Preamble

The SALT risk committee met on 5 May 2015 and began work on several priority action plans to identify and mitigate risks to the SALT Foundation. The lack of a Strategic Plan was one high risk item identified by the committee. This draft document was put together (largely by Lizette Lauschagne with input from Jack Hughes and Darragh O'Donoghue) from the following existing SALT documents:

1. Shareholders Agreement
2. Draft Annual Report - May 2015
3. Risk Register - 6 May 2015
4. Salt Capabilities 2015 - March 2015 (Ted Williams)
5. SALT Increased Operations Budget - Impact - Oct 2014
6. Saltwhitepaper2014v3 - Nov 2014
7. Darragh's email comment on Brian's letter - 5 May 2015

Please keep in mind the following as you review this document:

1. This is a working first draft based on the documents given above.
2. It has not been fully reviewed or vetted by the risk committee.
3. No judgments or decisions have been made about any of the contents of the document – at this stage it is an incomplete compendium of ideas and suggestions.
4. The SALT Board owns this document and so it needs to review, revise, expand and enhance it so that is becomes the strategic plan for SALT.
5. The plan should cover the 5-6 year period from now until 2020 in realistic detail considering available resources.
6. The next 5 yr period will consider more visionary ideas, but the astronomy landscape (summarized in section 4 below) should be kept in mind. We want SALT to be competitive in the era of LSST and the large 30-m class telescopes that will start operations in 2022 and beyond. This is the timeframe to focus our Strategic Planning efforts.
7. We are seeking comment from the Board on the current draft.
8. We propose to have a more complete, reviewed, and vetted draft, including wide Board input, by the November 2015 Board meeting.
9. There will be significant iteration with the full SALT Board as we finalize the plan.

SALT FOUNDATION (PTY) LTD

STRATEGIC PLAN 2015 – 2020 (and Beyond)

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1. Introduction

The Southern African Large Telescope (SALT) is the largest single optical telescope in the southern hemisphere and amongst the largest in the world. It has a hexagonal primary mirror array 11 metres across, comprising 91 individual 1m hexagonal mirrors. The light gathered by its huge mirror is fed into a suite of instruments (an imager and two spectrographs) from which astronomers infer the properties of planets, stars and galaxies, as well as the structure of the Universe itself. SALT is the nearly-identical twin of the Hobby-Eberly Telescope (HET) located at McDonald Observatory, Texas. HET and SALT represent a completely new paradigm in the design of optical telescopes.

SALT is owned by the SALT Foundation, a private company registered in South Africa. The shareholders of this company include universities and science funding agencies from Africa, India, Europe, New Zealand and North America. The South African National Research Foundation is the major shareholder with an approxiately1/3 stake. Other large shareholders are Dartmouth College, the University of Wisconsin-Madison, Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences and Rutgers University. Smaller shareholders (<10%) include the American Museum of Natural History, the Indian Inter-University Centre for Astronomy and Astrophysics, the University of Canterbury (in New Zealand), the University of North Carolina, Gottingen University and the UK SALT Consortium, the latter representing the Universities of Central Lancashire, Keele, Nottingham and Southampton, the Open University and the Armagh Observatory.

The size of the shareholding of each partner determines the access to the telescope which they enjoy. The HET Consortium, although not a shareholder, received ten per cent of the telescope time for the first 10 years of operation, in return for providing all the designs and plans of the HET as well as assistance during the construction of SALT. The 10 year term of the agreement with the HET Consortium has ended and HET's10% share of observing time has now reverted back to the remaining stakeholders

SALT is located at the observing site of the South African Astronomical Observatory, near the small town of Sutherland, about 400 km north-east of Cape Town in the Karoo. This site has been host to a number of other smaller telescopes since the early 1970s, and benefits from location in a semi-desert region with clear, dark skies. The quality of this site for optical astronomy is preserved by South African legislation.

2. SALT Capabilities

2.1 Current Capabilities of SALT (March 2014)

One of the notable capabilities of SALT is the possibility of rapid response to targets of opportunity (ToO): because of the queue-scheduling, an object in SALT's viewing annulus can be observed with any of the SALT instruments within 10 minutes of notification, and same-night ToO observations have been demonstrated. SALT is now in routine scientific operation, with observations carried out every clear night. Observing time is allocated through a competitive peer-reviewed proposal process, on a 6-month schedule.

Imaging

The main imaging instrument on SALT is **SALTICAM**. This provides seeing-limited imaging over the spectral range 320-900 nm for the full 8-arcminute field of view of the telescope. Available filters include standard Johnson-Cousins, Sloan, and Strömgren sets and also Hα, 380 nm, and neutral density. In addition to normal imaging mode, highspeed frame transfer and slot imaging modes provide high time resolution imaging at rates up to 10 Hz. Very high-speed imaging is provided by the Berkeley Visible Image Tube camera (BVIT), a photon-counting camera with a ~1.3-arcmin diameter field of view, capable of very high time resolution (millisec or microsec) photometry with a B, V, R or H-alpha filter. It can be used for objects with magnitudes ranging from V~12-20.

Spectroscopy

The **Robert Stobie Spectrograph (RSS)** is a multi-mode imaging spectrograph with a wide range of capabilities. It is located at the prime focus, with direct access to the full 8-arcminute focal plane of the telescope. All observing modes are remotely and rapidly reconfigurable. Current modes available are:

a) Long slit spectroscopy
b) Multi-object spectroscopy
c) High time resolution spectroscopy
d) Fabry-Perot imaging spectroscopy
e) Narrow-band imaging

Grating spectroscopy modes (a), (b), and (c) provide spectral resolving power (R=λ/δλ) from 250 to 5500 for 1.25 arc-second slits, over the spectral range 320-900 nm (R to 9000 for 0.6 arc-second slits). Continuous time-resolved spectroscopy with temporal resolution of a few seconds is available via frame transfer for all grating modes, and long-slit slot mode spectroscopy gives time resolution of 0.05 sec. Fabry-Perot mode provides spectroscopic imaging with R=300 to 1000 over the spectral range 430-860 nm, and R=2000 for emission-line objects only (currently limited by spectral blocking capability). Narrow band imaging with R~50 is available over the spectral range 430-890 nm.

The SALT **High Resolution Spectrograph (HRS)** is a dual-beam (370-555 nm and 555-890 nm) fibre-fed, white-pupil, échelle spectrograph, employing VPH gratings as cross dispersers. The cameras are all refractive. It is a single-object spectrograph with simultaneous sky measurement, using pairs of optical fibres. There are 3 resolving power modes R ~16,000 (unsliced 500 μm fibres), ~37,000 (sliced 500 μm fibres), and ~67,000 (sliced 350 μm fibres). There is also a high stability mode at R~67,000 employing fibre double-scrambling and optional iodine cell or simultaneous ThAr calibration injection.

