

# 2019 PROGRAM OPERATING PLAN OF THE GEMINI OBSERVATORY



## Table of Contents

<b>1. INTRODUCTION .....</b>	<b>4</b>
1.1. OVERVIEW OF GEMINI OBSERVATORY AND ITS FY19 PLANS .....	4
1.2. GEMMA: GEMINI IN THE ERA OF MULTI-MESSENGER ASTRONOMY.....	5
1.3. BALANCED SCORECARD PLANNING METHODOLOGY.....	5
1.4. TRANSITION TO NCOA.....	9
<b>2. OVERVIEW OF FY19 FINANCIAL &amp; STAFFING PLANS .....</b>	<b>10</b>
<b>3. DIRECTORATE.....</b>	<b>12</b>
3.1. INTERNSHIPS .....	13
3.2. SCIENCE RESEARCH .....	13
3.3. DIVERSITY AND INCLUSION .....	13
<b>4. SCIENCE AND ENGINEERING OPERATIONS.....</b>	<b>14</b>
4.1. REGULAR OPERATIONS.....	14
4.2. INFORMATION TECHNOLOGY SERVICES (ITS).....	16
4.3. SOFTWARE .....	16
4.4. OCS UPGRADE PROGRAM.....	17
4.5. GEMMA: TIME DOMAIN ASTRONOMY SOFTWARE .....	19
4.6. LONGEVITY.....	19
4.7. OTHER MAINTENANCE & RENEWAL .....	21
<b>5. SCIENCE USER SUPPORT .....</b>	<b>22</b>
5.1. DRAGONS (DATA REDUCTION FOR ASTRONOMY FROM GEMINI OBSERVATORY NORTH AND SOUTH) .....	22
5.2. PYGACQ: DEVELOPMENT OF A PYTHON VERSION OF THE GEMINI ACQUISITION TOOL.....	23
<b>6. INSTRUMENTATION AND FACILITY DEVELOPMENT.....</b>	<b>23</b>
6.1. GHOST .....	24
6.2. SCORPIO .....	24
6.3. GPI RELOCATION TO GEMINI NORTH.....	24
6.4. INSTRUMENT UPGRADE PROGRAM .....	25
6.5. GEMS.....	25
6.6. IR DETECTOR CONTROLLER .....	25
6.7. GEMMA: GNAO & RTC .....	25
6.8. GNAOI .....	26
6.9. IGRINS-2 .....	26
6.10. VISITOR INSTRUMENTS.....	27
<b>7. SAFETY .....</b>	<b>29</b>
<b>8. ADMINISTRATION &amp; FACILITIES.....</b>	<b>31</b>
8.1. BUDGETARY RESPONSIBILITY.....	31
8.2. BUSINESS SERVICES.....	31
8.3. BUSINESS SYSTEMS.....	31
8.4. FACILITIES SERVICES.....	32
<b>9. PUBLIC INFORMATION AND OUTREACH (PIO) .....</b>	<b>33</b>
9.1. DIGITAL GOVERNANCE IMPLEMENTATION .....	33
9.2. CREATION OF A NEW PUBLIC WEBSITE .....	33
9.3. SUPPORT OF JULY 2019 TOTAL SOLAR ECLIPSE IN CHILE .....	34
9.4. GEMMA: PUBLIC INFORMATION AND OUTREACH .....	34
<b>10. RISK REGISTER.....</b>	<b>35</b>

10.1.	METHODOLOGY .....	35
10.2.	GEMINI OBSERVATORY RISKS.....	36
<b>APPENDIX A: TENETS OF GEMINI WORKING CULTURE .....</b>		<b>37</b>
<b>APPENDIX B: ORGANIZATIONAL CHART .....</b>		<b>38</b>
<b>APPENDIX C: ACRONYMS.....</b>		<b>39</b>

# 1. Introduction

## 1.1. Overview of Gemini Observatory and its FY19 Plans

Gemini Observatory is an international partnership, comprised of Full Participants and Limited-Term Collaborators, operating twin 8-meter optical-infrared telescopes in Chile and Hawai'i.

Gemini's mission is:

*To advance our knowledge of the Universe by providing the international Gemini Community with forefront access to the entire sky.*

In 2019 Gemini's Full Participants are the United States, Canada, Chile, Brazil, Argentina, Korea and the University of Hawai'i (site host). Additionally, Gemini is working with several Limited-Term Collaborators, including Ben-Gurion University, and the Weizmann Institute. The operations and maintenance of the Observatory is managed by the Association of Universities for Research in Astronomy, Inc. (AURA) through a cooperative agreement with the National Science Foundation (NSF). The NSF acts as the Executive Agency on behalf of the international partners.

In this 2019 Program Operations Plan (POP), we present Gemini's planned principal activities for 2019. Gemini, in 2019, will continue to enable our user community's science by providing optical/infrared access with forefront instruments to the entire sky. We achieve this by making operations and maintenance our highest priority, while also spending significant effort on instrumentation and facility development in order to ensure Gemini remains competitive into the future. In 2019 Gemini will operate at a staffing level of 171.8 FTE integrated across the calendar year.

In addition to regular operations in 2019, Gemini has numerous projects to maintain its competitiveness, support its users, and provide increased capabilities to users. These include launching the design and construction of a major new Adaptive Optics (AO) facility for Gemini North under a separate NSF funding award and continued work on two new instruments, GHOST and SCORPIO. Gemini will host visits by several existing and new visiting instruments, providing additional unique capabilities to users beyond the suite of facility instruments. These and other projects are described in more detail in this report.

In previous years Gemini budgeted and operated on a calendar year basis (Jan-Dec). As part of Gemini's transition to NCOA in 2019 Gemini is transitioning its budgeting and planning calendars to the fiscal year (Oct-Sep). To accomplish this transition, Gemini is planning a 9-month FY19 covering January to September of 2019. This document presents Gemini's FY19Q2 (Jan-Mar), FY19Q3 (Apr-Jun), and FY19Q4 (Jul-Sep). FY19Q1 (Oct-Dec 2018) was covered in Gemini's calendar year 2018 plan and budget.

The most significant change coming to Gemini Observatory in 2019 is the planned transition to operating as part of the new National Center for Optical-Infrared Astronomy (NCOA), which combines the operations of Gemini Observatory, National Optical Astronomy Observatories (NOAO), and the future operations of the Large Synoptic Survey Telescope (LSST). However, many details of how Gemini will manage its transition to NCOA can only be defined once the NSF gives formal approval to proceed to implementation and provides directives to AURA regarding the implementation details and timeline. Once formal approval is obtained (expected in early 2019) and any additional directives are known, Gemini will present to the NSF its plans for the transition to NCOA.

Finally, fiscal responsibility remains critical to Gemini’s efficient operations and development of future enhanced capabilities. In 2019 Gemini will manage its spending to stay within -2%; +3% of the approved O&M 2019 Budget (\$22.88M for the 9-month FY19 of Jan-Sep 2019; when combined with final calendar quarter of 2018 for Gemini, this represents a Board approved spending authority of \$29.69M for the full 12-month FY19).

