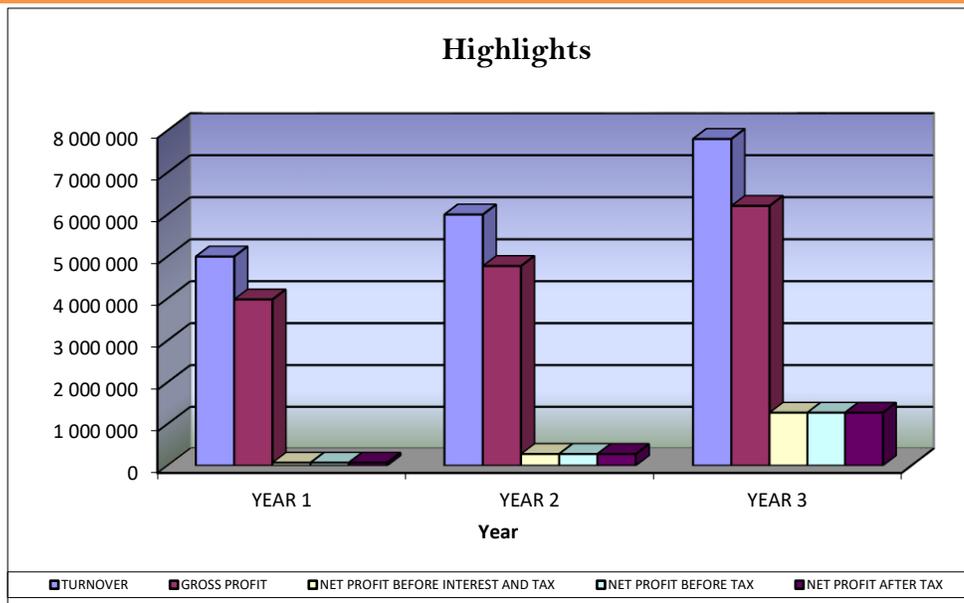
The financial plan is essential if the Carnarvon Science Visitors Centre is to meet its overall strategic objectives and most important achieve self-sustainability within 3 years. The core intention is to be able to finance a significant portion of future operational expenditure through cash flow.

The feasibility financial plan depends on important assumptions, most of which are included in the financial projections as annual assumptions. Revenue trends, cost structures, operational expenditure, interest rates, tax rates etc. are based on conservative assumptions.

Based on the feasibility study's six-year financial projections for 2019/20 to 2024/25, it is established that an amount of R 62 442 076 needs to be raised for the establishment of the Carnarvon Science Visitors Centre. The funding will be 100% grant funding thus meaning that the Carnarvon SVC will be operating in a debt-free environment, as is best practice for science centres.

Projected Income Statements for 6 years:

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
TURNOVER	5 000 000	6 000 000	7 800 000	8 580 000	8 580 000	9 009 000
COST OF SALES	1 021 100	1 225 320	1 592 915	1 752 207	1 752 207	1 839 817
GROSS PROFIT	3 978 900	4 774 680	6 207 085	6 827 793	6 827 793	7 169 183
OTHER INCOME	92 772	105 756	124 788	130 800	132 000	150 000
EXPENSES	3 999 556	4 599 489	5 059 438	5 059 438	6 324 297	6 640 512
Variable Expenditure	0	0	0	0	0	0
Fixed Expenditure	3 999 556	4 599 489	5 059 438	5 059 438	6 324 297	6 640 512
NET PROFIT BEFORE INTEREST AND TAX	72 117	280 948	1 272 435	1 899 155	635 496	678 671
FINANCE CHARGES	0	0	0	0	0	0
NET PROFIT AFTER TAX	72 117	280 948	1 272 435	1 899 155	635 496	678 671



20.1. Important Assumptions

In order to achieve some form of realistic projections, the financials have been benchmarked according to the structure, format and financial trends of the most established science centers' in South Africa such as the Cape Town Science Centre. In addition, the following assumptions have been made regarding the 6 year projections:

- Revenue has been projected to increase by 20% and 30% p.a. for year 2 and 3 respectively, then varies between 0% and 10% p.a. for year 4 to 6.
- Fixed Expenses has been projected to increase by 15% in year 2 and 10% in year 3, then varies between 0% and 15% p.a. for year 4 to 6.
- Electricity and water are both variable expenses and based on the Kareeberg Local Municipality municipal rates.

- Straight Line Depreciation of 30%, 25% and 25% p.a. is projected for Plant & Equipment, Vehicles and Furniture & Fixtures respectively.
- It is assumed that there are no unforeseen changes in economic policy to make the company's products immediately obsolete.
- Sales are 100% COD.
- Expenses are mainly on net 30 day basis.

The appropriation of the R 62 442 076 funding amount for the Carnarvon SVC will be as follows:

• Phase 1 (Exploratorium)	40 791 676
• <i>Land and Buildings</i>	22 391 676
• <i>Indoor exhibition & interactive content</i>	7 000 000
• <i>Motor Vehicles</i>	1 900 000
• <i>Furniture and Fixtures</i>	2 000 000
• <i>OPEX</i>	7 500 000
• Phase 2 (Accommodation facility)	21 650 400

Project cost estimation: Phase 1 - construction of the Carnarvon SVC:

ITEM	TYPE	EST. COST
Professional Fees	Architecture Category 04: Adjustments required to the technical drawings to bring in it line with the expansion of the design brief	144 000
	Engineering <ul style="list-style-type: none"> ▪ Structural ▪ Mechanical (greening) ▪ Electrical (greening included) 	544 800
Council Submission	<ul style="list-style-type: none"> ▪ Advertising. ▪ Application Fees 	30 000
Project Management	<ul style="list-style-type: none"> ▪ Project Management ▪ Inspections 	300 000
Construction	Construction of facility (priced for 2018)	19 452 876
Equipment and Softs	<ul style="list-style-type: none"> ▪ Appliances. ▪ Furniture ▪ Softs. ▪ Exhibition dish (Excludes indoor exhibition content and fit out of science visitor centre) 	1 740 000
Disbursements	<ul style="list-style-type: none"> ▪ Travel & Time 	180 000
TOTAL		22 391 676

Project cost estimation: Phase 2 - construction of the Accommodation facility:

ITEM	TYPE	EST. COST
Professional Fees	Architecture Category 04 <ul style="list-style-type: none"> ▪ Appraisal and definition of project. ▪ Elementary Quantity Surveying ▪ Finalising concept designs. ▪ Technical drawings – municipal approval. ▪ Technical drawings – construction. ▪ Contract administration and inspections. ▪ Close-Out Report 	540 000
	Engineering <ul style="list-style-type: none"> ▪ Structural ▪ Mechanical (greening) ▪ Electrical (greening included) 	518 400
Council Submission	<ul style="list-style-type: none"> ▪ Advertising. ▪ Application Fees 	60 000
Project Management	<ul style="list-style-type: none"> ▪ Project Management ▪ Inspections 	432 000
Construction	Construction of 1 200 sqm accommodation facility compliant with 3 star grading	14 400 000
Equipment and Softs	<ul style="list-style-type: none"> ▪ Appliances. ▪ Furniture ▪ Softs. 	5 520 000
Disbursements	<ul style="list-style-type: none"> ▪ Travel & Time 	180 000
TOTAL		21 650 400

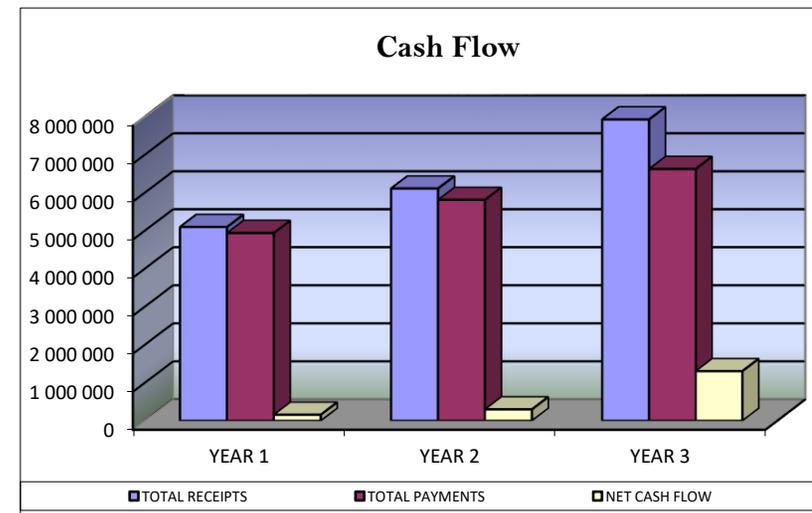
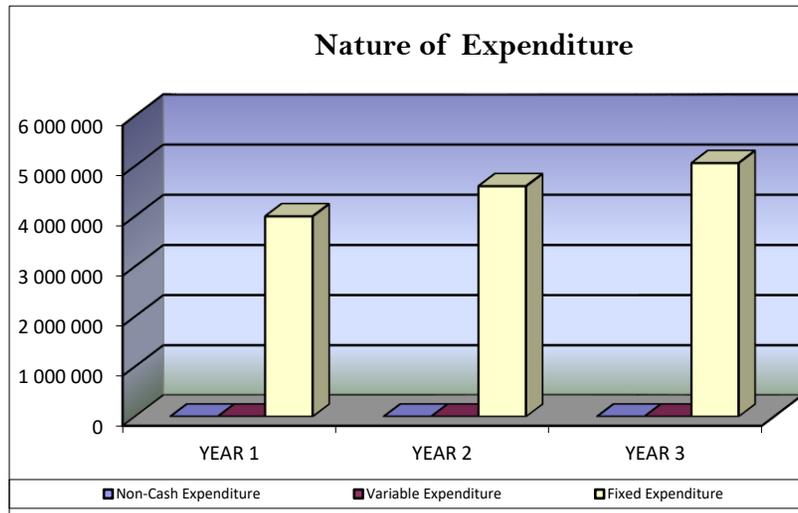
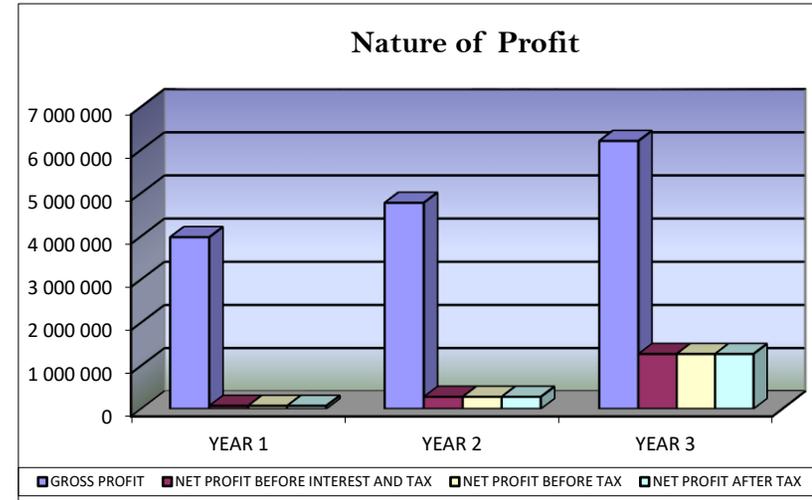
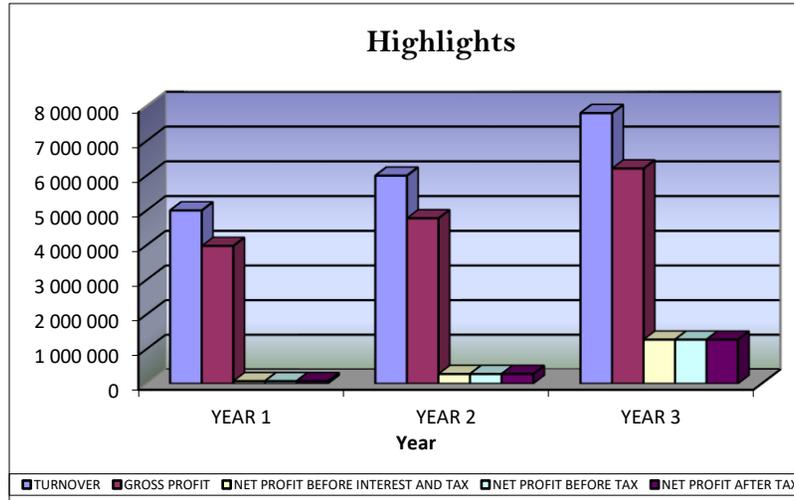
20.2. Break-even Analysis

The break-even analysis is based on all running costs that are costs which will be incurred in keeping the business afloat on a monthly basis.