2.2 Near-Future Capabilities of SALT (through 2015) Update

There are several on-going projects that will provide SALT with all of its planned initial capabilities. The RSS spectrograph was removed from the telescope in October 2014 for refurbishment. This led to a roughly 45 per cent improvement in throughput. Additional work involving replacement of the current collimator doublet and triplet is planned, leading to further improvements in throughput. We expect to recover almost the full designed throughput of the instrument.

Fabry-Perot modes

Medium and high spectral resolution modes of Fabry-Perot imaging require the use of two etalons in series to select a single interference order. This dual-etalon mode is currently not operable due to mechanical flexure in the etalon mounting, which leads to ghost imaging and loss of throughput. A new mounting structure is being manufactured and was installed during the October 2014 refurbishment. Full operation of all FP spectral resolution modes is being commissioned .

Polarimetry

All spectrographic modes of RSS are designed to allow spectropolarimetry. These have been successfully tested during telescope commissioning, but have been suspended due to mechanical problems with the Wollaston beamsplitter mosaic. This assembly has currently been repaired by the vendor and is soon to be installed in the telescope; polarimetry is expected to be re-commissioned in 2015 June.

Near-Infrared Spectroscopy

The RSS prime-focus imaging spectrograph has been designed to accommodate a second near-infrared (NIR) beam. This will extend all the capabilities of the visible side of the spectrograph out to a wavelength limit of 1.7 microns. The University of Wisconsin, a SALT Partner, has designed and built this NIR arm, and is assembling and testing it now. It is planned to deliver and install the NIR arm on the telescope in 2016. In order to accommodate the additional weight of the NIR system, the SALT tracker structure is being upgraded, and will be ready to accept the new instrumentation when it is delivered to the telescope. The upgraded spectrograph will be able to observe in both visible and NIR simultaneously, and will have longslit, multi-object, polarimetric, and imaging capabilities. Provision has been made to support NIR Fabry-Perot imaging spectroscopy, subject to generating funding for the NIR FP etalon and controller.

Primary Mirror Alignment System

As noted above, the original system for maintaining the alignment of the segments of the SALT primary mirror failed due to the effects of the local environment (mainly extreme humidity variation). A new system has been designed and thoroughly tested, and is expected to be able to effectively control the mirror system. The delivery of the first portion of this system has been installed and tested on SALT in 2014. The full system is expected to be operational by the end of 2015. This will improve both the delivered image quality and the observing efficiency of the telescope.

2.3 In-Capabilities of SALT

Sky Access

SALT is, by design, not a general-purpose telescope. The major limitation is restricted sky coverage: declinations north of +12° and south of -77° cannot be observed. Within the accessible declination range, observing time is limited to typically one hour (longer near the declination limits). For some observing programs this limited viewing time is not a significant restriction, however for other programs it is a major impediment. Examples of the latter include night-long monitoring of time variable objects and immediate access to transient events.

Image Quality

The spatial resolution of the telescope is limited by the seeing characteristics of the Sutherland site. Current median zenith image FWHM is 1.3 arc-seconds, with occasional seeing as good as 0.6 arcseconds. The SALT visibility annulus lies between 1.16 and 1.37 airmasses, which leads to a factor 1.1 to 1.2 degradation in the image quality on average. Thus SALT will never provide the consistent subarc-second images that can be obtained from the world's best ground based sites in Hawaii and Chile. In addition, the original edge sensing system designed to maintain the alignment of the segments of the primary mirror failed due to the unanticipated effects of the environment at the observatory site. A new system is currently being installed on the telescope, and when fully operational by the end of 2015 it should maintain the mirror alignment for periods of up to a week. In the current state, the mirror must be realigned several times a night, reducing the observing efficiency and lowering the average image quality. Absolute photometry: SALT's moving pupil and spherical aberration corrector design limit the photometric accuracy attainable with the telescope. Photometry relative to reference stars in the field of view can be done with a precision of a few percent, limited by the flat-field correction. Absolute photometry using standard optical techniques is not possible.

Field of View

SALT's optical system provides a science field of view of 8 arc-minutes diameter, with a wider annulus to 10 arc-minutes diameter available for guiding. While respectable by large telescope standards, this field of view can limit the number of targets simultaneously available for massively multiplexed spectroscopy, and precludes survey projects covering wide areas of the sky.

Mid and Far Infrared

SALT's optics and instruments are designed to give some of the best ultraviolet performance available on any ground-based telescope, down to the atmospheric limit of 320 nm. However, the large tracker structure and the gaps between segments of the primary mirror produce too much thermal background to carry out effective observations beyond the near-infrared wavelength range. The effective long-wavelength limit is around 1.7 microns.

3. Strengths, Weaknesses, Threats & Opportunities

Strengths:

- Engineering operations has run an excellent service for many years
- Development projects almost complete and SALT is entering a steady state operationally
- Improved scientific achievements – rapid increase in rate of publications
- Rate of science observations coming out of the telescope is over 80 per cent
- Technical down time has declined
- Initial telescope can evolve into range of offerings
- Dedicated engineers and technicians

Weaknesses:

- Insufficient cash resources
- Board of Directors not pro-active in company affairs outside Board meetings
- Lack of awareness amongst prospective telescope users
- Absence of strong marketing expertise
- Overdependence on few key staff
- Historic less-than-spectacular performance of SALT
- Suboptimal utilisation of SALT (by partner countries) for Human Capital Development (HCD) IS THIS REALLY TRUE?
- Long lead times to fill vacancies leading to reduced operational capacity
- Science proposals not optimised
- Long lead times to develop instruments

Threats:

- Financially stringent time in world astronomy funding
- Operations funding unsustainable for certain partners
- Partners defaulting on financial obligations
- Partners withdrawing from the consortium
- Less skilled and motivated staff needed to keep the facility maintained and operational once development is completed – loss of institutional knowledge. I DISAGREE WITH THIS POINT
- Inability to respond to demand and changing trends in astronomy
- New technology may make telescope obsolete
- Competing with high spec-ed instruments
- Partners perceive that there is no return on investment - previous disappointing

Opportunities:

- Weakening of Rand against major currencies makes investment in SA more attractive
- Located in the southern hemisphere
- Decadal plan for Astronomy in SA
- Operations costs of other 8-10-m class facilities much higher
- Scope to diversify
- Telescope time of defaulting partners are available for re-sale
- Prospective interest from China, Thailand, Korea and India

experiences
- Deterioration of site
- Reduced demand for usage of SALT
-

[Internal Assessment: Organizational assets, resources, people, culture, systems, partnerships, suppliers, etc] [External Assessment: Marketplace, competitor's, social trends, technology, regulatory environment, economic cycles, etc]

4. The Astronomy environment / Benchmarking

The SALT telescope will work in a different scientific environment in ten years from now with respect to new satellites, new ground based telescopes, and new scientific questions.