### **1.2. GEMMA: Gemini in the Era of Multi-Messenger Astronomy**

Gemini has received additional funding from the NSF under the award “Gemini Observatory in the Era of Multi-Messenger Astronomy: High Image Quality and Rapid Response to Cosmic Events” (NSF AST-1839225), in the following referred to as the GEMMA program. The funding is handled through a new Cooperative Support Agreement (CSA) between AURA and the NSF and runs over six years (FY2019-FY2024). The GEMMA program consists of four projects as follows:

- GNAO: A multi-conjugate AO system for Gemini North providing a 2 arcmin diameter AO corrected field to all facility instruments
- RTC: A common real-time computer platform for GeMS and GNAO that is extensible to other Gemini AO systems
- TDA: Gemini in the Time Domain Network, enabling Gemini’s participation and leadership in follow-up observations from discoveries from LIGO, LSST and other time domain alerts
- PIO effort for multi-messenger astronomy leading to development of planetarium programming as well as education for science communicators and media

The projects, their plans and milestones for FY2019 are briefly described in Sections 4.5 (TDA), 6.7 (GNAO & RTC), and 9.4 (PIO effort). As required by the CSA covering the award, Gemini will submit a detailed Program Execution Plan (PEP) to NSF by January 1, 2019.

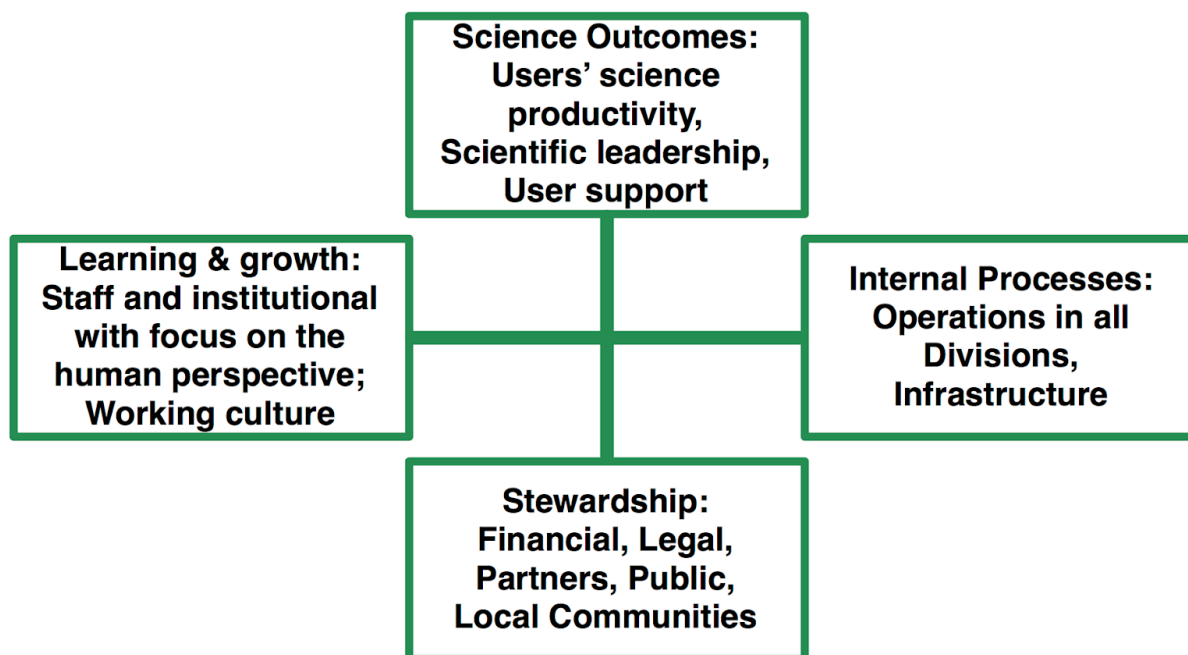
### **1.3. Balanced Scorecard Planning Methodology**

For the evaluation of benefits, we use the framework of a Balanced Scorecard<sup>1</sup> (Figure 2.1, Table 2.1) customized for our use to evaluate the benefits of proposed activities.

---

<sup>1</sup> In depth description of Balanced Scorecards as used in non-profit organizations: Paul R. Niven: “*Balanced Scorecard step-by-step for government and nonprofit agencies*”, Second edition, 2008, John Wiley & Sons, Inc.





**Figure 2.1: Conceptual view of the Balanced Scorecard for strategic planning and evaluating the benefits of proposed activities.**

**Table 2.1: Descriptions of perspectives in the Balanced Scorecard**

#	Perspective	Description	Weight
P1	Science Outcomes	Covers users' science productivity, scientific leadership, as well as user support. The emphasis is on Science outcomes from Gemini.	0.4
P2	Internal Processes	Covers the perspective of our internal processes in all divisions. A process is considered internal if it does not directly affect our users.	0.2
P3	Learning and Growth	Covers the perspective of staff and institutional growth and learning, with focus on humans. Covers the working culture.	0.2
P4	Stewardship	Covers financial and legal perspectives, including efficient use of funding. Covers stewardship from the perspective of partners, the public and the local communities.	0.2

In 2016 the Directorate committed the Observatory to work towards the following strategic objectives for the 5-year period 2017-2021:

- A. Remain scientifically relevant beyond 2025 by joining a long-lived structure and by renewing and upgrading the facility
- B. By 2021, be the best 8m-class observatory for flexible, innovative, and efficient science programs
- C. Be a model organization for diversity in the STEM workforce and inspire others

Figure 2.2 shows how the strategic objectives and associated programs map to the Balanced Scorecard.

In Table 2.2 we map the FY2019 Programs, projects and Operations activities to the Strategic Objectives and the Balanced Scorecard.