Break-even Table

Profit Breakeven Inputs			
	FY1	FY2	FY3
Breakeven Revenue Per Annum	5 026 010	5 779 894	6 357 842
Breakeven Production Per Annum	91 382	98 214	100 967
Fixed Costs Per Year:	3 999 556	4 599 489	5 059 438
Revenue Per Product (Ave)	55	59	63
Gross Profit Percentage	79,58%	79,58%	79,58%
Cost per Product	11,23	12,02	12,86

20.3. Graphs of Projected Financial Results



20.4. Accounting and Financial Policies

Adopting and implementing best Accounting and Financial policies and systems during the operation of the Carnarvon Science Visitors Centre is critical in ensuring the achievement of self-sustainability. The following Accounting and Financial policies should be implemented at the Carnarvon SVC:

20.4.1. Basis of preparation of annual financial statements

The annual financial statements are prepared on the ongoing concern basis with, and in compliance with, the international Financial Reporting Standards (“IFRS”) and international Financial Reporting Interpretations Committee (“IFRIC”) Interpretations issued and effective at the time of preparing these annual financial statements and the Companies Act 71 of 2008 of South Africa, as amended.

Annual financial statements comply with the requirements of the SAICA Financial Reporting Guides as issued by the Accounting Practices Committee and the Financial Reporting Pronouncements as issued by the Financial Reporting Standards Council.

The annual financial statements are prepared on the historic cost convention, unless otherwise stated in the accounting policies which follow and incorporate the principle accounting policies set out below. They are presented in Rand, which is the company’s functional currency.

20.4.2. Significant judgements and sources of estimation uncertainty

Preparation of annual financial statements in conformity with IFRS requires management, from time to time, to make judgement, estimates and assumptions that affect the application of policies and reported amounts of assets, liabilities, income and expenses. These estimates and associated assumptions are based on experiences and various other factors that are believed to be reasonable under circumstances. Actual results may differ from these estimates. These estimates underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates are recognised in the period in which the estimates are revised and in any future periods affected.

Trade receivables and Loans and receivables

The critical judgements made by management in applying accounting policies, apart from those involving estimations, that have the most significant effect on the amounts recognised in the financial statement, are outlined as follows:

Less classification

The company is partly to leasing arrangements, both as lessee and as a lessor. The treatment of leasing in the annual financial statements is mainly determined by whether the lease is considered to be an operating lease or a finance lease. In making this assessment, management considers the substance

of the lease, as well as the legal form, and makes a judgement about whether substantially all of the risks are rewards of ownership and transferred.

The company enters in lease of land with annual rentals of R 0, Significant judgement is applied by the management in concluding the correct lease classification. Leases of land are typically classified as operating leases but the present value of the future minimum lease payments is amounted to approximately 0% of the estimated fair and value of the land. Management therefore concluded that this is the finance lease.

20.4.3. Property, plant and equipment

Property, plant and equipment are tangible assets which the company holds for its own to use or for rental to others and which are expected to be used for more than one year. An item of property, plant and equipment, is recognised as an asset which is probable that the future economic benefits associated with the item will flow to the company, and the cost of the item can be measured reliably.

Property, plant and equipment is initially measured at cost. Cost includes all the expenditure which is directly attributable to the acquisition and construction of the asset, including the capitalisation of borrowing costs on qualifying assets and adjustments in respect of hedge accounting, where appropriate. Property, plant and equipment is subsequently stated at cost less accumulated depreciation and any accumulated impairment losses, except for land which is stated at cost less and accumulated impairment losses.

The residual value, useful line and depreciation method of each asset are reviewed at the end of each reporting year. If the expectation differs from the previous estimates, the change is accounted for prospectively as a change in accounting estimate. The depreciation charge for each year is recognised in profit or loss unless it is included in the carrying amount of another asset.

An item of property, plant and equipment is derecognised upon disposal or when no future economic benefits are expected from its continued use or disposal. Any gain or loss arising from the derecognition of an item of property, plant and equipment, determined as the difference between the net disposal proceeds, if any, and the carrying amount of the item, is included in profit or loss when the item is derecognised.

20.4.4. Financial instruments

Classification

The company classifies financial assets and financial liabilities into the following categories:

- Loans and receivables
- Financial liabilities measured at amortised cost

Classification depends on the purpose for which the financial instruments were obtained/ incurred and takes place at initial recognition. Classification is re-assessed on an annual basis, except for derivatives and financial assets designated as at fair value through profit or loss, which shall not be classified out of the fair value through profit or loss category.

Subsequent measurement

Loans and receivables are subsequently measure at amortised cost, using the effective interest method, less accumulated impairment losses. Financial liabilities at amortised cost are subsequently measured at amortised cost, using effective interest method.

Derecognition

Financial assets are derecognised when the rights to receive cash flows from the investment have expired or have been transferred and the company has transferred substantially all risks and rewards of ownership.

Fair value determination

The fair values of quoted investments are based on current bid prices. If the market for a financial asset is not active (and for unlisted securities), the company establishes fair value by using valuation techniques. These include the use of recent arm's length transactions, reference to other instruments that are substantially the same, discounted cash flow analysis, and option pricing models making maximum use of market inputs and relying as little as possible on entry inputs.

Impairment of financial assets

At each reporting date the company assess all financial assets, other than those at the fair value through profit or loss, to determine whether there is objective evidence that a financial asset or group of financial assets have been impaired.

For amounts due to the company, significant financial difficulties at the debtor, probability that the debtor will enter bankruptcy and defaults of payments are all considered indicators of impairment.

In the case of equity securities classified as available-for-sale, a significant or prolonged decline in the fair value of the security below. Its cost is considered an indicator of impairment. If any such evidence exists for available-for-sale financial assets, the cumulative loss measured as the difference between the acquisition cost and current fair value, less any impairment loss on that financial asset previously recognised in profit or loss – is removed from equity as a reclassification adjustment to other comprehensive income and recognised in the profit or loss.

Impairment losses are recognised in profit or loss

Impairment losses are reversed when an increase in the financial asset's recoverable amount can be related objectively to an event occurring after the impairment was recognised, subject to the restriction

that the carrying amount of the financial asset at the date that the impairment is reversal shall not exceed what the carrying amount would have been had the impairment been recognised.

Reversals of impairment losses are recognised in profit or loss except for equity investment as available-for-sale.

Impairment losses are also not subsequently reversed for available-for-sale equity investment which are held at cost because fair value was not determinable.

Where financial assets are impaired through use of an allowance account, the amount of the loss is recognised in the profit or loss within operating expenses. When such assets are written off, the write off is made against the relevant allowance account. Subsequent recoveries of amounts previously written off are credited against operating expenses.

Trade and other receivables

Trade receivables are measured at initial recognition at fair value, and are subsequently measured at amortised cost using the effective interest rate method. Appropriate allowances for estimated irrecoverable amounts are recognised in profit or loss when there is objective evidence that the asset is impaired. Significant financial difficulties of the debtor, probability that the debtor will enter bankruptcy or financial reorganisation, and default or delinquency in payments (more than 30 days overdue) are considered indicators that the trade receivable is impaired. The allowance recognised is measured as the difference between asset's carrying amount and the present value of estimated future cash flows discounted at the effective interest rate computed at initial recognition.

The carrying amount of these asset is reduced through the use of allowance amount, and the amount of the loss is recognised in profit or loss within operating expenses. When trade receivable is uncollectable, it is written off against the allowance account for trade receivables. Subsequent recoveries of amounts previously written off are credited against operating expenses in profit or loss.

Trade and other receivables are classified as loans and receivables.

Trade and other payables

Trade payables are initially measured at fair value, and are subsequently measured at amortised cost, using the effective interest rate method.

Cash and cash equivalents

Cash and cash equivalents comprise cash on hand and demand deposits, and other short-term highly liquid investments that are readily convertible to a known amount of cash and are subject to a significant risk of changes in value. These are initially and subsequently recorded at fair value.

Bank overdraft and borrowings

Bank overdrafts and borrowings are initially measured at fair value, and are subsequently measured at amortised cost, using the effective interest rate method. Any difference between the proceed (net transition cost) and the settlement or redemption of borrowings is recognised over the term of the borrowings in accordance with the company's accounting policy for borrowing costs.

20.4.5. Leases

A lease is classified as a finance lease if it transfers sustainability, all the risks and rewards incidental to ownership. A lease is classified as an operating lease if it does not transfer sustainability all the risks and rewards incidental to ownership.

Operating leases- lessor

Operating lease is recognised as an income on a straight-line basis over the lease term.

Initial direct costs incurred in negotiating and arranging operating leases are added to the carrying amount of the leased asset and recognised as an expense over the lease term on the same basis as the lease income.

Income for the leases is disclosed under revenue in profit or loss.

Operating leases- lessee

Operating lease payments are recognised as the expense on the straight-line basis over the lease term. The difference between the amounts recognised as expense and the contractual payments are recognised as an operating lease asset. This liability is not discounted.

Any contingent rents are expensed in the period they are incurred.

20.4.6. Impairment of assets

The company assesses at each end of the reporting period whether there is any indication that an asset may be impaired. If any such indication exists, the company estimates the recoverable amount of the asset.

Irrespective of whether there is any indication of impairment, the company also:

- Tests intangible assets with the indefinite useful life or intangible assets not yet available for the use of impairment annually by comparing its carrying amount with its recoverable amount. This impairment test is performed during the annual period and at the same time very period.
- Tests goodwill acquired in a business combination for impairment annually.

If there is any indication that an asset may be impaired, the recoverable amount is estimated for the individual asset. If it is not possible to estimate the recoverable amount of the individual asset, the recoverable amount of the cash generating unit to which the asset belongs is determined.

The recoverable amount of an asset or cash generating unit is the higher of its fair value less costs to sell and its value in use.