Important telescopes (and their associated wavelength ranges) in 2024

Space-based
- 6.5m James Webb Space Telescope (optical/IR imaging and spectroscopy), launch 2018+
- Euclid (optical/NIR imaging and NIR spectroscopy), launch 2020
- eROSITA (German/Russian hard X-ray all sky survey), launch late 2016
- Athena X-ray observatory, launch 2028

Ground-based
- Giant Magellan Telescope (GMT) in Chile, optical/NIR, commissioning to begin 2021
- 35–40m E-ELT in Chile, optical/IR imaging and spectroscopy, ready for use by about 2022+
- Thirty-Meter Telescope (TMT) on Hawai, optical/IR imaging and spectroscopy, first light: 2022+
- 8.4m LSST (Large Synoptic Survey Telescope) in Chile, wide-field deep astronomical surveys, opt./NIR variability, first light: 2019?
- Square Kilometre Array radio telescope (SKA), South-Africa+, construction of phase 1 will take place from 2018 to 2023
- Cherenkov Telescope Array (CTA) for high-energy gamma ray observations, Namibia?+, 2020
- The Atacama Large Millimeter/submillimeter Array (ALMA), Chile, 2014
- ESO VLT, Keck, .. (existing telescopes)

Competitive Landscape

- The baseline JWST mission is for 5 years; thus there is a possibility that JWST will be done by 2024 and we could be in legacy follow-up mode. This is likely to enhance the emphasis on NIR and even thermal IR observations, which also are being driven by ALMA and the capabilities of adaptive optics and OIR interferometers.
- The role of high angular resolution astronomy merits a more thorough discussion when thinking about SALT. We can expect adaptive optics to be in routine operation, possibly into the visual bands, on 8-m class telescopes and in the NIR on 30-m class instruments. In both cases the angular resolution will be in the 0.01 arcsec regime. In addition ground layer AO is likely to be routine, yielding 1/3 arcsec images over wider fields of view. This would effectively double or triple the effective apertures of telescopes working on point sources in the sky background limited regime. These capabilities will complement those of the 30-m class telescopes and comfortably exceed what JWST can do.

• A UV/optical HST-2 is likely to be near launch or in space with renewable instruments.
• It seems likely that observational astronomy will continue its trend towards focusing more on quantitative measurements versus the current emphasis on semi-qualitative survey studies. Any surveys with SALT will have to exceed the quality of the ongoing or planned projects.
• Most of the facilities that are compared with SALT will be considerably more expensive than even a SALT on steroids. Thus SALT doesn't have to do everything but it must be able to do something well!

Dedicated scientific questions in 2024

• Search for planets with dedicated satellites (e.g. Plato)
• Spectroscopy of planets with JWST, E-ELT, TMT
• Spectroscopy of most distant objects with JWST, E-ELT, TMT
• High spatial imaging/spectroscopy of planets, stars, centers of galaxies, distant galaxies with JWST, E-ELT, TMT
• Studying structure formation and evolution of the universe (galaxies, clusters, black holes, cosmic web)
• dark matter, dark energy
• what is the origin and mode of acceleration of the highest-energy cosmic rays?
• What is the nature of space-time under the extreme conditions in the vicinity of black holes and neutron stars?
• How are the relativistic jets from compact objects launched, accelerated, and collimated?
• What are the progenitors of Type Ia supernovae?

[Benchmarking is the process of comparing one's business processes and performance metrics to industry bests and/or from other industries. Dimensions typically measured are quality, time, and cost. Improvements from learning mean doing things better, faster, and cheaper.

Benchmarking involves management identifying the best institutions in their industry, or any other industry where similar processes exist, and comparing the results and processes of those studied (the "targets") to one's own results and processes to learn how well the targets perform and, more importantly, how they do it.]

5. Gap Analysis

[Identify the gap between the optimized allocation and integration of the inputs, and the current level of allocation. This helps provide the institution with insight into areas which could be improved. The gap analysis process involves determining, 'where you are now' and 'where you want to be'.]

Non-steerable telescope

It is a REAL impediment to productivity to spend only 1 hour or so on any given target, and more importantly, to have to wait for a target to get into the accessible zone. This has a HUGE impact on effectiveness.

Smart Focal Planes

With the current multi-object spectroscopy limited to about 50 slitlets, it is clear that this is grossly inadequate for a modern 10-m class telescope. Integral field units (IFU), hundreds or thousands of fibers, image slicers and lenslet arrays for focal plane slicing are the norm. SALT needs to acquire expertise and capability in two specific areas:

1. Positioning of fibers / IFUs at its focal stations
2. Construction and optimal usage of fibers, IFUs and the like

Humidity Control

The telescope has suffered from fogging over of its mirror in the past due to lack of humidity control in the dome. The same lack of humidity control requires of the night operations team to close the shutter even when the sky is clear and therefore shortens observing time.

Payload

An integrated study and proposal was put together in 2013 to address most of the payload problems. It was found that some modifications could be done in situ and those have been done. Some were done during the RSS Throughput Repair during September and October 2014, but others need the payload to be taken down from the tracker.

The payload suffers from the following deficiencies:

DEFICIENCY	IMPACT OF SOLVING IT
1. Requirement to re-home fold mirrors / pellicle during operations	Improve on-sky efficiency and remove the requirement to do some of the rehoming at rho stage at zero degrees.
2. Slow movement of the fold mirrors / pellicle reduces efficiency	Improve on-sky efficiency
3. Reliability of mechanisms and the software control system. Failures at these levels include firmware lock-ups on the guidance camera, as well as sporadic communications failures with various internal subsystems	Minimise downtime.
4. Accessibility / Maintainability – difficulty performing maintenance and repair operations	Reduce downtime due to better access for fault finding and in-situ maintenance. Some current inaccessible devices can be reached (e.g. RSS autoguider)
5. Obsolescence – the need to pre-emptively replace parts that are no longer available	Reduce downtime and ensure continued operations

The impact of these modifications will be more time on sky due to fewer problems with electromechanical glitches and breakdowns and more time for the software team to focus on improving and extending the control system.

Software

Two extra software FTEs are required for many tasks relating to improving and extending the telescope control system as well as providing dedicated support to instrument software.