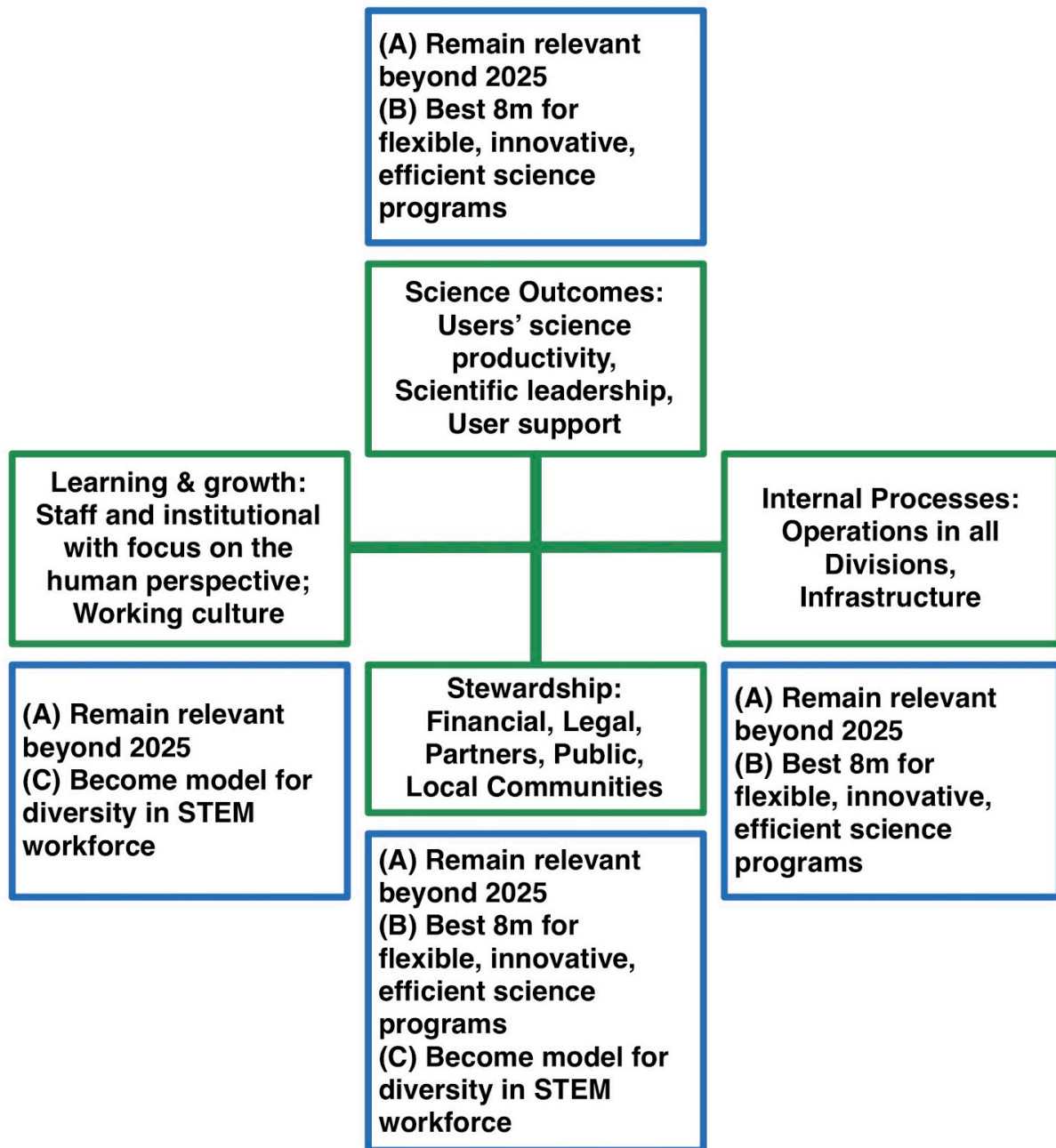


Figure 2.2: The strategic objectives and associated programs mapped to the Balanced Scorecard.

**Table 2.2: Mapping the FY2019 Programs, projects and Operations activities to the Strategic Objectives and the Balanced Scorecard.**

Strategic Objective	Balanced Scorecard Perspective	POP19 Section	Activity
A	P3,P4	1.4	Transition to NCOA
A,B	P1,P4	3, 5, 9	Presence & Participation at Partner Annual/User Meetings (Directorate, SUSL, PIO)
	P4	3, 8	FY20 Budget & POP Preparation
C	P4	3.1	Internship program
	P1,P3	3.2	Science Research by staff members
	P1	4.1	Regular Nightly Operations
	P1	4.1	Semester Proposal Process & Scheduling
B	P1	4.1	Large & Long Programs
B	P1	4.1	Fast Turnaround
A	P1	4.1	Commission F2-MOS mode
	P2	4.2	IT service improvements and cyber security enhancements
B	P2	4.3	Software: Operations Software Releases
A,B	P1	4.3	Software: Instrumentation Support
A	P2	4.3	Software Obsolescence Mitigation upgrades
A	P1,P2	4.4	OCS Upgrade Program
B	P1	4.5	Gemini in the Time Domain Network
A	P2	4.6	Longevity Program
A	P2	4.7	Maintenance and Renewal: GN coating chamber upgrade, GN M1 recoat, GS compressor upgrade, GeMS 3-person Operations
A	P1	5.1	DRAGONS Science quality imaging for Users
A	P1	5.2	PyGacq: Python Acquisition Tool
A,B	P1,P4	5	SUSL: User Committee and OpsWG Meetings



B	P1	6.1	GHOST
B	P1	6.2	SCORPIO
B	P1	6.3	GPI relocation
B	P1	6.10	Visitor Instrument Program
A	P1	6.4, 6.5, 6.6	Instrument Program Upgrade, GeMS NGS2, IR Detector Controller
B	P1	6.7	GNAO, RTC
A	P1	6.8	GNAOI
A,B	P1	6.9	IGRINS-2
A	P2,P3	7	Safety Projects & Trainings
	P4	8	Quarterly/Annual Budget & Progress reporting processes
	P4	9	PIO Activities
	P1	9.2	New Public Website
	P4	9.3	Support of July 2019 Total Solar Eclipse Chile

#### 1.4. Transition to NCOA

In 2019 Gemini Observatory continues to plan and prepare for the launch of the National Center for Optical-Infrared Astronomy (NCOA). NCOA is a new entity, bringing together Gemini Observatory, National Optical Astronomy Observatory (NOAO), and Large Synoptic Survey Telescope (LSST) operations into a new management structure. NCOA is planned to be a dynamic, flexible, agile organization that will respond appropriately as community research aspirations evolve with time. NCOA is designed to integrate, into a single matrixed structure, Gemini, NOAO, and the future operations of the LSST. By sharing operational, technical, and scientific expertise across its centers, NCOA will enable Gemini to maximize its scientific output and impact.

Within this new structure, Gemini Observatory remains an international entity with autonomous governance and funding, continuing to be governed by its International Agreement and the Gemini Board. The Gemini Board retains full authority and responsibility for all strategic, financial, and programmatic matters related to Gemini's operations, maintenance, and development. Further, the funding streams of the components of NCOA (Gemini, LSST Operations, MSO and CSDC) remain separate and will be fully accounted for; by NSF mandate, no Gemini funds can be used for activities that do not benefit Gemini.

Pending NSF approval, NCOA is expected to begin as an organization on 2019 October 1 (i.e., at the end of the period covered by this Program Operations Plan). The transition to NCOA will take several years following formal launch of the organization. A detailed plan for transitioning LSST Operations, Gemini,

and NOAO is the subject of an independent proposal submitted to the NSF by AURA. The award made in response to that proposal led to an associated program operating plan for NCOA Transition activity in FY19. Some senior managers in Gemini are expected to contribute time to that effort. The present Gemini FY19 POP covers all activity to be accomplished by Gemini Partnership funding. NCOA planning activity is not included in the Gemini FY19 POP.