If the recoverable amount of an asset is less than its carrying amount, the carrying amount of the asset is reduced to its recoverable amount. The reduction is an impairment loss.

An impairment loss of assets carried at cost less any accumulated depreciation or amortisation is recognised immediately in profit or loss. Any impairment loss of a revalued asset is treated as a revaluation decrease.

An entity assesses at each reporting date whether that there is any indication that an impairment loss recognised in prior periods for assets other than goodwill may no longer exist or may, have decreased. If any such indication exists, the recoverable amounts of those assets are estimated.

The increased carrying amount of an asset other than goodwill attributable to a reversal of an impairment loss does not exceed the carrying amount that would be determined had no impairment loss been recognised for the asset in prior periods.

A reversal of an impairment loss of assets carried at cost less accumulated depreciation or amortisation other than goodwill is recognised immediately in profit or loss. Any reversal of an impairment loss of a revalued asset is treated as a revaluation increase.

20.4.7. Employee benefits

Short-term employee benefits.

The cost of short term employee benefits (those payable within 12 months after the service is rendered, such as a paid vacation leave, sick leave, bonuses, and non-momentary benefits such as medical care), are recognised in the period in which the service is rendered and are discounted.

The expected cost of compensated absence is recognised as an expense as the employees render services that increase the entitlement or, in the case of non-accumulating absences, when the absence occurs.

The expected cost of the profit sharing and bonus payments is recognised as an expense when there is a legal or constructive obligation to make such payments as a result of past performances.

20.4.8. Provisions and contingencies

Provisions are recognised when:

- The company has a present obligation as a result of a past event:
- It is probable that the outflow of resources embodying economic benefits will be required to settle the obligation: and
- A reliable estimate can be made of the obligation.

The amount of a provision is the present value of the expenditure expected to be required to settle obligation.

When some or all the expenditure required to settle provision is expected to be reimbursed by another party, the reimbursement shall be recognised when, and only when, it is virtually certain that the reimbursement will be received if the entity settles the obligation. The reimbursement shall be treated as a separate asset. The amount recognised for the reimbursement shall not exceed the amount of the provision.

20.4.9. Government grants

Government grants are recognised when there is reasonable assurance that:

- The company will comply with the conditions attaching to them; and
- The grants will be received

Government grants are recognised as income, over the periods necessary to match them with the related costs that they are intended to compensate.

A government grant that becomes receivable as compensation for expenses or losses already incurred or for the purpose of giving immediate financial support to the entity with no future related costs is recognised as income for the period in which it becomes receivable.

Government grants, related to assets, including non-monetary grants at fair value, are presented in the statement of financial position by setting up grants as deferred income or can by deducting the grant in arriving at the carrying amount of the asset.

Grants related to income are presented as credit in the profit or loss (separately).

20.4.10. Revenue

- The amount of revenue can be measured reliably
- It is probable that the economic benefits associated with the transactions will flow to the company
- The stage of completion of the transaction at the end of the reporting period can be measured reliably; and
- The costs incurred for the transaction and the costs to complete with the transaction can be measured reliably.

When the outcome of the transaction involving the rendering of services cannot be estimated reliably, revenue shall be reorganised only to extent of the express recognised that are recoverable.

Revenue is measured at the fair value of the consideration received of receivable and represents the amounts receivable for goods and services provided in the normal course of business, net of trade discounts and volume rebates, and add value added tax.

Interest is recognised, in profit or loss, using the effective interest rate method.

20.4.11. Borrowing costs

All borrowing costs are recognised as expense in the period in which they are incurred.

20.4.12. Non-current asset reverse

Accumulated funds are transferred to the non-current asset reserve at an amount equal to the movement in the net book value of property, plant and equipment for the current year. The remaining operating surplus or delict is allocated to retained income.

20.4.13. Risk management

The SVC activities expose it to a variety of financial risks (including currency risk, fair value interest rate risk, cash flow interest rate risk and price risk), credit risk and liquidity risk.

20.4.14. Liquidity risk

Prudent liquidity risk management implies maintaining sufficient cash and marketable securities, the availability of funding through an adequate amount of committed credit facilities and the ability to close our market positions. Due to the dynamic nature of the underlying businesses, company treasury maintains flexibility in funding by maintaining availability under committed credit lines.

The company's risk it liquidity is a result of the funds available to cover future commitments. The company manages liquidity risk through an ongoing review of future commitments and credit facilities.

20.4.15. Interest rate risk

As the company has no significant interest-bearing assets, the company's income and operating cash flows are substantially independent of changes in market interest rates.

20.4.16. Credit risk

Credit risk consists mainly of cash deposits, cash equivalents, derivative financial instruments and trade debtors. The company only deposits cash with major banks with high quality credit standing and limits exposure to any one encounter-party.

20.4.17. Going concern

The annual financial statements are prepared on the basis of accounting policies applicable to a going concern. This basis presumes that funds will be available to finance future operations and that the realisation of assets and settlement of liabilities, contingent obligations and commitments will occur in the ordinary course of business.

21. Narrowing Down the Options & Business Model

It is anticipated that the business model may result in a number of options being taken forward for further study before a final selection is made as to the model to be taken forward to a proposed Business Plan that will be used to raise funding for the Carnarvon Science Visitor Centre. Narrowing down the options for the business model depends on important assumptions, most of which are financial and target market potential projections.

21.1. Important Assumptions

In order to achieve some form of realistic projections, the financials have been benchmarked according to the structure, format and financial trends of the most established science centres' in South Africa such as the Cape Town Science Centre. The following assumptions have been made for the modelling of 4 potential financial scenarios for the Carnarvon Science Visitors Centre:

- Revenue has been projected to increase by 20% and 30% p.a. for year 2 and 3 respectively, then varies between 0% and 10% p.a. for year 4 to 6.
- Fixed Expenses has been projected to increase by 15% in year 2 and 10% in year 3, then varies between 0% and 15% p.a. for year 4 to 6.
- It is assumed that there are no unforeseen changes in economic policy to make the company's products immediately obsolete.
- Sales are 100% COD.
- Expenses are mainly on net 30 day basis.

- The potential immediate target market (focusing just within the Northern Cape) based on the feasibility analysis which outlined the various target market segments are the following:
 - NC School Learners (2016) 291 490
 - NC Foreign Tourist (2016) 98 214
 - Karoo Region Tourist (2016) 193 000
 - NC Domestic Tourist (2016) 234 000

In total, school learners are 291 490 and tourists are 525 214.

Stargazing by foreign tourist was listed as 5% of the total foreign tourists in 2016.

The above mention target market figures exclude a large number of potential visits that could come from schools and other types of visitors in surrounding provinces in the Northern Cape such as Western Cape, Eastern Cape and Free-State.

- Total revenue in the financials is made up of:
 - Entrance fees (31%)
 - Rental income (7%)
 - Sponsorships (14%)
 - Project income (48%)
- Ticket sales are generated totally or partially from Entrance fees (100%), Sponsorships (70%) and Project income (60%). These collectively make-up 70% of revenue from ticket sales.

Ticket sales are averaged at R 50 p/p.

The ratio of sales of tickets will be mainly by schools (60%) and tourist (40%).

- To further prove commercial feasibility, it should be noted that the revenue projections made are further conservative in the fact that as much as 11 other additional potential revenue streams have been omitted that could significantly increase the viability, feasibility, profitability and sustainability of the Carnarvon Science Visitors Centre. These additional potential revenue streams are: (1) Turnover rental income from: restaurant, internet café, coffee shop, science shop, craft and souvenir shop, tourist guides; (2) Revenue from the accommodation facility; (3) Merchandise revenue; (4) Travelling display revenue; (5) Exhibition hall revenue; (6) Auditorium revenue; (7) Visitor workshop income; (8) Guided tours; (9) Movie evenings; (10) Outreach programmes; and (11) Outdoor display income.

21.2. Business model scenario options

21.2.1. Scenario 1

This scenario looks at year 1 with a turnover of R 5 000 000 which would require in its first year at minimum \pm 69 603 visitors to the Carnarvon SVC. Based on the target market assumptions, this translates into 43 342 scholars (62%) and 26 261 tourists (38%).

The above means that only 15% of the scholar target market and 5% of the tourist target market is required to make the turnover in Scenario 1. This is a very conservative and achievable target. Below is the Projected Income Statements for 6 years for Scenario 1:

i. Projected Income Statements for 6 years – Scenario 1

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
TURNOVER	5 000 000	6 000 000	7 800 000	8 580 000	8 580 000	9 009 000
COST OF SALES	1 021 100	1 225 320	1 592 915	1 752 207	1 752 207	1 839 817
GROSS PROFIT	3 978 900	4 774 680	6 207 085	6 827 793	6 827 793	7 169 183
OTHER INCOME	92 772	105 756	124 788	130 800	132 000	150 000
EXPENSES	3 999 556	4 599 489	5 059 438	5 059 438	6 324 297	6 640 512
Variable Expenditure	0	0	0	0	0	0
Fixed Expenditure	3 999 556	4 599 489	5 059 438	5 059 438	6 324 297	6 640 512
NET PROFIT BEFORE INTEREST AND TAX	72 117	280 948	1 272 435	1 899 155	635 496	678 671
FINANCE CHARGES	0	0	0	0	0	0
NET PROFIT AFTER TAX	72 117	280 948	1 272 435	1 899 155	635 496	678 671

For a detailed financial report please refer to the attached Scenario 1 six Year Financial Projections.