Communication between for example the TCS and subsystems is currently HTTP-based and while generally reliable, can be improved by new technology becoming available on the market (e.g. EtherCAT and Data-Distribution-Service). Alternatives for the current control system-architecture can be researched and implemented. This will result in better user interface handling and reliability and can be ported on operating systems such as Linux.

RSS Guidance Probe

It is well known that the current RSS Guidance probe suffers from slow movement, and is not accurate enough to be used for sub-arcsecond offsets and blind pointing. Its main drawback, however, is low throughput, which prevents focus control and limits its use to bright guide stars. The new probe will be based on the recently commissioned FIF guider (which has a factor of 8 better throughput) and be fitted with an autofocus mode. A second probe will also be included which will allow for rho compensation, essential for Multi-Object Spectroscopy.

SAC Reflectivity Restoration and Maintenance

During the image quality repair, it was possible to clean three of the four SAC mirrors. There is, however, some evidence from telescope throughput tests that the SAC throughput is declining. At the time of the cleaning of M5, it was apparent after cleaning that many pinholes and other minor damage to the coating remained.

We believe that, currently, the impact of SALT in the context of international astronomy has been limited by:

1. Technological challenges to get the telescope up to its originally envisaged performance, ranging from the inefficiency in the throughput of RSS, to the lack of edge sensors, and a host of other less important technological issues.
2. The operational limitations of SALT which restrict the observation of any specific target to about an hour. This, along with the setup overhead of a 10-15 min, results in a significant inefficiency in shutter open time.
3. The number of observing programs in the queue, which is a result of the number of scientists at the partner institutions who are users of the telescope. This results in a large diversity of observational programs and, in view of the oversubscription for time, a relatively small amount of time for each program and a poor completion rate.
4. The lack of focus amongst the users and TACs on the strengths of this telescope and the need to prioritize programs taking advantage of these. For example, SALT wasbilled as ultraviolet sensitive, polarimetry capable, Target of Opportunity suited etc., but thus far, little exploitation of these advantages has been made.

Point 1 is being addressed at the moment, will be completed over the next couple of years and will lead to substantial improvements. Point 2 would require a major re-engineering of the telescope. Points 3 and 4 are as much astrosociological issues as scientific and technological ones.
Expanding on Point 4, astronomy has developed to the point where facilities dedicated to specific goals have become the norm, rather than wanting general purpose telescopes. We

believe that SALT needs to develop in this direction with an instrument and/or telescope capability unrivalled by any other telescope of similar size. HETDEX on HET is a prime example of the kind of thing we mean: a 33000 fiber spectrograph covering much of a 19 arcmin field of view.

6. Vision

[What the org/dept wants to be; it should be compelling, vivid and concise,, challenges everyone to reach for something significant – inspires a compelling future; it is time bound. An organisation's **Vision** sets out its aspirations for the future. The Vision is the 'dream' of the future, a picture painted in words, which is intended to inspire people by appealing to the heart as well as the head.]

SALT is a multi-partner enterprise, each of whom brings their own vision:

- The National Research Foundation (NRF) is the foundation in South Africa that supports the development of human resources skilled in science, engineering and technology disciplines through the provision of grants to tertiary training institutions and the operation of national research facilities. The South African Astronomical Observatory (SAAO) is the national research facility in South Africa for optical/infrared astronomy operated by the NRF. The NRF is funded by the South African government through the Science Vote allocation from the Department of Science and Technology (DST). For the Government of the Republic of South Africa, SALT also presents a unique opportunity to overcome and redress the consequences of the policies of pre-1994 governments that excluded the majority of South Africans from science, engineering and technology education, training and careers.

- Rutgers, the State University of New Jersey (RU), USA is a public institution of higher education, teaching, and research operating under the direction of its Board of Governors. RU believes that through a shareholding in the Company, the participation in the activities associated with SALT will be of great value to the students, faculty, and other associates of the Department of Physics and Astronomy, to the University as a whole in its educational and research activities, and to the State of New Jersey.

- Georg-August-Universitt Gottingen (GU) is a public institution of higher education, teaching, and research of the German Federal Country Lower Saxony (Land Nieder-sachsen). GU, represented by the University Observatory, Department II, will become a Shareholder in the Company. The Departmental faculty and students believe that access to SALT will greatly help them to carry out cutting edge research and teaching in Extragalactic Astronomy and that participation in the SALT collaboration under this Agreement will be a great asset to Gttingen University and to the Federal Country.

- The University of Wisconsin-Madison (UW) is a state institution of higher education within the University of Wisconsin System under control and supervision of the Board of Regents, a body corporate of the State of Wisconsin (USA). UW believes participation in SALT as a Shareholder will be of great value as a forefront laboratory for the Astronomy Department, and to the University as a whole in its research, educational, and outreach activities. We anticipate that the collateral benefits associated with SALT project will be farreaching within the University and State of Wisconsin.

- The University of Canterbury, New Zealand (UC), is a public institution of higher education, teaching and research within the New Zealand tertiary education sector and will become a Shareholder in SALT. Access to SALT will provide scientific and technological opportunities for a

new generation of New Zealand researchers, engineers and technicians. There will also be significant benefits for research-informed teaching.

- Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences (CAMK) is a public institution of research and represents the Polish community of astronomers who will participate in SALT. CAMK will be responsible for administering funds from the Polish budget provided by the State Committee for Scienti_c Research (KBN). CAMK, together with four Polish universities (Cracow, Poznan, Torun and Wroclaw) is also intending to create a foundation in Poland for sourcing funds from other resources for supporting the Polish participation in SALT. SALT will give the Polish community of astronomers access to a large telescope facility in the southern hemisphere and enable faculty and students to carry out cutting-edge astronomical research.

- The United Kingdom SALT Consortium (UKSC), is a group of UK institutions that undertake research and teaching at higher education level. It comprises: The Armagh Observatory, The University of Central Lancashire, The University of Keele, The University of Nottingham, The Open University and The University of Southampton. The UKSC believes that participation in SALT will be of great value to students and sta_ of the institutions in their research programmes in astronomy and related sciences, and in the promotion of general understanding and appreciation of science, engineering and technology.

- The University of North Carolina-Chapel Hill (UNC-CH) is a state institution of higher education within the University of North Carolina system under the control and supervision of the Board of Governors, a corporate body of the State of North Carolina, USA. UNC-CH includes among its faculty engaged in research, teaching and service the Department of Physics and Astronomy. The Departmental faculty believe that its faculty and students, graduate and undergraduate, would bene_t greatly by access to the Southern African Large Telescope that is the subject of this Agreement.