## 2. Overview of FY19 Financial & Staffing Plans

Since inception, Gemini Observatory has based its financial year (FY) on a calendar year (CY) (January to December) basis, for budgeting and reporting purposes. The calendar year aligns with the majority of the Partners' financial year, while other Partners have a different 12-month cycle for their financial year. In pursuit of aligning the fiscal year of Gemini with that of the Management Organization for the Observatory (AURA) and with the fiscal year of the Executive Organization (National Science Foundation) in May, 2018 the Board approved our request to change to a fiscal year that will run from October 1st in any one year to September 30, in the year immediately following.

A key financial target is that the FY2019 budget does not exceed Gemini 2019 partners' contributions. An added key target is to guarantee that FY2019 O&M spending does not overrun Gemini Observatory management spending authority. Table 2.1 presents FY2019 spending authority approved by the Gemini Board in its Resolution 2018.B.5. O&M's budget targets for FY2019 (Oct 2018 to Sep 2019) are represented in Table 2.2.

**Table 2.1: Gemini Board Approved Spending Authority FY2019**

	US \$
Operations and Maintenance (Oct 1, 2018 – Sep 30, 2019)	29,693,712
Operations and Maintenance (Jan 1, 2019 – Sep 30, 2019)	22,876,817
Instrument Development Fund (Jan 1, 2019 – Sep 30, 2019)	6,481,000
Total (Jan 1, 2019 – Sep 30, 2019)	29,357,817

**Table 2.2: FY2019 Budget Overview**

	FY 2019
WAGE & BENEFITS	19,469,515
PERMANENT EQUIPMENT	1,210,235
TRAVEL	1,289,186
OTHER DIRECT COSTS	5,154,461
INDIRECT COSTS	2,570,314
<b>TOTAL EXPENSE</b>	<b>29,693,712</b>
<b>CY 2019 PARTNERS' CONTRIBUTIONS</b>	<b>29,389,492</b>
<b>CY 2019 CONTRIBUTIONS VS FY2019 EXPENSES \$</b>	<b>(304,220)</b>
<b>CY 2019 CONTRIBUTIONS VS FY2019 EXPENSES %</b>	<b>-1.02%</b>

Gemini aims at requesting funds for FY2019 O&M budget that do not exceed Gemini partners' contributions for CY2019. The next table presents a set of potential FY19 budget adjustments that are likely to occur throughout the fiscal year, but that due to the risk associated with uncertainty of these values, in Table 2.3 we are reporting them as "upsides" that may reduce Gemini O&M FY2019 budget request.

**Table 2.3: Anticipated potential budget adjustments**

	FY2019 Budget Overrun / (Underspending)	FY2019 budget Adjustment	Comments
<b>TOTAL OVER-BUDGET</b>	<b>304,220</b>		
Front loaded items		269,540	FY2019 O&M front loaded spending is funded with CY2019 contributions
Potential labor cost reduction due to increasing CLP rate in FY2019		143,000	Factor CLP FX rate variance: Budget rate = CLP 600 per USD, FY2019 expected rate = CLP 630 per USD
Labor charges to the GEMMA CSA award		226,653	Factor in FY2019 labor costs of 2 Gemini O&M FTEs (average) to be crossed charged to GEMMA CSA's accounts.
Potential reduction of FY19 travel budget		33,158	O&M Jan-Sep 2019 travel budget adjustment agreed with the Observatory Directorate on 10/31/18
<b>TOTAL BUDGET ADJUSTMENTS</b>		<b>672,351</b>	
<b>Potential FY 2019 Budget Overage (Savings)</b>	<b>(368,131)</b>		

Table 2.4 presents the IDF 2019 spending plan by IDF project. The bulk of these funds are spent on external contracts and procurements and therefore vary significantly quarter to quarter.

**Table 2.4: 2019 IDF spending plan**

IDF (USD\$)	2FQ-19	3FQ-19	4FQ-19	FY 2019
GI1320001 Instr. Prog. Support and Maint.	8,250	8,250	53,250	<b>69,750</b>
GI1320300 GHOST	1,087,326	550,000	162,000	<b>1,799,326</b>
GI1320301 GHOST – Internal	55,996	104,699	53,449	<b>214,144</b>
GI1322000 Instrument Upgrades	39,450	170,828	57,971	<b>268,249</b>
GI1323000 AO upgrades (ALTAIR, Canopus)		55,924		<b>55,924</b>
GI1335000 Visiting Instrument Program	9,956	5,534		<b>15,490</b>
GI2320010 GNIRS Detector Controller	20,959	5,000	10,457	<b>36,416</b>
GI2330330 SCORPIO	32,708	1,947,708	1,932,708	<b>3,913,124</b>
GI2330331 SCORPIO Internal	39,322	12,403	25,903	<b>77,628</b>
GI2330540 GEN5#1				
GI2330541 GEN5#1 Internal				
<b>TOTAL IDF</b>	<b>1,293,967</b>	<b>2,860,346</b>	<b>2,295,738</b>	<b>6,450,051</b>

The staffing plan presented in Table 2.5 shows total labor units of 171.8 FTEs integrated over the twelve months of the fiscal year 2019 (FY2019).

**Table 2.5: Staffing Plan**

Directorship	Department	Location	FY2018	FY2019	FY2020
<b>ADMINISTRATION</b>	ACCOUNTING	HI	2.00	2.00	2.00
	ADMIN & FACIL-GEN	CH	6.00	6.00	6.00
	ADMIN & FACIL-GEN	HI	6.00	6.00	6.00
<b>ADMINISTRATION Total</b>			<b>14.00</b>	<b>14.00</b>	<b>14.00</b>
<b>DEVELOPMENT</b>	ADAPTIVE OPTICS	CH	3.94	4.00	4.00
	ADAPTIVE OPTICS	HI	3.00	3.67	3.00
	DEVELOPMENT/SYS ENG	CH	1.17	2.00	2.00
	DEVELOPMENT/SYS ENG	HI	3.00	3.00	3.00
	INSTRUMENTATION	CH	1.00	1.00	1.00
	INSTRUMENTATION	HI	2.50	2.50	2.00
<b>DEVELOPMENT Total</b>			<b>14.61</b>	<b>16.17</b>	<b>15.00</b>
<b>OPERATIONS</b>	ENGINEERING OPS	CH	22.50	22.00	22.00
	ENGINEERING OPS	HI	20.67	21.00	21.00
	INFORMATION TECHNOLOGY SERVICES	CH	5.00	5.00	5.00
	INFORMATION TECHNOLOGY SERVICES	HI	6.00	6.00	6.00
	SCIENCE OPS	CH	22.44	23.67	22.04
	SCIENCE OPS	HI	21.63	21.88	20.92
	SOFTWARE	CH	12.00	12.00	12.00
	SOFTWARE	HI	5.00	5.00	5.00
<b>OPERATIONS Total</b>			<b>115.24</b>	<b>116.54</b>	<b>113.96</b>
<b>DEPUTY DIR</b>	SAFETY	CH	1.00	1.00	1.00
	SAFETY	HI	1.33	1.00	1.00
<b>DEPUTY DIR Total</b>			<b>2.33</b>	<b>2.00</b>	<b>2.00</b>
<b>DIRECTORATE</b>	DIRECTORATE	CH	2.00	2.00	2.00
	DIRECTORATE	HI	7.00	6.13	6.00
<b>DIRECTORATE Total</b>			<b>9.00</b>	<b>8.13</b>	<b>8.00</b>
<b>HEOF SCIENCE</b>	PUBLIC INFO/OUTREACH	CH	2.50	2.50	2.50
	PUBLIC INFO/OUTREACH	HI	5.97	5.47	5.00
	SCIENCE USER SUPPORT	CH	3.00	4.00	4.00
	SCIENCE USER SUPPORT	HI	3.00	3.00	3.00
<b>HEOF SCIENCE Total</b>			<b>14.47</b>	<b>14.97</b>	<b>14.50</b>
<b>Grand Total</b>			<b>169.65</b>	<b>171.80</b>	<b>167.46</b>