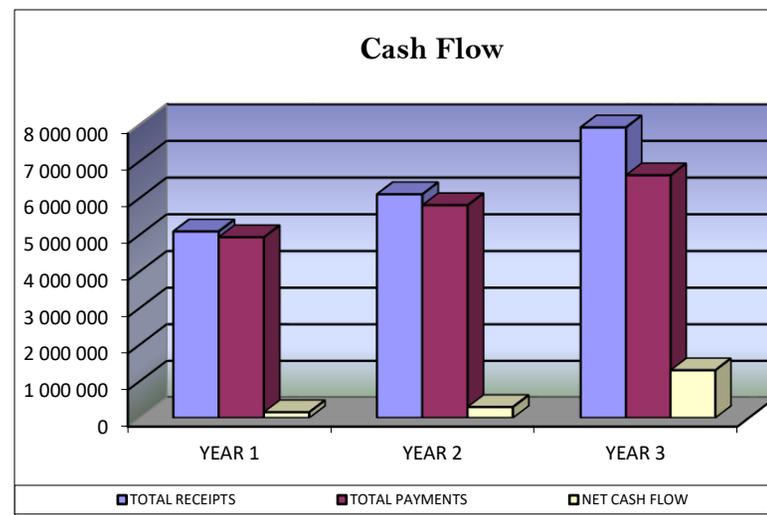
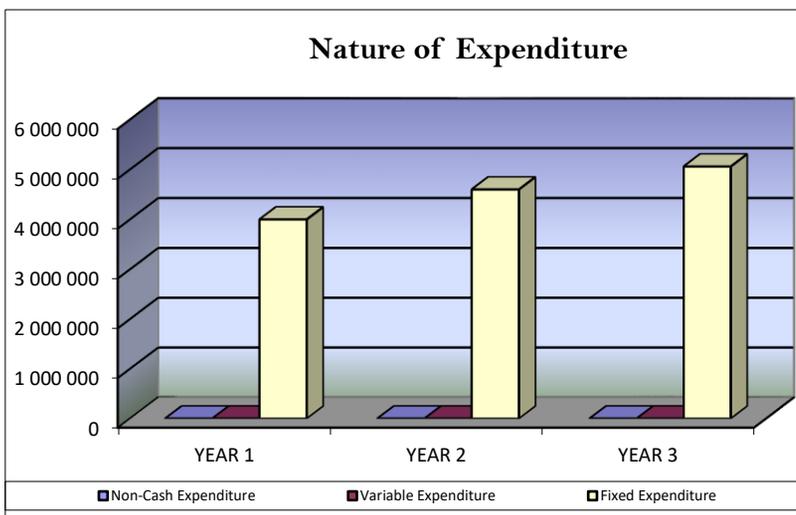
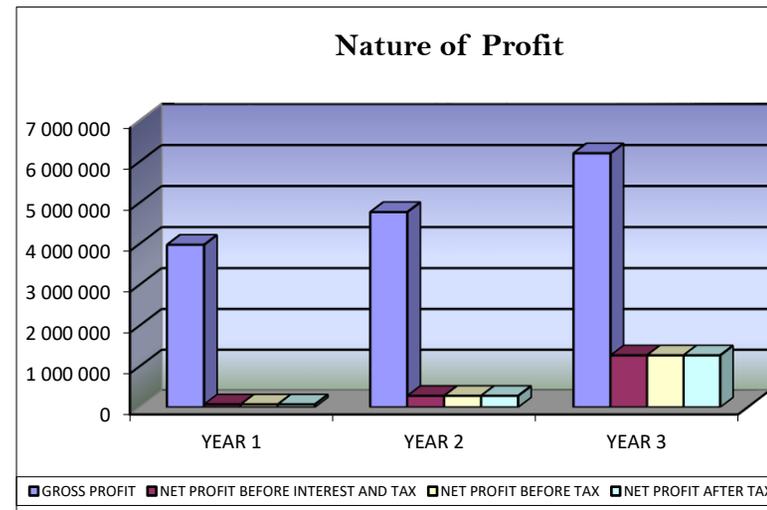
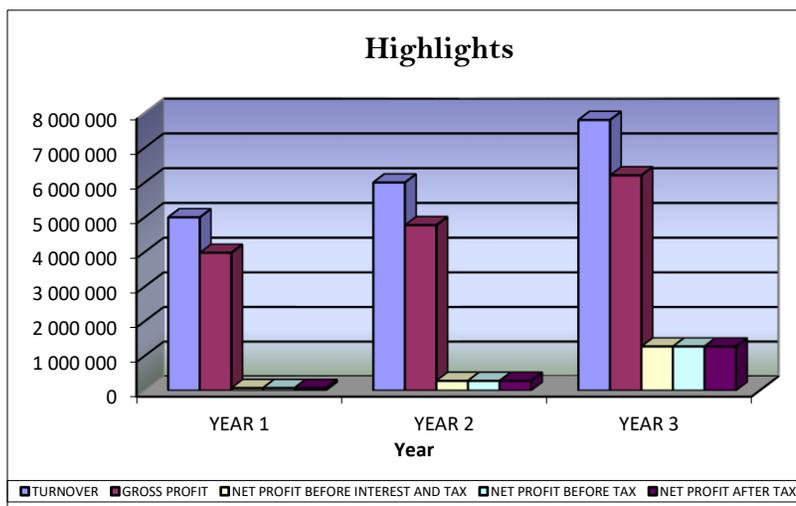
ii. Break-even Analysis – Scenario 1

The break-even analysis is based on all running costs that are costs which will be incurred in keeping the business afloat on a monthly basis.

Break-even Table

Profit Breakeven Inputs			
	FY1	FY2	FY3
Breakeven Revenue Per Annum	5 026 000	5 779 873	6 357 859
Breakeven Production Per Annum	100 520	108 035	111 064
Fixed Costs Per Year:	3 999 556	4 599 489	5 059 438
Revenue Per Product (Ave)	50	54	57
Gross Profit Percentage	79,58%	79,58%	79,58%
Cost per Product	10,21	10,93	11,69

iii. Graphs of Projected Financial Results – Scenario 1



21.2.2. Scenario 2

This scenario looks at year 1 with a turnover of R 3 500 000 which would require in its first year at minimum \pm 48 722 visitors to the Carnarvon SVC. Based on the target market assumptions, this translates into 29 233 scholars (60%) and 19 489 tourists (40%).

The above means that only 10% of the scholar target market and 3.7% of the tourist target market is required to make the turnover in Scenario 2. This is an extremely conservative and achievable target. Below is the Projected Income Statements for 6 years for Scenario 2:

i. Projected Income Statements for 6 years – Scenario 2

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
TURNOVER	3 500 000	4 200 000	5 460 000	6 006 000	6 006 000	6 306 300
COST OF SALES	714 770	857 724	1 115 041	1 226 545	1 226 545	1 287 872
GROSS PROFIT	2 785 230	3 342 276	4 344 959	4 779 455	4 779 455	5 018 428
OTHER INCOME	92 772	105 756	124 788	130 800	132 000	150 000
EXPENSES	2 871 558	3 302 292	3 632 521	3 632 521	4 177 399	4 386 269
Variable Expenditure	0	0	0	0	0	0
Fixed Expenditure	2 871 558	3 302 292	3 632 521	3 632 521	4 177 399	4 386 269
NET PROFIT BEFORE INTEREST AND TAX	6 444	145 740	837 226	1 277 734	734 056	782 159
FINANCE CHARGES	0	0	0	0	0	0
NET PROFIT AFTER TAX	6 444	145 740	837 226	1 277 734	734 056	782 159

For a detailed financial report please refer to the attached Scenario 2 six Year Financial Projections.

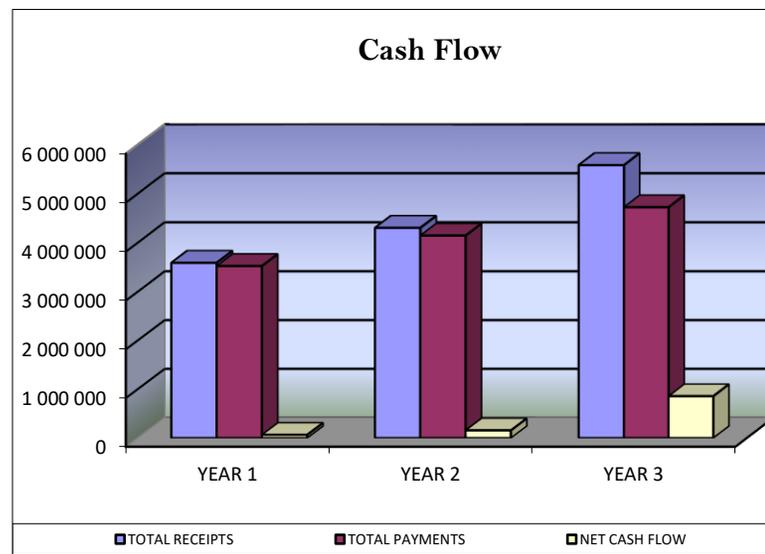
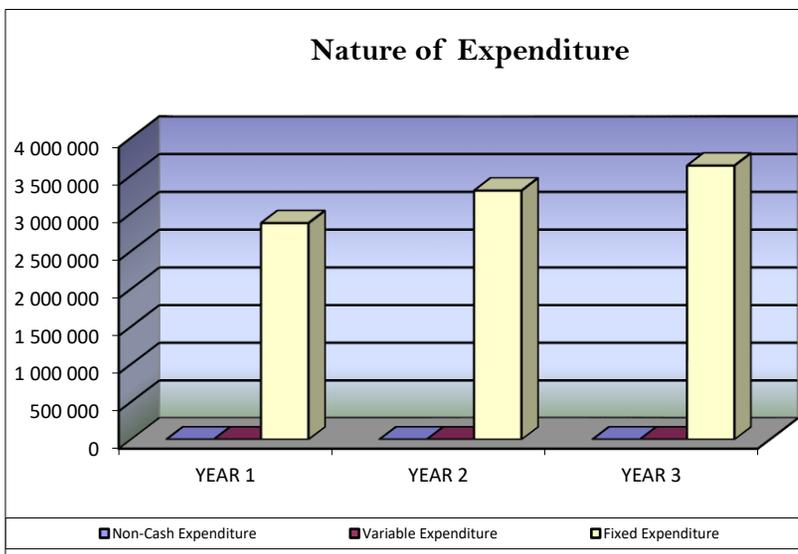
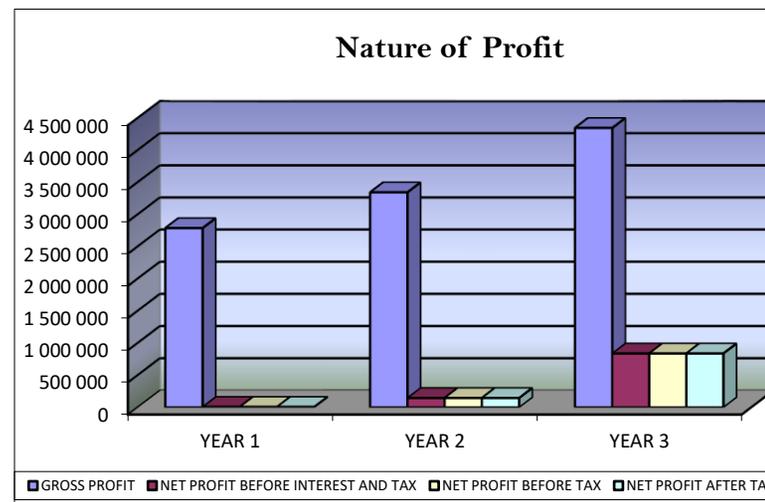
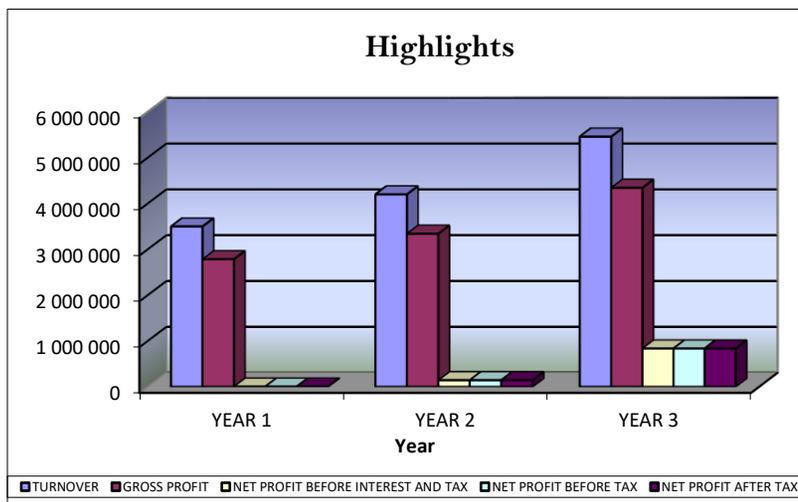
ii. Break-even Analysis – Scenario 2

The break-even analysis is based on all running costs that are costs which will be incurred in keeping the business afloat on a monthly basis.