- Dartmouth College is a private institution of higher learning, teaching, and research in the USA. Dartmouth faculty includes a Department of Physics and Astronomy engaged in teaching and research. Dartmouth believes that its faculty and its under-graduate and graduate students would bene_t by having access to the large telescope to be constructed and operated under this agreement.

- The Inter-University Centre for Astronomy & Astrophysics (IUCAA) is an autonomous institute of the University Grants Commission (UGC) of India. The main objectives of IUCAA are to provide a Centre of Excellence within the university sector for teaching, research and development in astronomy and astrophysics, as well as to promote nucleation and growth of active groups in these areas in colleges and universities. Besides conducting a vigorous research programme of its own, the IUCAA enables workers from Indian universities, teachers as well as students, to visit IUCAA for various durations for participating in research and executing developmental projects. The aim is to provide the visitors access to the best facilities needed for their research and development. For the past one decade IUCAA is supporting various observational programmes with its 2-m telescope at the IUCAA Girawali observatory.
IUCAA believes that participation in SALT will help researchers from IUCAA and

Indian universities carry out cutting edge Astronomical projects with a 10-m class telescope.

- The American Museum of Natural History's (AMNH) Astrophysics department is responsible for the scientific messages powerfully displayed in the exhibition halls of the Rose Center for Earth and Space in New York City. The Planetarium and Earth Science halls, as well as the museum itself host 5 Million visitors each year. The scientific staff in astrophysics carries out research based on ground and space-based telescope observation, computational modeling of star formation and extraterrestrial impacts, and direct imaging and characterization of exoplanets. AMNH's commitment to outreach and lifelong learning are now extended to South Africa via SALT. As part of its outreach efforts in South Africa, the museum has donated copies of its state-of-the-art planetarium shows to South African planetaria; enrolled South African teachers in distance-learning courses; and hosted visiting groups of South African high schoolers and their teachers for week long visits to AMNH.

SALT will not only enable its partners to explore the mysteries of the Universe. It will play its part in developing a world in which all humankind is inspired and united by the pursuit of knowledge of the infinite variety and richness of the Universe.

In 10 years we see SALT as one of the most efficient, in terms of instrument reconfiguration and setup time, OIR telescopes in the world. It will have a powerful suite of instruments (RSS-VIS+NIR, HRS, Salticam, another?) in which all modes are fully functional and performing at design spec. It may have a GLAO system routinely delivering sub-arcsec images through at least the middle of the optical range. It will have a mix of PI-led science and larger dedicated experiments that are fed by well-calibrated data processed through a robust and effective pipeline.

7. Mission

[Our purpose of existence; should be brief and to the point; it provides context for major decisions and capable of infinite fulfilment; it is not time bound].

The Mission of the SALT Foundation is to design, construct, and operate a ten-metre class telescope, with instrumentation and related support buildings, and which is located at the Sutherland Outstation of the South African Astronomical Observatory in South Africa, the purpose being to advance science and training through the promotion of astronomy and astrophysics in the Southern Hemisphere and to enhance collaboration between scientists and countries in these fields.

8. Strategic Objectives

8.1. Achieving world class science: publishing highly cited papers in front rank journals

a) Enhancing Science Outputs

SALT is currently suffering from a reputation of low science productivity. One way to address this is improving science deliverables to the SALT community through providing pipeline reduced data. This would have the potential to decrease the time between receiving data and eventual publication.

Right now the person responsible for the SALT pipeline development is the SALT Data Manager, who is currently funded 100% by SAAO. This dates to a decision back in 2004 where the SALT Board decided they were not interested in supporting a data reduction pipeline. But things have moved on and the expectations are now that more than just raw data is provided on a ~weekly basis (i.e. data available on a 24 hour timescale from observations, basic pipeline reductions, observations statistics, assistance for users, TACs, commissioning and performance reports, etc.)

Much was achieved with a small pot of commissioning budget funds (~R400k) to support various outstanding commissioning tasks (e.g. flat field investigations, RSS commissioning), through the assistance of short term visitors (e.g. from SALT partners) or contractors. The need for this type of support remains, and will be more so with the advent of RSS NIR in 2016.

It would therefore seem appropriate, on the basis of historical experience, to increase Ast Ops staffing by 2 FTEs to support these efforts (i.e. to cover the work currently paid by SAAO and an additional postdoc or similar position) for pipeline data reduction and quality control support.

b) Responding to demands and changing trends in astronomy

There is a need to finalize the white paper and compile the instrument development roadmap in close consultation with the Board. Estimate costs.

c) Monitor the performance of the telescope

At each Board meeting, there should be a review of the effectiveness of telescope (science, engineering, operations, development)

Monitor the equitable distribution of science observations amongst partners. Provide guidance to SALT Operations to correct cases where there is a problem.

d) Acceptance of science proposals with a high impact outcome and effective telescope usage

Working with TACs and users to ensure high quality proposals and effective telescope usage.

Implement communication program within consortium

Get multi-partner proposals going

e) Shorten lead times to develop instruments

Develop a Programme Management framework for core processes, including scope, time, cost, quality, communication, risk and performance management.

f) Prevent telescope failure

Effective implementation of a preventative maintenance programme.

Regular management review and reporting on maintenance programme.

g) Protect the observing site

Develop and promulgate AGA regulations, Implement monitoring of condition of Sutherland site

8.2 Ensure sustainability: scientific, financial, development

a) Retention of key staff

Now that SALT is entering a steady state operationally, the most capable staff are working on projects most of their time, but are available to jump in and help whenever there is a major issue such as a Tracker breakdown. In 2016 March, some of the existing engineering staff will have to be retrenched. Certain key people will either have to move back to Sutherland, or leave. SALT will then loose valuable institutional knowledge.

Develop and implement a succession planning strategy (support by an implementation plan). Identify key staff and determine appropriate succession plan for each key staff member

b) Annual subscriptions and development funding

Follow-up on outstanding subscriptions.

Fund-raising campaign by assisting existing partners to raise funds, and seeking new partners to buy shares or telescope time.

Manage the annual budget to stay within the financial means of the Board

Financial management (including reprioritisation of projects)

c) Return on investment

Standing item on Board agenda to discuss effectiveness of telescope and prospects for partner funding.

Produce and publish an annual report (should report on the value-add and return on investment)

8.3 Instrumentation development: telescope capability, as well as better and more capable instruments

It is clear that a combination of operations and development projects is the optimal work environment to retain excellent engineering staff as well as to bring the performance of the telescope to what was originally intended. It has long been recognized that the telescope will become more and more obsolete if efforts are not made to upgrade it with new and better capability, either in the telescope itself, or in new and better instruments. (Note that this is in direct contradiction to subsection (a) in section 8.2. This needs to be resolved.)