### 3. Directorate

The Gemini Directorate, consisting of the Director, Deputy Director, Chief Scientist, Associate Directors, Chief Financial Officer, and Portfolio Manager, provides leadership, management, and budgetary control across Gemini Observatory. The Directorate is the primary interface of the Observatory to its governance committees, the Gemini Board, the STAC, and AURA's NCOA Management Oversight Council (NMOC). The Directorate meets with the Gemini Board and STAC at their twice per year meetings. The

Directorate leads the Observatory wide planning, budgeting, and reporting processes. The Directorate is responsible for implementing the strategic vision of the Board and STAC. In 2019 that means aligning Gemini activities with the new *Strategic Scientific Plan for Gemini Observatory* that was developed in response to the Gemini Board's *Beyond 2021: A Strategic Vision for Gemini Observatory*. The Directorate, in close coordination with Science User Support (Section 5) and Public Information & Outreach (Section 9), interacts with the Gemini user community by attending each of the Participant's major national astronomy meetings as well as other occasional meetings. The Gemini Directorate will work closely with the Gemini Board during the renegotiation of the International Agreement in 2019. The Gemini Directorate will lead the development of memoranda of understanding with any new limited-term collaborators. The Gemini Directorate will work with the Gemini Board to engage potential new full participants to the Gemini International Agreement.

### **3.1. Internships**

Gemini Observatory regularly hosts interns in every area of its operations, from administration to PIO to software to research. Interns are hired on hourly contracts for typically 4 month internships, with a maximum duration of 6 months except in exceptional situations. Interns gain valuable experience and also complete valued projects for the observatory. The number of interns hired in a given year varies some with the availability of funding, availability of projects, and availability of applicants well-matched to the available projects. As the internship program extends across every area of the observatory, responsibility for the program is held in the Directorate. In FY19 Gemini Observatory has budgeted for 11 interns across its operations and 4 internships to support staff research. Gemini Observatory participates in an MOU with the University of Victoria to jointly fund one intern per year in the New Technologies for Canadian Observatories program during the years 2018-2023. In addition, Gemini supports the Akamai internship program in Hawaii, at no cost to the Observatory.

### **3.2. Science Research**

The Gemini Observatory values the research activity and results of Gemini staff. Staff are engaged with the research community and regularly publish their work in the refereed literature and present at workshops and conferences. Responsibility for oversight of staff research is held in the Directorate with the Chief Scientist. Staff research time advances the Observatory mission by better connecting the staff with the needs and issues of Gemini users, by advancing initiatives in line with the Observatory's strategic goals, and by enabling the recruitment and retention of staff who have skills that the Observatory requires. Gemini supports staff initiatives to promote the research environment and culture at both sites. Staff research productivity is reviewed regularly through the Gemini Science Personnel Committee chaired by the Chief Scientist.

### **3.3. Diversity and Inclusion**

Gemini Observatory aspires to be a model organization for diversity in the STEM workforce and holds "Embracing our diversity and promoting an inclusive environment" as one of the tenets of its working culture (See Appendix A). The Directorate and hiring committees engage with Human Resources to ensure best practices are followed during hiring processes, including diversity in composition of hiring committees and frequent discussions of unconscious bias. At each site Gemini Observatory has appointed Diversity Advocates (two co-leads in Hawai'i and one lead in Chile who works closely with the CTIO Diversity Advocate). These Diversity Advocates work part time in addition to their regular duties to support diversity and inclusion activities across the Observatory. In recent years that has included organizing events such as a "Diversity Day" social event in Hilo and the hosting of meetings of AURA's Workforce and Diversity Committee. These Diversity Advocates meet with the Director and Deputy

Director monthly to discuss Diversity and Inclusion activities and issues. Additionally, in response to recent employee surveys, the Directorate holds informal meetings with each employee group across the observatory several times per year and a new mentoring program was established to pair willing mentors and mentees. In Chile an “ambassador” program exists to pair newly arrived ex-pat employees with an employee not in their direct reporting line to assist and advise the employee and their family. At Gemini North many managers attend a weekly Mastermind Leadership Group meeting to discuss issues of management and leadership that often directly touch on how Gemini Observatory ensures an inclusive workplace. A similar regular meeting for AURA managers in Chile, not just Gemini, is planned to start in 2019.

**Table 3.1: Milestones in Directorate**

Activity	FY2019		
	Q2	Q3	Q4
Gemini Governance Meetings		1	
AURA’s NCOA Management Oversight Council Meetings	2	3	
FY19 Annual Report			4
FY20 POP			5
Partner Annual Meetings <sup>9</sup>	6	7,8	
Milestones and major deliverables: <ol style="list-style-type: none"> <li>1. 2019B STAC, GFC, and Gemini Board meetings scheduled for May 2019</li> <li>2. 2019B NCOA Management Oversight Council (NMOC) meeting scheduled for January 2019</li> <li>3. 2019C NCOA Management Oversight Council (NMOC) meeting scheduled for May 2019</li> <li>4. Preparation and submission of FY19 Annual Report of Gemini Observatory</li> <li>5. Gemini Observatory’s FY20 POP will be a component of NCOA’s combined FY20 POP. This will be prepared and submitted in Q4</li> <li>6. Directorate representation at AAS &amp; leading a Gemini Observatory Open House evening event</li> <li>7. Directorate representation at CASCA 2019</li> <li>8. Directorate representation at Korean 2019 Annual Meeting</li> <li>9. Argentina, Brazil, and Chile are holding a combined 2019 LARIM meeting in November 2019, which is in FY20Q1</li> </ol>			

## 4. Science and Engineering Operations

Regular day-to-day and night-to-night Operations is the Observatory’s top priority. In addition to regular operations support, in 2019 Science and Engineering Operations will commence or continue several programs and projects to improve longer-term sustainability impact or to improve service to users. This section of the POP also includes details of the plans of the Information Technology Services (ITS) group and the Software group. Given the wide scope of programs and projects in this section of the POP, separate milestone tables are included for each sub-section.