Break-even Table

Profit Breakeven Inputs			
	<u>FY1</u>	<u>FY2</u>	<u>FY3</u>
Breakeven Revenue Per Annum	3 608 500	4 149 781	4 564 774
Breakeven Production Per Annum	72 170	77 566	79 741
Fixed Costs Per Year:	2 871 558	3 302 292	3 632 521
Revenue Per Product (Ave)	50	54	57
Gross Profit Percentage	79,58%	79,58%	79,58%
Cost per Product	10,21	10,93	11,69

iii. Graphs of Projected Financial Results – Scenario 2



21.2.3. Scenario 3

This scenario looks at year 1 with a turnover of R 10 007 741 which would require in its first year at minimum ± 139 313 visitors to the Carnarvon SVC. Based on the target market assumptions, this translates into 83 588 scholars (60%) and 55 725 tourists (40%).

The above means that only 29% of the scholar target market and 11% of the tourist target market is required to make the turnover in Scenario 3. This is an ambitious target but a potential and possible target. Below is the Projected Income Statements for 6 years for Scenario 3:

i. Projected Income Statements for 6 years – Scenario 3

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
TURNOVER	10 007 741	11 508 902	13 235 237	14 558 761	14 558 761	15 286 699
COST OF SALES	2 043 780	2 350 347	2 702 899	2 973 189	2 973 189	3 121 848
GROSS PROFIT	7 963 961	9 158 555	10 532 338	11 585 572	11 585 572	12 164 851
OTHER INCOME	92 772	105 756	124 788	130 800	132 000	150 000
EXPENSES	7 589 157	8 727 530	9 600 283	9 600 283	11 040 326	11 592 342
Variable Expenditure	0	0	0	0	0	0
Fixed Expenditure	7 589 157	8 727 530	9 600 283	9 600 283	11 040 326	11 592 342
NET PROFIT BEFORE INTEREST AND TAX	467 576	536 781	1 056 843	2 116 089	677 247	722 509
FINANCE CHARGES	0	0	0	0	0	0
NET PROFIT AFTER TAX	467 576	536 781	1 056 843	2 116 089	677 247	722 509

For a detailed financial report please refer to the attached Scenario 3 six Year Financial Projections.

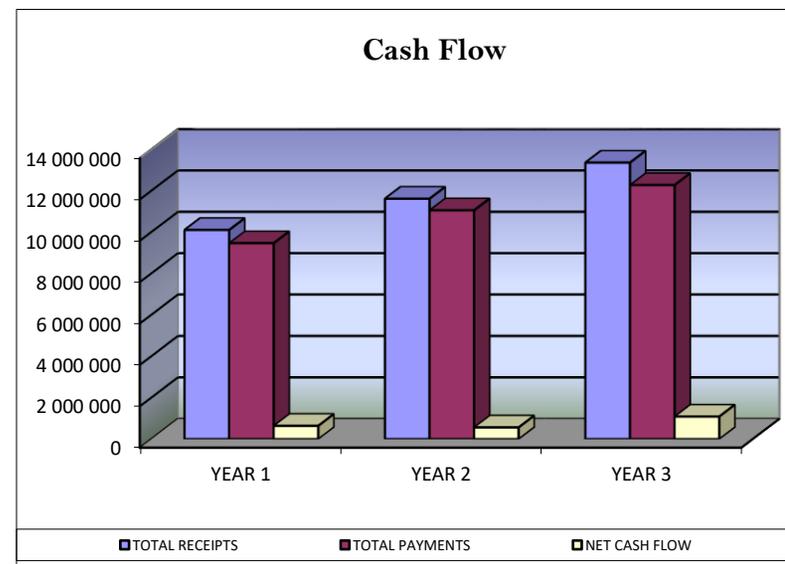
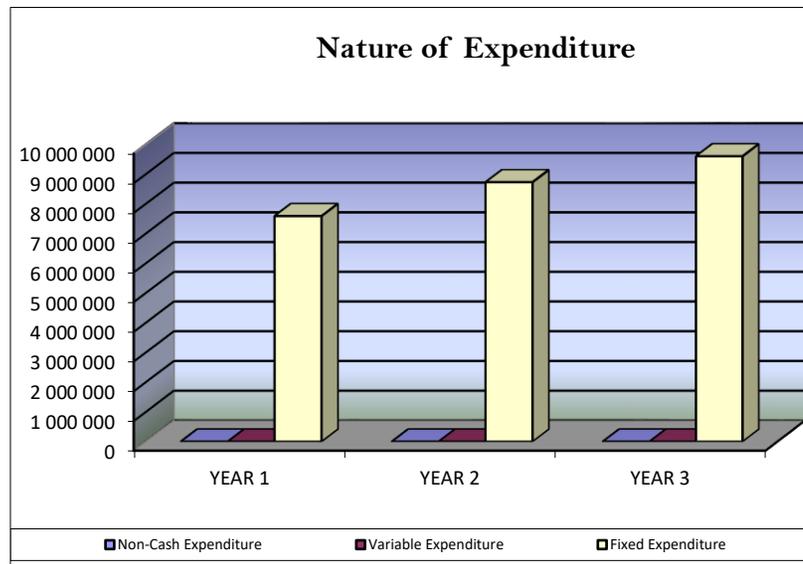
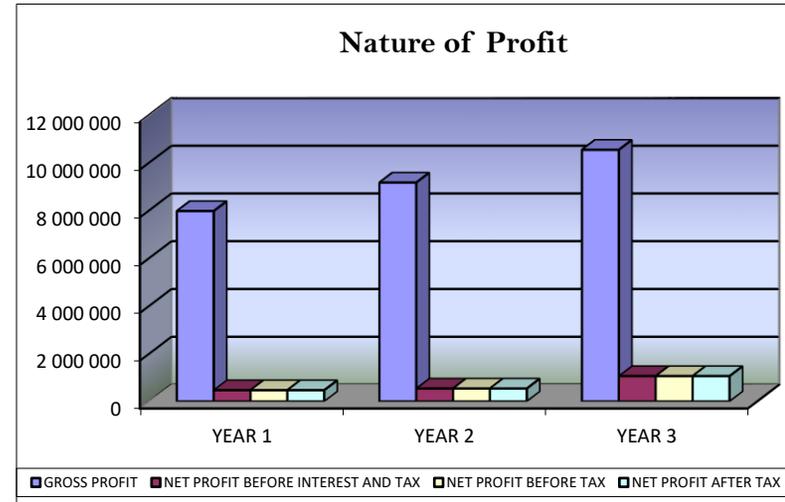
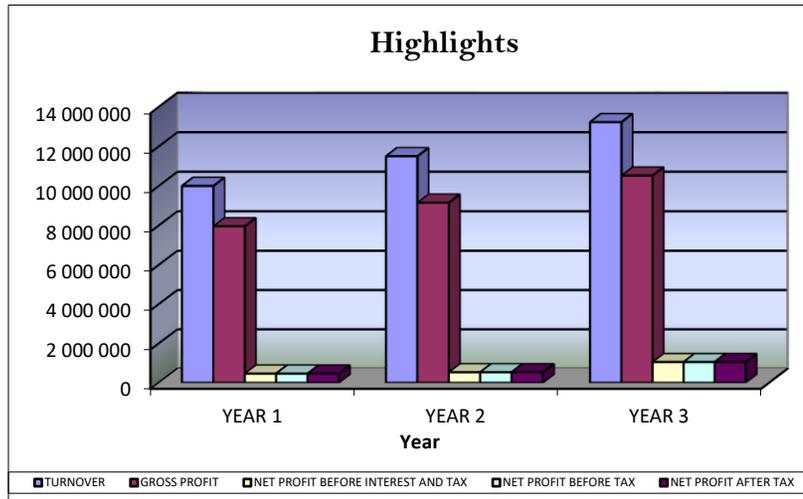
ii. Break-even Analysis – Scenario 3

The break-even analysis is based on all running costs that are costs which will be incurred in keeping the business afloat on a monthly basis.

Break-even Table

Profit Breakeven Inputs			
	<u>FY1</u>	<u>FY2</u>	<u>FY3</u>
Breakeven Revenue Per Annum	9 536 800	10 967 286	12 064 040
Breakeven Production Per Annum	190736	204996	210744
Fixed Costs Per Year:	7 589 157	8 727 530	9 600 283
Revenue Per Product (Ave)	50	54	57
Gross Profit Percentage	79,58%	79,58%	79,58%
Cost per Product	10,21	10,93	11,69

iii. Graphs of Projected Financial Results – Scenario 3



21.2.4. Scenario 4

This scenario looks at year 1 to year 6 where there is no entrance fee, therefore turnover is not determined by number of visitors to the Carnarvon SVC. Scenario 4 could result in $\pm 150\ 000$ visitors. Based on the target market assumptions, this translates into 90 000 scholars (60%) and 60 000 tourists (40%). The aforementioned means that only 31% of the scholar target market and 11% of the tourist target market is required to get to $\pm 150\ 000$ visitors in Scenario 4.

This scenario simply gives us an indication what would be needed at minimum to operate the Carnarvon SVC without charging and entrance fee. Below is the Projected Income Statements for 6 years for Scenario 4:

i. Projected Income Statements for 6 years – Scenario 4

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
TURNOVER	2 500 020	2 500 020	2 500 020	3 000 000	3 150 000	3 244 500
COST OF SALES	87 501	87 501	87 501	366 000	384 300	395 829
GROSS PROFIT	2 412 519	2 412 519	2 412 519	2 634 000	2 765 700	2 848 671
OTHER INCOME	92 772	105 756	124 788	130 800	132 000	150 000
EXPENSES	2 500 010	2 500 010	2 500 010	2 722 010	2 830 890	2 915 817
Variable Expenditure	0	0	0	0	0	0
Fixed Expenditure	2 500 010	2 500 010	2 500 010	2 722 010	2 830 890	2 915 817
NET PROFIT BEFORE INTEREST AND TAX	5 282	18 266	37 298	42 790	66 810	82 854
FINANCE CHARGES	0	0	0	0	0	0
NET PROFIT AFTER TAX	5 282	18 266	37 298	42 790	66 810	82 854

For a detailed financial report please refer to the attached Scenario 4 six Year Financial Projections.

22. Synthesized Summary and Recommendations

The purpose of synthesized summary and recommendations is to summarise that this Feasibility Study has found that the establishment of the Carnarvon Science Visitors Centre is a feasible and viable project. The Feasibility Study through three potential financial modelling scenarios indicates that after a 100% grant funded CAPEX phase the Carnarvon SVC can become a commercially self-sustainable and even profitable non-profit company, provided strict corporate governance systems (i.e. King 4) is practiced and implemented. As a result of three scenarios proving financial viability for the Carnarvon SVC, as per standard practice for raising funding, a proposed business plan should be used to raise funding for the Carnarvon Science Visitor Centre.