SALT has established a fund to support the development of future instruments for the telescope. The consortium hopes to produce new major instruments on a 5-year cycle. No decisions have been taken yet for the next instrument to be developed, but preliminary investigations are underway in two areas.

New Spectrograph Design

• D. O'Donoghue and collaborators have invented an innovative new spectrograph design that is currently in the lab breadboard design phase. This design promises to provide highly compact and cost efficient spectrographs with very high optical throughput. Thus these could be the basis for a massively multiplexed multi-object spectrograph that would allow thousands of simultaneous spectra to be obtained with a fibre-fed system on SALT. Such a spectrograph could possibly be deployed on the telescope by 2018.

Adaptive Optics System

• SAAO astronomers are investigating the characteristics of the atmosphere at Sutherland to assess the feasibility of image quality improvement with an adaptive optics system for SALT. It is clear from these observations that a substantial contribution to the seeing arises from a relatively thin layer of turbulent air near the ground level, and thus a significant improvement in image sharpness (and hence telescope efficiency) could be obtained by implementing a ground-layer adaptive optics system similar to those employed at other observatories. Investigation of possible designs for such a system at SALT will be pursued.

• Ground-layer adaptive optics (GLAO) system for reaching 0.6 arcsec images.

Ground-layer adaptive optics (GLAO) could make a huge improvement to SALT. A conventional high order AO system, indeed, is not feasible for SALT. However, SAAO site measurements over the past couple years have revealed that the majority of seeing occurs in the ground layer, which means it is correctable. GLAO systems do not try to correct down to the diffraction limit, but to something in the sub-arcsec range. A GLAO system would correct the limitations of the site, which have drastically degraded in recent years from 0.9 arcsec to 1.5 arcsec median seeing. The IR sees the greatest improvement, but these systems have demonstrated some improvement down into the optical as well. One limitation, however, is that one only gets correction over a few arcminute field of view. Steve Crawford is heading up a low level study on this with Matt Kenworthy. Devoting some extra resources to this effort should be a high priority for improving the efficiency of SALT. Remember that the goal is not to reach the diffraction limit. Rather, it is to compress the image quality histogram so that many nights are closer to or at the spec for the SALT optical system (1.1 arcsec). This would provide an enormous boon to spectroscopic observations and make imaging much more competitive.

Importance of SALT in 2024

Scientific questions/problems that can be tackled by SALT with its **present Instrumentation** (HRS spectrograph, direct imaging camera/high speed photometer, RSS/Prime Focus Imaging Spectrograph):

- Optical follow up spectroscopy and detailed investigation of radio sources (SKA), gamma ray sources (CTA), mm-sources (ALMA) with SALT
- Follow up spectroscopy of variable/faint LSST sources
- High speed photometry of planets, variable sources
- Dedicated spectroscopic/imaging projects of planets, stars, galaxies/AGN, large scale structures
- dedicated surveys for bright and dark time: planets and extended faint objects

Importantce of SALT (**with new instrumentation**) in 2024:

- A wide field (at least 30 arcmin x 30 arcmin, with at least 300 fibers) low resolution spectrograph would enable SALT to take full advantage of LSST. The same is true for follow up discoveries by SKA. (For comparison: one VIRUS spectrograph at HET has 230 fibers.

SALT in 2024

In 2024, LSST will have been operating for a couple of years. The next generation of ELTs (EELT, TMT, GMT) will have begun operating or be in commissioning. MeerKAT will have been subsumed into SKA1 which will also have begun operating. EUCLID will be imminent. SALT will, accordingly, be a 2nd rank facility much as the 4-m telescopes of today are. Some of todays 4-m telescopes, lacking a dedicated mission, are being closed. Remarkably, others are being rejuvenated and put to use in dedicated surveys. It is likely that SALTs survival as a competitive facility on the world stage will depend on its ability to focus on specific research projects of the day.

To this end, we foresee SALT:
- Being fully-steerable, at least over a substantial fraction of the sky centred on the zenith
- Have a wide field of view of at least a degree and preferably two degrees
- Have spectroscopic capability of many tens of kilofibers
- Have a unique instrument or capability which will be unrivalled anywhere else in the world

These capabilities are entirely dependent on progress in astronomical technology. One of the great and unanticipated benefits of repairing and operating SALT is the development of a culture of astronomical technology associated with SALT. People with front rank skills are employed at SALT and provided adequate resources are provided, this infrastructure will be maintained into the future.

SALT II: Whether or not it is possible to realise the above ambitions in regard to the existing SALT is not clear. Another possible platform is the development of a SALT II. Such a facility should have a larger aperture than SALT I, probably at least 16-20 m. It should have all the capabilities outlined in the bulleted list above. Of course, considerable resources will be needed to turn such a telescope into reality.

As for scientific emphasis, there is no doubt that many large and/or focused surveys have been very effective and are important parts of the astronomical landscape. However, there are reasons to be cautious about converting SALT predominantly into a survey engine. First, this growing trend, at least in North America, will soon leave the community with very few publically available OIR options for general purpose flexible observing. A near total reliance on targeted experiments may lead to more groupthink and less innovative follow-up. Second, there is the practical limitation of organizing so many disparate partners and scientific interests into large-scale programs. The more successful approach likely will be moderate scale experiments that come with funding, either through the coordination of the observing time of one or two partners or through a dedicated funding stream through a national agency or a private foundation. LSST is heavily discussed everywhere by everyone.

In addition there are other exiting new surveys on the horizon. One example is LIGO-Virgo. The smallest positional errors for gravitational wave sources will occur in the southern Indian Ocean and over North America, making SALT well positioned for follow-up, particularly in collaboration with North American facilities.

A Wider Field of View

While the synergy with the wide field of view of MeerKAT (and, subsequently, the SKA) and, potentially, LSST, achieving a 30 arcmin field of view (FoV) on SALT will be difficult, if not impossible. The VIRUS instrument on HET required an entirely new spherical aberration corrector (SAC) design, and only achieved a 20 arcminute FoV. Even that has not yet been successfully manufactured. This system has pushed the FoV to as large as possible and stopped there due to the growing complexity and size of the required SAC mirrors. The total HETDEX project is $40M (which may include the 5-year survey too). Before considering such a costly upgrade for SALT, a study should be done on designing a fully steerable SALT II telescope. This may prove to be the most economic option for a wide field telescope that is not limited by short track times.

In general, the discussion of radically re-engineering the telescope and instruments at first thought seems somewhat challenging to Wisconsin. That will take the bulk of the 10-year period, during which we may have a large opportunity cost by not being able to use the existing instruments. The current & upcoming instrument suite has a lot of unusual, if not unique, capabilities for a telescope of this size. Rather than spend many tens of millions of dollars to radically alter the telescope (e.g, the VIRUS system), why not invest a small fraction of that into making the current system and instruments work really well?