### 4.1. Regular Operations

Regular day-to-day and night-to-night Operations includes the following items.

- Maintain the instruments and telescopes in working order consistent with the requested science time on sky; monitor performance and take remedial action as needed.
- Run the International Time Allocation Committee (ITAC) process to combine the national TAC results into an executable queue and visitor program consistent with available time, conditions, and instrumentation.
- Support the user community (in conjunction with the NGOs) in preparing their observations for the telescope.



- Provide web-based documentation suitable for PI reference on instrumentation, software and Observatory processes.
- Execute queue observing programs on behalf of the community as required; currently this equates to more than 80% of the observing.
- Support visiting observers in their execution of their own and others' programs on the telescopes.
- Ensure integrity of data (headers & quality control information) entering the Gemini Observatory Archive.
- Support visiting instruments as needed and as possible.
- Propose and execute continual improvements in instrumentation, telescope, and enclosure to maintain performance levels. In FY19 this includes final commissioning of the FLAMINGOS-2 Multi-Object Spectrograph (MOS) observing mode.
- Propose and execute continual improvements in operations software on behalf of the community and for internal usability, to maintain performance levels.
- Propose and execute continual improvements in operations processes on behalf of the user community, with guidance and input from the appropriate committees.
- Provide expertise and input to the Development Division in carrying out major enhancements of instrumentation.
- To ensure economical operations and a consistent interface with the user community, maintain approximate symmetry between the processes, equipment, and staffing at the two Gemini sites.

A regular system of preventive and corrective maintenance supports the first requirement of maintaining the instruments, telescopes, and enclosures in working order. Preventive maintenance is carried out at the summits on a regular schedule (daily, weekly, etc. depending on the system) using a system of work orders. More major items requiring additional staffing are handled by planning on a variety of timescales. A central list of major maintenance work is held by the Heads of Engineering Operations and is discussed weekly among engineering managers. Items are tracked according to progress or completion, and new needs are evaluated before adding to the list and determining a possible schedule.

**Table 4.1: Milestones for Regular Operations**

Activity	FY2019		
	Q2	Q3	Q4
Semester Proposals & Scheduling	1,2	3	4
Large & Long Program	5	6	7
Fast Turnaround	8	9	10
FLAMINGOS-2 Multi-Object Spectrograph (MOS) mode		11	12
Milestones and major deliverables: 1. 2019A semester starts 2. 2019B Call for Proposals released 3. 2019B ITAC meets & 2019B queue finalized 4. 2019B semester starts 5. 2019 LLP Letters of Intent deadline; LLP TAC formed based on submitted Letters of Intent 6. 2019 LLP Proposals deadline; LLP TAC meets; New LLP time awarded 7. 2019 LLP observations commence in semester 2019B 8. FT Proposal Process run every month 9. FT Proposal Process run every month 10. FT Proposal Process run every month 11. F2-MOS mode commissioned 12. F2-MOS mode released to Fast Turnaround proposals			

#### 4.2. Information Technology Services (ITS)

The Information Technology Services (ITS) department delivers and supports integrated IT services throughout Gemini, spanning two core functions; Business and Astronomy IT Operations. Both of these functions benefit from the combined use of enterprise-class IT infrastructure to deliver the required services as needed. ITS staff, therefore, provide a wide range of general services such as end-user support and system provisioning, software management, asset management, core network services, commercial and scientific Internet connectivity, telecommunications, video conferencing, remote access service, centralized system logging, centralized data storage, authentication administration and web architecture design and maintenance.

Leveraging the combination of the enterprise IT infrastructure, ITS staff also provide services dedicated to delivering the scientific output, including system redundancy provisioning, standardized system configuration, scientific data collection, control system network management, operational and scientific data storage management and backup services, operational system security management and oversight and system monitoring. Additionally, ITS provides development environments for computing systems that are deployed in a state of ongoing change, experimentation, proof-of-concept, or evaluation.

All of these services and systems are protected under a rigorously maintained cybersecurity framework including IT policy creation, vulnerability assessments, intrusion detection, patch management, user awareness training and network monitoring.

**Table 4.2: Milestones**

Activity	FY2019		
	Q2	Q3	Q4
Infrastructure Modifications		1	2
Cybersecurity Enhancements	3,4	5	
Service improvements		6,7	
Milestones and major deliverables: 1. RTEMS control traffic redesign and deployment 2. Supporting Facility and Visitor Instrument deployment 3. Federated authentication rollout (staff & visitor) 4. Cross subnet traffic-flow restriction 5. Automated end-point connectivity management services (Business and Astronomy) 6. External Helpdesk deployment 7. Video-Conference Room feature upgrades			

#### 4.3. Software

The Software group is part of Gemini Operations and provides software expertise to develop, sustain and maintain telescope and instrument software systems. The team focuses its effort in two main areas, namely real-time/control systems and high level software.

There are three basic activities that the software group performs:

1. **Maintenance:** These activities involves both corrective and preventive changes to correct discovered problems and modifications of systems to detect and correct latent faults before they become effective issues. Also, includes the changes necessary to keep the telescope software subsystems working when changes to the telescope systems are introduced.

2. Sustaining: Involves modifications to the software to improve performance, maintainability, extend life-cycle, and software activities targeted to lower the total cost of ownership of the software (compliance with coding standards, upgrade to newer development tools, refactoring activities, upgrade paths, capacity improvements, cross training, etc).
3. Development: Creation of new functionality and tools based on the observatory needs.

The software group is composed of a core of real-time/control and high-level staff programmers. These are trained professionals, but they feature widely differing skill sets. Real time programmers use different tools and solve different problems than the high-level programmers. Due to the nature of the systems and the problems the group addresses, the focus on each one of these activities varies from high-level to real-time activities. The real time activities have a greater maintenance orientation (as all the telescope systems and instruments development is outsourced) and have a big impact on telescope and instruments performance. The high-level work affects a wider audience (internal and external users) and emphasizes development to a greater extent. The high-level tools are developed in-house, as they are custom made to satisfy specific needs of the telescope operation and observing model.

Software leads and is involved with projects across Gemini Observatory in both operations and development, described throughout this POP in their relevant functional sections. Milestones for these projects are contained those sections, in particular in Sections 4.4 to 4.5.