It was critical to first do a deeper study and analysis into the proposed concept of a science visitors centre, before the study could investigate the commercial financial viability of the Carnarvon Science Visitor Centre. In addition, the need to do a deeper study and analysis into the proposed concept, stems from the fact that the previous studies done had not unpacked enough on the key components that would make a science visitor centre at its core function a success, this refers to the education aspect of a science centre. The study and research done indicated consistently that the norm as to the structure of a science visitor centre is that the facility is first education and then tourism, this meaning that the tourism potential and opportunity is a consequence of the educational aspect of the facility. This point is also directly imbedded in the financial viability and sustainability of existing science visitor centres in South Africa and internationally i.e. pre-booked school visits are the 'bread-and-butter' of South African science centre's, and constitute a substantial component of the visitor base during the school terms.

Furthermore, research has found that while it is sometimes tempting to consider that science centre projects are primarily about entertainment, displays, attractions, people management and marketing etc., it is important to bear in mind that their line function is education, both formal and informal. For this reason, it is imperative that all planning associated with the Carnarvon SVC should be directed at improving the quality and scope of the educational programmes on offer on an annual basis.

The Feasibility Study found that a substantial amount of income to a science centre could derive, not from paying customers, but from sponsors who subsidize visits for disadvantaged communities. This however is not a normal economic model as it means that it is not 'actual consumer demand' that is driving gate income, but 'created consumer demand'. This consumer demand is 'created' by the sponsors, who make it possible for an individual to visit the facility that he/she had no intention or means of visiting previously. If this will be an important income category of the Carnarvon SVC, it means that the supply can be shaped to meet the demand, i.e. the SVC and its sponsors largely dictate how many visitors there are, and therefore how much it costs to operate the science centre, and hence the importance of the Northern Cape Department of Education as an anchor stakeholder in the Carnarvon Science Visitor Centre. Science tourism gets its biggest numbers from scholars, it's also targeted at both scientists traveling to specific places and sites for research purposes and to tourists with specialized interests in cultural and natural heritage.

The Feasibility Study shows that a business case indeed does exist for the Carnarvon SVC and proof of market is proven through a big market within both the education and tourism sectors, which both have high sustainable and growth potential, especially since the financial modelling scenarios were done at very conservative projections.

The Study also demonstrated that a stand-alone facility is feasible, however the Carnarvon SVC could be even more viable once the accommodation facility and SMME hub is established. As a result of the Carnarvon SVC being allocated a plot size which is approximately 4.5 hectares, there is opportunity to develop the plot even further with strategic economic development activities that could further

supplement and compliment the Carnarvon SVC, which would in turn further improve the sustainability and viability of the Carnarvon Science Visitor Centre. These developments would however need to be done in a phased approach. First would be the Carnarvon Science Visitor Centre, second the Accommodation Facility, third the SMME Hub and thereafter additional developments. As phase two, the accommodation establishment should consist of minimum 30 to maximum 100 rooms with the ability to accommodate between 60 to 150 guests. The facility will include amongst others, a dining area, kitchen, reception area, laundry, storage and courtyard recreational areas for recreational purposes to accommodate visiting group, conference bookings and other travellers. The facility will not only enhance the income generation potential of the Carnarvon SVC but also increase employment creation.

The science visitor centre has the potential to contribute significantly to job creation, local SMME development and the empowerment of young people. The proposed SVC will create an attraction in Carnarvon that is unique only to the Kareeberg Local Municipality and the Northern Cape, and will from a tourism perspective attract both domestic and international tourist and investment to Carnarvon.

The Carnarvon SVC also has considerable potential to act as a major tourist destination by offering cutting edge attractions in the context of its theme and direct link to the SKA Project. The Carnarvon SVC will be perfectly located to provide an interactive and participative experience that will allow visitors to obtain an understanding of the scientific and technological principles behind the development of the SKA. If this project is established, other developments will follow that will firmly establish the Carnarvon SVC as a flagship project for the province, and the possible location to host National Science Week and other important local, district, provincial, national and international events.

The establishment of the Carnarvon Science Visitor Centre will result in both a socio-economic and economic development project, and will contribute significantly to education, training, skills development and social transformation in Carnarvon, the Kareeberg Local Municipality, the Pixley ka Seme District Municipality and Northern Cape.

ANNEXURES

Annexure A – Business model scenario options Financial Projections:

- ❖ Scenario 1
- ❖ Scenario 2
- ❖ Scenario 3
- ❖ Scenario 4

Annexure B – Benchmarking and Fact-Finding Mission

Annexure C – Sol Plaatje University Proposal

Annexure A:

Business model scenario options

Financial Projections:

Scenario 1 - 4

Annexure B:

Benchmarking and Fact-Finding Mission

16 February 2018



Economic Development & Tourism

Department:
Economic Development & Tourism
NORTHERN CAPE PROVINCE
REPUBLIC OF SOUTH AFRICA

Carnarvon Science Visitor Centre: Benchmarking and Fact-Finding Mission



Submitted by:



ReA-Con

1. Science Visitor Centre Benchmarking and Fact-Finding Mission

The purpose of the benchmarking visits was to establish from existing centres what it takes to establish a science visitor centre and keep it operational. The three science visitor centre's that were visited were: The Sci-Bono Discovery Centre; the Unizulu Science Centre; and Maropeng. Across the three science visitor centre's, amongst others, the following points were considered to guide the fact finding process:

- Operating structure and business entity
- Start-up lessons learnt
- Business models/plans
- Costing, budgeting (income streams)
- Community involvement
- Revenue structure
- Sustainability model
- Interaction/relationship with Schools
- Interaction/relationship with government and other stakeholders
- Events/activities around marketing
- How impacts are measured

One of the most important lessons learnt from the meetings with management at the Sci-Bono Discovery Centre, the Unizulu Science Centre and Maropeng was that it is generally found that a science visitor centre cannot independently sustain itself through its visitor entrance income, and without significant and long-term partnerships with both public and private sector involvement and sponsorships.

The benchmarking exercise found that different science visitor centres have different models of governance and operation and that there is no one perfect or good model. A number of factors should be considered when deciding on the appropriate structure and model upon which the centre is established.

Generally, all visitor centres are not set up to make a profit, they are rather established for public good and as such government is always involved over a very long time. The different operating models found in South Africa include for science visitor centres are:

- University operated
- Section 21 entities
- Proprietary Limited (PTY)
- Private Public Partnerships (PPP)
- Government owned

Solely depending on visitor entrance fees is not sustainable and thus multiple revenue structures are critical. Other reliable income streams to assist in sustainability include rental of office space and conferencing and naming rights for sections of the science visitor centre for private sector sponsorship.

The Physical Space, Programmes and People (PSPP) Model is the backbone of the success of any science visitor centre. The physical space available in the centre determines the nature of programmes that can be implemented, whilst in turn the ability and expertise of the people in the centre will determine the success of programmes.

The surrounding communities are also essential to the commercial success of the centre. They need to be developed to a level where they can provide additional commercial products such as crafts, services, entertainment, etc.

From the meetings with management of all three science visitor centre's there was consensus that it's not possible to accurately and confidently measure the impact of a science visitor centre, this was especially emphasised by Sci-Bono management who twice contracted professionals who could not succeed in satisfactorily measuring the impact of Sci-Bono. A science visitor centre however that has been established for public good can be measured against the development that it is able to bring to the community through socio-economic upliftment i.e. job creation.

1.1. The Sci-Bono Discovery Centre

The Sci-Bono Discovery Centre is Southern Africa's largest science centre and it is affiliated to the Gauteng Department of Education to support maths, science and technology education and to help build to South Africa's science, engineering and technology capacity. Sci-Bono is also responsible for implementing of the Gauteng Mathematics, Science and Technology Education Strategy.

Sci-Bono started as a partnership project of the Gauteng Department of Education and various private sector partners. Sci-Bono offers its visitors a large collection of interactive science and technology exhibits and exhibitions. Sci-Bono also offers a broad programme of science and technology related events, activities and programmes for both the general public and the school community. Sci-Bono has in recent years positioned itself as one of the most popular leisure and educational destinations in Gauteng.

Sci-Bono is a Non-Profit Company funded by its principal, the Gauteng Department of Education, and also benefits from grants and donations from donors in the broader public and private sector. Sci-Bono is also supported by various scientific and engineering bodies in industry and by the diplomatic community in South Africa.

All of the nearly 400 permanent exhibits at Sci-Bono are interactive and visitors are encouraged to touch, feel, press and play to their hearts content. The centre also hosts various temporary and travelling local and international exhibitions such as Body Worlds. In addition, Sci-Bono also has its own mobile exhibits and exhibitions that visit schools, community centres and other venues in Gauteng and other provinces. These exhibits and exhibitions assist Sci-Bono to serve its core purpose of increasing awareness, interest and enjoyment of science, mathematics, engineering and technology.

Sci-Bono Discovery Centre has also become one of its most sought-after venues and destination of choice for unique corporate launches, events and conferences.

Sci-Bono hosted a record number of visitors during 2016, largely as a result of the successful Body Worlds Vital exhibition. A total of 295 950 people visited the centre during 2016, the highest since opening in 2004.

Sci-Bono visitor numbers are made up of roughly 80% scholars and 20% public visitors. Of the 80% a large majority are bused in scholars through the partnership and funding from the Gauteng Department of Education.

Roughly 90% to 95% of the funding comes from the Gauteng Department of Education, while private sector sponsorship is also a big revenue income stream for Sci-Bono.

Findings and Lessons Learnt for Carnarvon Science Visitor Centre:

- Need proper funding model for sustainability.
- Funders must be constantly engaged and given feedback.
- Constant fundraising essential.
- Consider lease of facilities as income stream.
- Need clear vision on game plan for science visitor centre.
- Partnerships essential – funders, science, other science visitor centre.
- Start small.
- Source seed funding to facilitate project kick-off.
- Develop facility in phases as more funds become available.
- Department of Education must be involved.
- Department of Education must subsidise trips to science visitor centre to support sustainability.
- Be mindful of maintenance requirements.
- Make sure that your first exhibition / display is excellent.

- Market facility for events – birthday parties for kids, conferences, musical performances, etc.
- Attract international exhibitions.
- Travelling exhibitions are important.
- Interactive exhibitions essential.
- Focus on STEM careers for youth.
- Present holiday / special day programmes.
- Social media and competitions important to promote facility.

1.2. Unizulu Science Centre

The establishment of the Unizulu Science Centre was granted by a request from the University of Zululand's Physics Department and work at the Centre started early in 1983, with a donation from Old Mutual. The Unizulu Science Centre was housed in an old laboratory on the top floor of the Zoology building. The Centre has been open for 25 years with 30 000 visitors in 2017 and has about 130 interactive exhibits.

The Centre has been run by the University with inputs from various other donors. As well as hosting visitors to the Centre, the project runs a number of outreach activities, many in cooperation with local (Richards Bay) industries.

The Science Centre, with all its exhibits, was moved to the new facility, and opened on the 27th of February 1997. The new facility, sponsored by Alton, enabled the Unizulu Science Centre to expand its programmes, visitors and staff, where it now is visited by over 30 000 learners annually.

With funding from the Department of Science and Technology, the Unizulu Science Centre has over 400 square metres of exhibit space and a multi-purpose classroom. Private sector has been at the heart of the Unizulu Science Centre expansions a good example being the 200-seater auditorium and TRAC-Lab funded by BHP Billiton (building) and Murray and Roberts (TRAC-Lab). In 2011 the Unizulu Science Centre made international history with the opening of the very first official children's museum in Africa.