ADDRESSING GAPS

Non-steerable telescope

It is a REAL impediment to productivity to spend only 1 hour or so on any given target, and more importantly, to have to wait for a target to get into the accessible zone. This has a HUGE impact on effectiveness. The only feasible option seems to be azimuth steering plus limited elevation steering. The Tracker would no longer be required, increasing reliability as this sub-system is arguably the most complex of all sub-systems on the telescope.

Such a modification to the telescope would probably require:

- A new azimuth drive that will be installed on top of the pier and be accurate enough the rotate the struture at the required tracking speeds.
- Elevation steering between the current elevation of the telescope and the zenith.
- The azimuth drive will have to bear the weight of the new elevation drive. The pier is the structure originally designed to take the telescope load.
- It will require substantial modifications to the structure (to stiffen it up), dome (to allow light to enter from the zenith) and shutter.
- The dome and shutter will have to be of a completely new design. The sheer size of the aperture required during elevation may require a dome that is able to split in 2 halves. This means that the dome will have to be removed and the new dome and shutter fitted in the process.
- The dome and shutter may become substantially heavier. The effects of the heavier dome on the telescope building will have to be analyzed to determine if the building must be strengthened and/or stiffened up.

- Many effects on the current optics, instruments, components, segments etc will have to be studied. For instance, the capabilities of the new SAMS to keep the mirror alignedduring elevation will have to be determined.

The upside will be that this would give access to objects from the lowest edge of the current annular zone of accessibility with the inner currently excluded region all now becoming accessible (filling in the so-called “toilet ring”). In addition, the full aperture of the primary mirror would always be used; there would no longer be a moving pupil.

Summary:

- A study to determine the implications of modifying the current telescope to allow limited elevation steering and full azimuth steering.
- The cost of a detailed feasibility study that will devise a workable concept, detailed costing and schedule will be R1-2,5million, depending on the level of detail investigated.
- This modification will give access to objects from the lowest edge of the current annular zone of accessibility with the inner currently excluded region all now becoming accessible (in effect filling in the so-called observable “toilet ring”), as well as always using the full aperture of the primary mirror. The Tracker would no longer be required.

Smart Focal Planes

With the current multi-object spectroscopy limited to about 50 slitlets, it is clear that this is grossly inadequate for a modern 10-m class telescope. Integral field units (IFU), hundreds or thousands of fibers, image slicers and lenslet arrays for focal plane slicing are the norm. SALT needs to acquire expertise and capability in two specific areas:

1. Positioning of fibers / IFUs at its focal stations
2. Construction and optimal usage of fibers, IFUs and the like

Such work will require a mechanical and electronic engineer, as well as an instrumentation scientist, to survey what is currently available, and come forward with the most cost-effective scheme with the biggest scientific impact. It is estimated that this would require R1.0-R1.5 million spread across 1 or 2 financial years.

Humidity Control

The telescope has suffered from fogging over of its mirror in the past due to lack of humidity control in the dome. The same humidity requires of the night operations team to close the shutter and therefore shortens observing time.

It is proposed that industrial de-humidifiers, or modifications to the current air-handling units, be investigated and installed to mitigate this situation as best possible. A specialist consultant will be contracted to conduct the feasibility study. A previous amount of R50k has been allocated for such a study but that study has not been commissioned yet due to higher immediate priorities on operations and projects. If found to be feasible, such an installation can cost as much as R1m.

Humidity sensors must be installed in various locations on the tracker, near instruments and the

primary mirror. Surface temperature measurements are required to determine the dew point delta. The impact will be that the dome can be kept open for longer and it will have a positive impact on time on sky.

Software

Two extra software FTEs are required for many tasks relating to improving and extending the telescope control system as well as providing dedicated support to instrument software. Communication between for example the TCS and subsystems is currently HTTP-based and while generally reliable, can be improved by new technology becoming available on the market (e.g. EtherCAT and Data-Distribution-Service). Alternatives for the current control system-architecture can be researched and implemented. This will result in better user interface handling and reliability and can be ported on operating systems such as Linux.

A feasibility study will have to be launched to determine the costs and man hours for these improvements. The impact will be on better support of current operations, instruments and new developments and modifications over a wide spectrum of issues.

RSS Guider

We desperately need a new RSS guider. The HRS guider (built 18 months ago) registers 8 times more light than the RSS guider (the RSS guider uses a coherent fiber bundle which was a serious design mistake made 12 yrs ago). Many programs are severely compromised when there are no guide stars bright enough. ALL multi-object spectroscsopy programs are compromised because of the lack of rho guiding (which the RSS guider can't do).

• New Star Tracker System for faster pointings / for reducing the overhead

A feasibility study will have to be launched to estimate the cost and schedule for the development of a new RSS guidance probe. It is well known that the current probe suffers from slow movement, and is not accurate enough to be used for sub-arcsecond offsets and blind pointing. Its main drawback, however, is low throughput, which prevents focus control and limits its use to bright guide stars. The new probe will be based on the FIF guider with a much-improved throughput and be fitted with an autofocus mode. The feasibility of including a second probe can be studied, which will allow for rho compensation.

The manpower for this project cannot be spared from the current FTEs.

SAC Reflectivity Restoration and Maintenance

During the image quality repair, it was possible to clean three of the four SAC mirrors. There is, however, some evidence from telescope throughput tests analysed by Petri that the SAC throughput is declining. At the time of the cleaning of M5, it was apparent after cleaning that many pinholes and other minor damage to the coating remained. How can this be addressed:

- A spare SAC is clearly unaffordable (the original cost over one million euros)
- Accepting telescope downtime of 3-6 months would be painful and perhaps unacceptable. During this time, the SAC would be removed, and the mirrors be shipped overseas for recoating, followed by re-integration, re-alignment and re-installation.
- These possibilities may not be needed if a lower scope of work were accepted. For example,

it is likely that the downward looking mirrors M2 and M4 are in good condition. M5 is likely to be the major problem, with M3 second priority. It may be possible to remove these mirrors from the telescope and clean them again.

- All the above solutions would be temporary as dirt would build up again. A permanent solution would involve procuring a new M5. With a new coating on it, and a slightly altered prescription, it may be possible to seal the SAC with fused silica windows, a strategy followed by HET in their new Wide Field Corrector.

The cost will have to be determined depending on the chosen final solution

RSS Collimator

There remains a large throughput gain in the RSS collimator (typically 15 per cent, *far* more in the UV) to be had if the R1.7M can be found to fund the optomechanical mounting and installation of the already fabricated and coated doublet and triplet lens elements.