**Table 4.3: Milestones in Software**

Activity	FY2019		
	Q2	Q3	Q4
Operations Software Releases	1	2,3	4
Instrumentation Support	5,6		7,8
Obsolescence mitigation upgrades		9	
Milestones and major deliverables: 1. Updated Phase 1 Tool released for 2019B Call for Proposals (March 2019) 2. Updated Observing Tool (OT) released (June 2019) 3. Updated ITAC support software released for 2019B (May 2019) 4. Updated Phase 1 Tool released for 2020A Call for Proposals (September 2019) 5. Support SCORPIO Critical Design Review 6. Support NGS2 integration to GeMS 7. Support final commissioning of GeMS NGS2 8. Support GHOST commissioning 9. Upgrade the A&G to RTEMS			

#### 4.4. OCS Upgrade Program

Building on recent high-level software projects, this program will upgrade the Observatory Control Systems (OCS) software tools used for proposal submission, program preparation, planning and execution. There are two main goals for this program:

1. Prepare Gemini for its role in the next decade as the prime facility for execution of flexible, innovative and efficient science programs.
2. Modernize the software infrastructure to enable Gemini to support and sustain these software systems in the future with the planned software staffing levels.

This program will collect input from all levels and roles of users and make an analysis of requirements from first principles. We do not intend to just write the current tools in a new environment. This system will replace the functionality of the current Phase I Tool (PIT), Observing Tool (OT), Sequence Executor (seqexec), Telescope Control Console (TCC) and Queue Planning Tool (QPT), creating a modern set of

applications for proposal submission, planning and execution. The software will be designed for scalability, ease of maintenance, and will be primarily web-based.

The plans for FY2019 include completing the Sequence Executor Upgrade and starting on the TCC Upgrade and the OCS Science Platform Project. Details for each are provided below. Closely related to these OCS Upgrades, in 2019 Gemini is embarking on a project to enable Gemini's participation and leadership in a Time Domain Network of telescopes to follow-up on discoveries from LIGO, LSST, and other sources of time domain astronomy alerts. This project is described in *Gemini in the Time Domain Network* in Section 4.5.

### Sequence Executor Upgrade

Gemini Observations are carried out at the telescope using the Telescope Control Console (TCC) and seqexec. This project provides a web-based, client server sequence executor, with the capability of running multiple sequences at the same time, and with the ability of having multiple clients connected at the same time. In addition, it creates the necessary software components to collect information that is generated during program execution, in particular execution events, that are used by tools like data manager and obslog.

The project is in progress and is expected to end at the end of FY2019Q3 (June 2019).

### TCC Upgrade

Gemini Observations are carried out at the telescope using the Telescope Control Console (TCC) and seqexec. This project provides a web-based, client server Telescope Operator Console, that replaces the existing Tcl/Tk based TCC.

### OCS Science Platform Project

The project provides a new system to support proposal submission, program preparation, planning and execution, along with the necessary infrastructure to support the rest of the projects in the OCS Upgrade Program.

**Table 4.4: Milestones for OCS Upgrade Program**

Activity	FY2019		
	Q2	Q3	Q4
Sequence Executor Upgrade	1	2,3	
Telescope Control Console Upgrade	4	5	
Science Platform	6,7		8,9
Milestones and major deliverables: 1. GMOS fully supported by new Sequence Executor 2. All modes fully supported by new Sequence Executor 3. System fully deployed 4. Project plan for TCC finalized 5. Kickoff of TCC upgrade 6. Preliminary design of Science Platform completed. 7. OCS core infrastructure completed. 8. Web development of Science Platform started. 9. Critical design of Science Platform completed			

#### 4.5. GEMMA: Time Domain Astronomy Software

Under the CSA of the new NSF Gemini in the Era of Multi-Messenger Astronomy (GEMMA) Award, in 2019 Gemini is embarking on work to enable Gemini's participation and leadership in a Time Domain Network of telescopes to follow-up on discoveries from LIGO, LSST, and other sources of time domain astronomy alerts. Software will lead a design review of this project in FY19Q2 in which plans for each of the following components will be addressed:

- Gemini TDA APIs: A new set of application programming interfaces (APIs) that will allow observations to be requested, provide the required feedback, and allow automated data access.
- Gemini Plugins for Target Observation Managers (TOMs): Provide software to help Gemini users work with these new APIs
- Scheduler: Provide an efficient, dynamic way to schedule large numbers (order 10-100) of transient observation requests per night.
- Real Time Pipelines: Provide a mechanism to automatically reduce imaging and longslit spectroscopic data in real-time for rapid characterization of transient sources and more responsive decision-making during night operations.
- Product Distribution Manager: Updates the Gemini Observatory Archive to be able to deliver reduced data to users.

Detailed plans and milestones for the Time Domain Astronomy software project are described in the GEMMA Program Execution Plan (PEP) submitted separately to NSF.

**Table 4.5: Milestones for Gemini in the Time Domain Network**

Activity	FY2019		
	Q2	Q3	Q4
Design Review	1		
Milestones and major deliverables:			
1. Design Review of Gemini in the Time Domain Network software plans			

#### 4.6. Longevity

The primary goal of the Infrastructure Sustainability and Scientific Longevity Program is initially to carry out the highest priority items identified in the 2016 Obsolescence Plan. In addition, the Program is being expanded to meet a new objective – to adapt the Observatory to remain scientifically relevant beyond 2025 by renewing and upgrading our facilities. To meet the new objective, we work with managers and staff in all departments, not only engineering and computing, to find areas where the efficiency of the telescope may be improved, daily operations streamlined, and hardware, software and processes may be updated proactively based on input from experts in all areas of the Observatory. All projects undertaken in the Longevity Program are carried out in coordination with, and with the assistance of, staff in the departments affected by any changes.

The plans for FY2019 focus on obsolescence of hardware and include work on ALTAIR STRAP APD, the M2 CEM replacement, the A&G motor control and replacement of drives on the enclosure and the platform lift. Details for each are provided below.

##### **ALTAIR STRAP – spare APD**

ALTAIR uses a tip-tilt wavefront sensor (STRAP) unit that feeds light directly from a focal plane lenslet array to the Avalanche PhotoDiodes (APDs). We have a spare unit with an older head with a central

obscuration and weak cooling lines. This needs to be refurbished by Microgate. The contract for this work will be issued in early FY2019, with completion expected by FY2019Q3.

### **Secondary Mirror (M2) CEM replacement**

Our options study indicate that the best way forward for replacing M2 control system is using PowerPMAC controllers. This is a significant change from the DOS computer running custom (and antiquated) software that we will be replacing. We will first perform a thorough feasibility study, particularly to ensure that there are no conflicts between the PowerPMACs and the Synchrobus replacement (likely to be EtherCAT) and the new operating system RTEMS (Real-Time Executive for Multiprocessor Systems) that we have recently installed successfully in other real-time applications on the telescope and enclosure. The feasibility study is expected to complete by the end of FY19.

### **Synchobus replacement**

The Synchrobus is part of the Gemini Standard Instrument Controller package, which provides a connectivity framework for instruments and systems running on the telescope. This communications bus is used by all instruments and the wavefront sensors that need to control the secondary mirror. There are two reasons for pursuing a replacement: obsolescence and the impracticality of the system. The current architecture is obsolete, the boards are no longer available. GHOST will be the last system for which this is an option. As the technology has advanced, more possibilities to provide a fast, semi-deterministic interface have become available. The front-runner is EtherCAT, currently being tested to confirm compatibility with RTEMS and PowerPMAC. Testing is expected to be completed in 2018, and replacement equipment procurements to start in FY19.