At present the Unizulu Science Centre is 2600 square metres, with a dedicated exhibit area of 1600 square metres, a state of the art auditorium, a smaller theatre, TRAC lab and two classrooms and small outdoor exhibits area.

The Unizulu Science Centre visitor numbers are made up of roughly 95% scholars and 5% public visitors. These scholars are not funded by the provincial Department of Education rather it is organised visits by schools that have established a culture of annual educational excursions for their pupils.

Schools pay an entrance fee of R10 per learner which is sometimes subsidised up to R70 by willing private industry.

The operational costs for the Science Centre is mainly carried the University of Zululand, but supplemented by funds received from private sector in Richards Bay.

The Unizulu Science Centre has only two income streams: (1) Ticket sales; and (2) Private sector sponsorship.

Findings and Lessons Learnt Carnarvon Science Visitor Centre:

- Physical facilities/Programmes/People are key building blocks.
- Core value of science visitor centres is STEM.
- Science visitor centres should be about edutainment.
- Partnerships with other science visitor centre essential.
- Partnership with University of Zululand essential for sustainability and success.
- Attract expertise from inception of the science visitor centre.
- Science visitor centre is a public good.
- Fundraising via leveraging from networks is essential.
- Always provide feedback to funders.
- Do not sell name of the science visitor centre to anchor sponsor but allow such for different exhibitions/rooms.
- Go after exhibitions that are free to minimise budget required for exhibitions.
- Do not be ashamed to buy second hand exhibitions to save money.
- Advertise at the beginning of each year and target schools.
- Design programmes in line with school curriculum.
- Ensure interactive component of programmes/exhibitions.
- Work in close relationship with teachers.
- Follow themes – e.g. the science of soccer; spinning in space.
- Always keep innovation in mind and at the forefront of the programmes and exhibitions at the science visitor centre.
- Strong community outreach – “best science centres are the ones that meet community needs best”.

1.3. Maropeng

The Cradle of Humankind World Heritage Site and Dinokeng are initiatives of the Gauteng Provincial Government to establish geo-spatial tourism destinations in the north-west and the north-east of the province, close to the densely populated metropolitan areas of Johannesburg, Tshwane and Ekurhuleni.

The Gauteng Provincial Government has invested over R250 million in roads and bulk infrastructure in the two destinations in order to boost tourism development. In 2017 there were 663 tourism attractions in the two destinations having only started with 163 tourism establishments since 2003.

The projects promote economic growth and social upliftment, relieving the burden of poverty, particularly for historically-disadvantaged communities living in and around the two destinations. The Cradle of Humankind is one of eight World Heritage Sites in South Africa, and the only one in Gauteng. It is widely recognised as the place from which all of humankind originated.

The Cradle of Humankind is located over 47 000-hectare of land where ongoing scientific discovery into human origins takes place. The Gauteng Provincial Government is the designated Management Authority responsible for developing and protecting the site. There are 13 excavated sites which have been identified within the area. These have already been internationally-recognised in the World Heritage Site listing, and have now individually been declared as national heritage sites by the South African Heritage Resources Agency (SAHRA).

The world-renowned Sterkfontein Caves is home to the oldest and most continuous paleontological dig in the world. It is also the site of discovery of the famous pre-human skull affectionately known as “Mrs Ples”, and an almost complete hominid skeleton called “Little Foot”, dated 2.3 and 4.17 million years old respectively. The World Heritage Site status the area now enjoys ensures that what is deep within its core will be protected and explored forever.

An amount of R189 million has been invested in roads and bulk infrastructure to develop the site and leverage in private sector investment in tourism development. In October 2003, the Gauteng Provincial Government entered into a contract valued at R163 million with Maropeng a’Afrika Leisure (Pty) Ltd for the construction, design and operation of world-class visitor exhibition and recreational facilities showcasing the site. This Public Private Partnership is the first of its kind, a concession agreement requiring Maropeng a’Afrika Leisure (Pty) Ltd to pay an annual concession fee which government invests in community benefit projects and in scientific research.

The Cradle of Humankind World Heritage Site has become a major international tourism destination with a total of 387 tourism attractions including 91 graded establishments. There are 175 places to stay and 113 restaurants in and around the area to choose from. Seventy Conference venues and 44 wedding

and event venues can accommodate from 20 to 800 guests. The attractions directly employ an estimated 7,000 permanent and 2,200 casual employees.

When Maropeng was first established the visitor numbers were made up of roughly 85% scholars and 15% public visitors. Currently this ratio is 60% scholars and 40% public visitors (domestic and international tourist).

Majority of the scholar visitor numbers are from schools that have established a culture of annual educational excursions for their pupils, however Gauteng Department of Economic Development provides sponsorship for 4 000 scholars p/a. Maropeng also has a very close working relationship with the National Department of Education.

Maropeng has four main income streams: (1) Tours; (2) Food and Beverage; (3) Special Events; and (4) Accommodation.

One of the most important success for Maropeng is its intensive marketing strategy, especially packaging Maropeng as a tourism destination.

Maropeng is currently not self-sustainable after more than 10 years from establishment and continues to receive an annual subsidy from the Gauteng Department of Economic Development, to the tune of R 7 million p/a. It is envisioned to achieve self-sustainability in the next three years.

The success of Maropeng is hinged on one of its core partners which is the partnership with the University of the Witwatersrand.

Findings and Lessons Learnt Carnarvon Science Visitor Centre:

- Feasibility thresholds not achieved (even by as much as 50%).
- Project designed as a business but was not considered a good idea.
- PPP as special purpose vehicle (but private partner later pulled out).
- Government will always have to fund to ensure sustainability.
- Quality and expertise of management authority essential.
- Design/Build/Operate model.
- Partnership with Wits University critical.
- Strong emphasis on interpretation of science.
- Strong emphasis on relationships including with provincial DMO and SAT.
- Strong emphasis on community benefit – knowledge sharing, jobs, infrastructure development.

- Support academic training, school education, research, tourism.
- Programmes to support school curriculum to ensure schools visit facility.
- Has basic accommodation to accommodate schools.
- Accept that a science visitor centre competes with other leisure activities – shopping, movies, restaurants.
- Prepare that market will consider science visitor centre as museum – prevent brand confusion.
- Accommodate local SMMEs – tourist guides, food, craft, photography.
- Facility leased for special events – product launches, musical performances, Tai Chi classes.

2. Summarised findings for consideration for the Carnarvon SVC

The following are the most important findings and lessons learnt for the Carnarvon Science Visitor Centre and are summarized from all three benchmarks:

- Travelling exhibitions are important, coupled with a strong community outreach programme – “the best science centres are the ones that meet community needs best”.
- Ensure programmes and exhibitions are interactive, and that they are theme focused – e.g. the science of soccer; spinning in space; astronomy programmes.
- The Department of Education must be involved, and amongst other things it must subsidise trips for scholars to the science visitor centre to support sustainability.
- A science visitor centre is a public good, and therefore public sector will always have to provide annual funding as 100% self-sustainability is not possible.
- Acquire exhibitions that are free to minimise budget required for exhibitions and do not be ashamed to buy second hand exhibitions to save money.
- Market the science visitor centre facility for corporate and private events – birthday parties for kids, conferences, musical performances, etc.
- Central to the success of a science visitor centre is the relationship and partnership with a university, this is also critical for sustainability.
- There must be a strong emphasis on interpretation of science, whilst positioning the science visitor centre as an edutainment centre.
- Do not sell the name of the science visitor centre to an anchor sponsor but allow such for different exhibitions/exhibition space.

- Make sure that your first exhibition/display is excellent, while also ensuring that you attract international exhibitions.
- A strong funding model is paramount with more than one revenue stream, while fundraising via leveraging from networks.
- Quality and expertise of the governance structure and the management team of the science visitor centre is very important.
- Always keep innovation in mind and at the forefront of the programmes and exhibitions at the science visitor centre.
- Physical facilities/Programmes/People are key building blocks in the strategic planning of the science visitor centre.
- Lease facilities at the science visitor centre as an additional income stream: office space and special events.
- At the core of successful science visitor centres is the focus on STEM subjects for youth careers.
- Align programmes to support school curriculum to ensure schools visit the science visitor centre.
- Strong emphasis on community benefit – knowledge sharing, jobs, infrastructure development.
- Aggressively, advertise and market at the beginning of each year and target schools.
- Constant fundraising, interaction, and communication with funders is very important.
- Social media and the science competitions are important to promote the facility.
- Incorporate relevant local SMMEs into the science visitor centre opportunities.
- Partnerships with other science visitor centres are very useful and crucial.
- Accommodation to accommodate schools and visitors for overnight stay.
- Start small and develop the science visitor centre facilities in phases.

3. Conclusion and Recommendations

The visits managed to highlight a number of factors that need to be considered carefully in order to make the Carnarvon Science Visitor Centre a success:

- The basic concept of using a mega scientific project, such as SKA, as a springboard for science tourism is critical.
- A science visitor centre should not be established for profit rather to focus on its core mandate such as STEM and uplift the community and stimulate entrepreneurship.

- It is advisable to start small and continue to phasing the development of the science visitor centre to its ultimate vision. The centre should be able to adjust to visitor trends and developments in the education and tourism market.
- The Physical space, Programmes and People (PPP) model in the science visitor centre should be well balanced in order to provide quality visitor experience.
- The science visitor centre should not do what schools already are doing or can do, rather it should enhance the school and learner experience by offering what the normal school environment cannot offer.
- Government should be prepared to support the science visitor centre over a very long-time, as its noted that 100% self-sustainability highly unlikely.
- The science visitor centre should focus on sustainability rather than profitability and as such the goal of sustainability should be clearly defined.
- An NPC, PPP or University model for operation provides the most stable approach for implementation.
- The impact of the science visitor centre is difficult to measure, however the positive community and socio-economic developments brought about as a direct involvement of the science visitor centre does exist.

Annexure C:

Sol Plaatje University Proposal



Concept Proposal: Establishing the Sol Plaatje University - Northern Cape Knowledge Hub for Rural Development at Carnavon

Submitted to: Provincial Department of
Economic Development – Northern Cape

Prepared by: Prof Yunus Ballim
(Vice-Chancellor)

Date: 22 January 2018

1. Introduction

This proposal makes an argument for the establishment of a Sol Plaatje University - Northern Cape Knowledge Hub for Rural Development in the Carnarvon area. The Hub is conceived to provide a concentration of knowledge production, learning and innovation, translation, dissemination and policy application directed at the critical development challenges facing the rural context in the broader Northern Cape region. The initiative will rely on a mutually supportive, respectful and high-functioning university-government-community partnership, and can inform the development efforts in the whole region and beyond.