8.4 Optimise Operations: science productivity maximized, downtime minimized

We still need to better understand SALT's technical limitations with the key question being whether SALT can operate as a significantly more efficient observatory (e.g. much faster set ups, stable calibrations, etc.) that will compete with, say, 6.5-m and larger aperture telescopes. The near-term (3 year) strategic goal should be to understand what combination of instruments and observing modes will yield the most efficient operations. In other words, we should be looking at what SALT can do best and asking how to craft an effort to make use of this in the coming years, rather than building a general science case. We have a specialized telescope that seems to have potential to do some projects very well, not a general-purpose large aperture telescope. In thinking on these terms, it is good to consider where we can produce competitive quantitative results. We should be willing to rethink our plans for further instrumenting SALT in order to get out of our current state. For example, can we take advantage of fiber optics to overcome some of SALT's problems and to provide a more efficient operations? Are there ways to enhance our queue system that seems close to but not quite working? What have we missed?

The focus of the partnership must be on maximizing the performance and scientific output of SALT, perhaps through modest investments that would improve its operational efficiency and mitigate the marginal seeing of the Sutherland site. Achieving these twin goals would leave SALT in an excellent position to take advantage of some, but not all, of the scientific opportunities created by the suite of new and soon-to-be built facilities both on the ground and in space.

SALTs future is inexorably dependent upon the successful completion of five major initiatives: implementing SAMS; fixing the RSS throughput; upgrading the tracker; completing and commissioning the NIR spectrograph; and, perhaps most critically, completing a full pipeline for data calibration and analysis. Without these, SALTs future will be highly uncertain.

The primary aim is to improve the telescope efficiency, improve throughput and reduce downtime.

Payload

An integrated study and proposal was put together in 2013 to address most of the payload problems. It was found that some modifications could be done in situ and those have been done. Some were done during the RSS Throughput Repair during September and October 2014, but others need the payload to be taken down from the tracker.

The payload suffers from the following deficiencies:

DEFICIENCY	IMPACT OF SOLVING IT
1. Requirement to re-home fold mirrors / pellicle during operations	Improve on-sky efficiency and remove the requirement to do some of the rehoming at rho stage at zero degrees.
2. Slow movement of the fold mirrors / pellicle reduces efficiency	Improve on-sky efficiency
3. Reliability of mechanisms and the software control system. Failures at these levels include firmware lock-ups on the guidance camera, as well as sporadic communications failures with various internal subsystems	Minimise downtime.
4. Accessibility / Maintainability – difficulty performing maintenance and repair operations	Reduce downtime due to better access for fault finding and in-situ maintenance. Some current inaccessible devices can be reached (e.g. RSS autoguider)
5. Obsolescence – the need to pre-emptively replace parts that are no longer available	Reduce downtime and ensure continued operations

The impact of these modifications will be more time on sky due to fewer problems with electromechanical glitches and breakdowns and more time for the software team to focus on improving and extending the control system.

Emphasis on Efficiency

The emphasis on efficiency is well placed. The short time span for most tracks puts a major premium on this, and it is currently one of SALTs weaknesses. Its worth pausing to remember that SALT already has a remarkable operational efficiency: the ability to switch so quickly between many different instruments and modes is envious. The target acquisition time is a real problem. Rather than re-engineer the telescope at great expense, how about much cheaper hardware and software solutions? For example, WIYN recently successfully implemented a Star Tracker-like system using off-the-shelf hardware and software (Rajagopal et al., Improving the WIYN Telescopes Pointing and Tracking Performance with a Star Tracker Camera, Proc. SPIE 9152, 91521Z, 18 July 2014) for low cost and modest effort. It saved a large, expensive, time consuming, and uncertain direct engineering solution to the pointing issues. With a similar system on SALT, along with predictive guide star acquisition, the guider could be pre-positioned along with instrument reconfiguration during slew. In fact, with a second Star Tracker camera with a narrower field of view and more precision once the primary pointing is known, it may be possible to perform final target acquisition for spectroscopy, including blind offsets, automatically and without a setup pre-image. This, combined with improved queue management software, should reduce overheads to near the minimum imposed by slew and settling times.

Calibration of the instruments and their various modes is fundamental. This deserves very strong support in terms of personnel and funding to take the necessary calibration data, perform the necessarily modeling (e.g., Ken Nordsieck), make hardware changes (e.g., the proposed scrambling fiber system) and incorporate these into an effective and relatively easy to use pipeline.

A list of possible projects has been given:

1. Humidity control will prevent mirror and instrument fogging. It may also lengthen shutter open time.
2. Payload improvements will improve science efficiency and reduce down time.
3. Enhancing Science output. This would have the potential to decrease the time between receiving data and eventual publication
4. Software and communication improvements will have far reaching positive impacts on almost all telescope systems.
5. SAC reflectivity restoration and maintenance would enhance the light throughput of the telescope.
6. Smart Focal Plane development would enable the scientific effectiveness of existing and future instruments to be greatly increased.
7. A revamp of the entire telescope involving removing the need for a tracker (and moving pupil) by installing an elevation drive of limited range, along with an enhanced azimuth drive, would give the telescope a step change in operational effectiveness.

8.5 Use SALT for Human Capital Development: graduate student training, outreach to undergrads & schools, general public

9. Key Strategies/Initiatives

[These are actions that will lead to achievement of your objectives, often taking the form of **projects** or **programs**]

10. Measures (KPI(s), Timeline and Deliverables)

[These are objective, quantifiable methods for measuring success. Indicators and monitors of success. It includes; performance measurement, initiatives and projects and action plans.]

[Each Initiative has a supporting Action Plan(s) attached to it. Action Plans are geared toward operations, procedures, and processes They describe who does what, when it will be completed, and how the organization knows when steps are completed Like Initiatives; Action Plans require the monitoring of progress on Objectives, for which measures are needed]

Where we are	*Where we want to be*	*How we will do it*	*How are we doing*
Assessment	**Baseline**	**Components**	**Down to Specifics**	**Evaluate**
• *Environmental Scan*	• *Situation – Past, Present and Future*	• *Mission & Vision*	• *Performance Measurement*	• *Performance Management*
• *Background Information*	• *Significant Issues*	• *Values / Guiding Principles*	• *Targets / Standards of Performance*	• *Review Progress – Balanced Scorecard*
• *Situational Analysis*	• *Align / Fit with Capabilities*	• *Key Objectives*	• *Initiatives and Projects*	• *Take Corrective Actions*
• *SWOT – Strength's, Weaknesses, Opportunities, Threats*	• *Gaps*		• *Action Plans*	• *Feedback upstream – revise plans*