The Square Kilometre Array (SKA) project, which is expected to be fully functional by 2025, holds promise to turn the greater Carnarvon area in the Northern Cape into a centre of high-level scientific activity and international focus. This is an exciting scientific project that brings to South Africa the possibility of direct engagement with the front end of research and development in radio astronomy and data analytics. The promise of an SKA project has already generated much activity and investment in infrastructure and human intellectual capacity development to take advantage of the opportunities presented by the project. In addition to developing physical infrastructure, the local SKA project office is itself investing in training programmes and postgraduate support to ensure that the necessary human capacity is available in good time, the Council for Scientific and Industrial Research (CSIR) and the Department of Science & Technology have jointly established the National Integrated Cyber Infrastructure System (NICIS); many local universities are implementing postgraduate programmes in Data Science and Data analytics and SPU has itself implemented and successfully generated the first graduates in its BSC Data Science programme.

However, while there is much promise of benefit for South African institutions interested in high-level intellectual activity in the scientific discipline of radio astronomy, there is also recognition that the SKA project must show tangible benefit to the lived experience of individuals and communities in the greater Carnarvon area. It is in the need to address this objective that this proposal is located. Drawing on the possible synergies of the infrastructure development in the area as well as the high-level scientific research interest, this document presents a proposal to establish a Knowledge Hub in the Carnarvon area that will undertake research and development on the local context in a manner that informs policy development strategies for rural development in the Northern Cape Province.

This document is presented as an exploration of the concept of a knowledge hub for rural development in the Northern Cape. In this sense, it is intended to form the basis for discussion and possible further elaboration in a manner that fits with the broader intentions of the Northern Cape Provincial Government around SKA-related developments in the greater Carnarvon area.

2. The Concept of a Knowledge Hub for Rural Development

The metaphor of an observatory is useful in developing an understanding of the operations and inter-relationships of a knowledge hub. This is illustrated in Figure 1 below, where the structure is conceived as a series of telescopes or observation facilities that are focused on different aspects of a framework of interest or knowledge domain – in our present case, rural development. Each telescope brings different strengths and provides information to academics, researchers and research teams to further develop understanding of the subject area and to use for teaching and student development. For most researchers and academics, this is a sufficient function and the opportunities for using their observations and analyses as a knowledge base for policy development is usually lost.

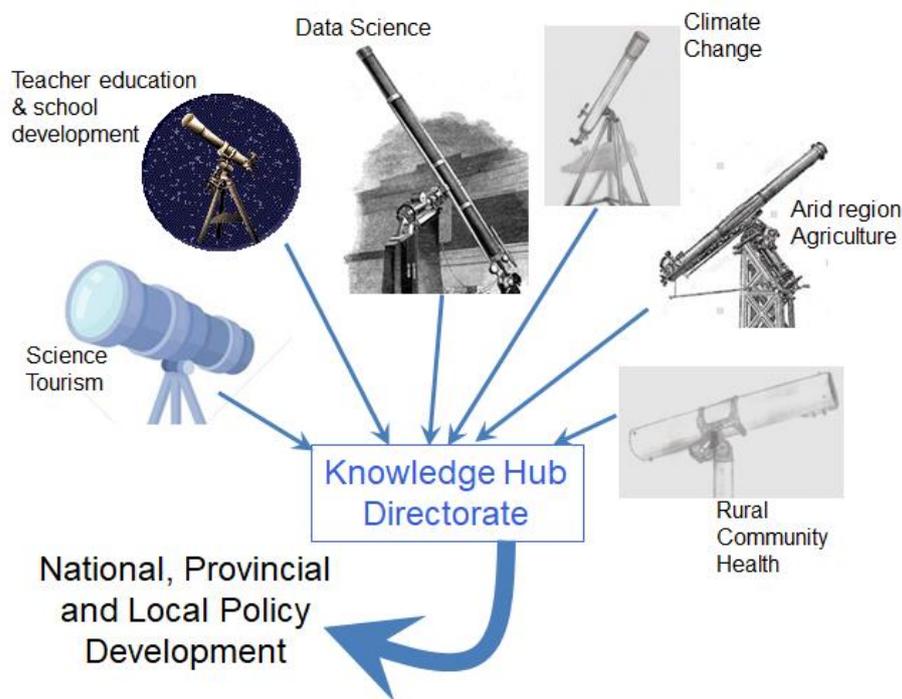


Figure 1: Conceptualisation of the Knowledge Hub for Rural Development at Carnarvon in the Northern Cape

The knowledge hub concept responds to this opportunity by creating a contextual coherence to the different research areas – in our case, the geographical region of Carnarvon and its social development needs – and then creates facilities for stimulating research and knowledge development in targeted study areas. The “Knowledge Hub Directorate” acts as the centre for gathering the knowledge developed from the different research areas, then interprets, integrates and synthesises this knowledge in a form that is useful policy development by a range of levels of Government. For proper functioning, the knowledge hub requires critically engaged and mutually supportive long-term relationships between the Knowledge Hub Directorate and the researchers as well as the Knowledge Hub Directorate and the Provincial/Local Government structures.

The Knowledge Hub must have a physical presence in the region of interest, with the necessary land, buildings and research infrastructure in place. The Knowledge Hub Directorate acts as the on-site coordinating structure to manage the research and engagement activities of the facility. While students and researchers may be transient at the facility, spending time ranging from a few days to a few months, the Directorate has a more permanent presence at the facility.

Figure 1 also indicates the proposed knowledge areas with which the Knowledge Hub for Rural Development is to engage. This is discussed in more detail below.

3. Proposed Knowledge Areas of activity at the Knowledge Hub for Rural Development (KHRD) in Carnarvon

The knowledge areas proposed here for engagement at the KHRD are based on our perceptions of need in the Carnarvon area and the region as well as the current and intended academic strengths at Sol Plaatje University. While these are proposed as the main research “thrusts” at the KHRD, it is understood that there may well be an ongoing engagement of research and knowledge development activities that are related to these research thrusts without being located within the particular disciplines indicated. By way of example, the KHRD could support research activities on urban development, undertaken by sociologists, that links to school development, agriculture and/or community health. Necessary as such a study may be, in itself, it does not form a separate research thrust.

3.1 Teacher education and school development

The region is clearly in need of this area of development, particularly in the areas of languages, mathematics and science teaching. SPU has a particular strength in this area and teacher education has occupied an important position in the suite of academic programmes offered. Postgraduate programmes in education are planned for introduction in 2019 and we envisage that rural education development will be one of the focus areas at SPU. A focused research thrust at the KHRD on school development and teacher education will provide an exciting context for further development of this knowledge area at SPU, while providing the necessary evidence to support the Northern Cape Department of Education to strategies and policies for responding to the local and regional need for improved education of young people in the province.

3.2 Data science

There is a growing capacity and interest in data sciences at SPU. The university produced its first graduates from the BSc (Data Science) programme at the end of 2017 and we are planning to introduce an Honour's programme in Data Science in 2019. While engagements with the theoretical and analytical aspects of data science does not require a physical presence close to the SKA in the Carnarvon area, the infrastructure that supports the SKA and its ability to capture, store, process and transfer large sets of data is of direct interest to researchers in this field who would benefit from a supportive facility close to the SKA.

However, of greater importance is the possible application of data science techniques and approaches to the other research thrust areas proposed. Activities in this Data Science Thrust will include applications to areas such as climate change, community health and genetic studies in agriculture.

3.3 Climate change

Climate change is a phenomenon of global concern. While the causes of climate change may be the subject of dispute, the present realities of climate change are causing changes to land usage, threats to plant and animal species, threatening food security and forcing human migration, all with consequences that are difficult to understand or predict. The arid regions of the Northern Cape, of which the Carnarvon region is a good example, present a unique opportunity to 'look backwards' in time to evidence of the effects of historical climate change events. The patterns of floods, droughts and long-term climate changes are 'written' in the landscape, fossils and geology of the Northern Cape as it changed from a region of lush vegetation to its present arid condition. Such a research thrust located at Carnarvon has the potential to generate global interest in understanding and trying to predict the likely future impacts of the present cycle of climate change. SPU has developed a good platform of research-active academics in the life sciences who would be interested in developing such a research thrust at Carnarvon. We have also established good working relationships with organisations like the South African Earth Observation Network (SAEON – in NRF/DST) and the Habitable Planet project at the CSIR, who would be included in the development of such a research thrust. Of course, this aspect of the KHRD also holds promise of developing new, environmentally sensitive technologies and applications in communities in and around Carnarvon for better utilisation of resources like energy and water.

3.4 Arid region agriculture

Associated with an interest in climate change, the realities of food security under water-stressed conditions demand attention to the matter of agricultural development in arid areas like the Carnarvon region. SPU is in the process of developing academic programmes in agricultural sciences with a particular focus on water-stressed farming conditions. As these programmes develop, our teaching and research interests will require access to an area like Carnarvon. The Northern Cape Department of Agriculture, Land Reform and Rural Development operates an experimental farm in the Carnarvon area and it is our intention to associate this research thrust with the activities at the experimental farm. The research activities in this thrust will be focused on improved effectiveness of farming practices in the area, with a particular emphasis on developing the smaller, family farm sector in the area into commercially viable entities.

3.5 Rural community health

This research thrust is expected to take a strong public health approach in dealing with community health challenges in the region. There will be a particular focus on health issues related to living conditions and lifestyle such as substance abuse, nutrition and family health. While SPU does not have an academic capacity in the health sciences, and is not likely to develop this in the short-term, the rural health programme at University of Stellenbosch has expressed a strong interest in partnering with SPU and the Northern Cape Provincial Government to establish a rural health research, teaching and community engagement presence in the Carnarvon area. This is envisaged as an extension of the University of Stellenbosch's rural health facility at Wellington in the Western Cape that is currently used as a research, community outreach and teaching platform.

3.6 Science tourism

The Knowledge Hub Directorate will be expected to manage and develop science tourism in the Carnarvon area. While scientific aspects related to astronomy will be a predominant theme, the area also offers exciting opportunities to develop tourism interest in areas like geology, birdlife, exploration hiking and health-spa services that will attract the otherwise reluctant visitor to the Carnarvon area. Each of these areas offer opportunities for education, training, employment and business development to members the local community. The Knowledge Hub Directorate will also take responsibility for managing a science tourism centre, preferably indirectly through a concession agreement, including marketing, curating exhibitions and supporting visitors to the facility.

4. The Knowledge Hub Directorate

The Knowledge Hub Directorate is clearly a central component of this proposal. The head of such a Directorate will have to be a competent researcher, scientifically literate and with a visionary management and development approach. Equally important will be the need to cultivate relationships with the local community, the scientific sector and with the necessary government structures to ensure that information and development initiatives flow inward and outward. The Director will be located in Carnarvon on a full-time basis in order to develop and manage the Knowledge Hub.

5. Infrastructure

In order to facilitate fundraising and facilities development, it will be important that an area of land, preferably outside but close to the town of Carnarvon, be allocated for ownership by SPU. This facility will primarily be for staff and student housing, working offices for the Directorate and for basic research laboratory facilities. Infrastructure will be developed as funding becomes available and as research needs of the KHRD evolves over time.

6. Governance

While the KHRD will primarily be an SPU project, subject to the academic oversight of our University Senate and the fiduciary oversight of our Council, it is proposed that a project governance and steering structure be established that will include members of SPU, Provincial Government, Local Government and, depending on the level of their involvement, the main research partner organisations. The main purpose of this steering and governance structure will be to ensure that the focus areas of the KHRD are correctly aligned, that the important research questions are being addressed and that the programme is properly managed and funded.