### **Acquisition and Guiding Motor Control Obsolescence Mitigation**

Within the next five years, we need to completely replace the current, obsolete motion control in the A&G units on both Gemini telescopes. This work is in its infancy, with a proposed solution (Power PMAC) under discussion in the Longevity Program. The FY2019 work will focus on a lab study, with effort from a student intern. Procurement of replacement hardware is foreseen in FY2020.

### **Enclosure Drive Replacement (Kollmorgen Drives)**

Kollmorgen drives are used for essentially all motion control on the enclosures, both north and south. The variety employed at Gemini can no longer be purchased; the best we can do in the event of failure is to have them repaired. Newer drives by the same manufacturer are better, providing functionality that might help protect the enclosure mechanisms better than the present generation. This part of the Longevity program therefore seeks to replace these drives.

### **Platform Lift Drive Replacement (Thor Drives)**

The Thor drives on the platform lifts are obsolete. We have one spare drive, and these are different from all other drives employed in the Gemini enclosures. Things are working ok at the moment but if they fail, we would have a problem in e.g. a coating process. This work involves replacing the drives and redoing the controls. The units are standalone and there will be very little internal FTE needed to complete the work; particularly no software. Contractor would do the design for us, and we would gain experience with them.



**Table 4.6: Milestones in Longevity**

Activity	FY2019		
	Q2	Q3	Q4
ALTAIR STRAP – spare APD		1	
M2 CEM replacement – feasibility study			2
Synchrobus replacement			3
A&G Motor Control Obsolescence Mitigation			4
Enclosure Drive Replacement			5
Platform Lift Drive Replacement	6		7
Milestones and major deliverables: 1. Completion of contract for production of spare ADP for Atrair STRAP. 2. Completion of M2 CEM replacement feasibility study with associated recommendation for implementation. 3. Procurement started for Synchrobus replacement hardware. 4. Approach agreed on A&G motor control obsolescence mitigation. 5. Prototype for enclosure drive replacement completed. 6. Contractor identified for platform lift drive replacement. 7. Working prototype in place for platform lift drive replacement			

#### 4.7. Other Maintenance & Renewal

In addition to the continuous maintenance that makes up a significant component of annual regular operations, Gemini Observatory regularly undertakes other maintenance and renewal projects that are either one-time or occur less frequently than annually. These include:

##### Gemini North Coating Chamber Upgrade

The goal of this project is to upgrade the coating chamber at Gemini North to increase coating quality and enable sputtering of an UV-enhanced silver coating. These upgrades will ensure that the current coating quality can be maintained and improved for better reflectivity and durability.

##### GN 2019 Shutdown and M1 recoating

The Gemini North primary mirror (M1) was last recoated in 2013 and is due to be recoated in 2019. Recoating the primary mirror is a significant operation, involving removal of the mirror cell from the telescope, stripping of the old coating, application of a new coating, and re-installation of the mirror cell to the telescope. To make efficient use of time off sky, other maintenance tasks will be completed in parallel with the M1 recoating, including replacement of the Cassegrain wrap hoses, and the regular annual A&G maintenance tasks.

##### Gemini South Compressor Upgrade

The goal of this project is to improve the compressed air system reliability at Gemini South. Power glitches often affect the power supply on the summit. The fault affects the operations since the compressed air supply is required to operate the telescope, the loss of compressed air disables the telescope of being operated because of the failure of the PCS active optics. The solution to this issue will be implemented in several steps. First, increasing the survival of air compressors beyond 10% of phase unbalance, by the addition of external switches. Second, adding a new backup air compressor. Third, upgrading the control system to allow improved remote monitoring and operation. With these improvements it will be possible to minimize failures related to the compressed air system.

### BTOOB Improvement Project – GeMS 3-person Operation

Currently operations of the GeMS laser and adaptive optics systems at Gemini South require 4 personnel to work each night. With upgrades to the laser's Beam Transfer Optics Optical Bench (BTOOB), the need for a separate laser operator during GeMS operations can be eliminated. This allows more efficiency in personnel assignment, more reliable night-time operations of GeMS, and more flexibility to schedule GeMS observing on more nights each year. This project is planned to complete in FY20Q1.

**Table 4.7: Milestones in Other Maintenance & Renewal**

Activity	FY2019		
	Q2	Q3	Q4
Gemini North Coating Chamber Upgrade	1,2,3	4,5	6
GN Shutdown and M1 recoating			7
Gemini South Compressor Upgrade	8	9,10	11,12
BTOOB Improvement	13	14,15	16
<p>Milestones and major deliverables:</p> <ol style="list-style-type: none"><li>1. Install new gas lines, gas panel, and mass flow controllers</li><li>2. Complete software upgrades to LabView and PLC</li><li>3. Begin testing new system with software without vacuum</li><li>4. Fully disconnect old hardware and begin new hardware integration</li><li>5. Finish hardware integration, test system under full vacuum</li><li>6. Produce coating test samples in preparation for shutdown</li><li>7. GN Shutdown and M1 recoating completed</li><li>8. Contractor selection</li><li>9. Engineering study and equipment selection</li><li>10. Plant room reorganization</li><li>11. Equipment delivery</li><li>12. Installation &amp; testing leading to project completion</li><li>13. Launch camera specified and procured</li><li>14. Launch camera installed and commissioned</li><li>15. BTOOB motor control procured</li><li>16. BTOOB motor control installed and commissioned</li></ol>			

## 5. Science User Support

The Science User Support Department (SUSD) advocates for the users and enables Gemini Principal Investigators to produce world-class scientific results in a timely manner. The SUSD leads post-observing user support. Its staff maintain a data reduction package for the user community that enables astronomers to remove instrumental signatures from data obtained using Gemini facility instruments, and they support users in its use. The SUSD maintains communications between the Observatory and the National Gemini Offices and ensures that NGO staff members receive appropriate training. The SUSD leads the observatory's interactions with its User Committee, which holds an annual in-person meeting.

In 2019 the Science User Support group is involved in a significant cross-department effort with PIO to develop a new website for Gemini Observatory. This is described further in Section 9.2 of the PIO section of this POP.

### 5.1. DRAGONS (Data Reduction for Astronomy from Gemini Observatory North and South)

The IRAF data reduction package is near end-of-life and therefore Gemini is creating the Data Reduction for Astronomy from Gemini Observatory North and South (DRAGONS) facility. This software package is

being developed within the Science Users Support Department to provide IRAF-free data reduction software for Gemini users. In 2019 the Science Quality Imaging for Users portion of this project will provide software that will enable science-quality data processing of active Gemini facility imagers. The next phase will include reduction of spectral data taken on GMOS in Longslit mode. The project plan for this next phase will be developed in FY19.

## 5.2. PyGacq: Development of a Python version of the Gemini Acquisition tool

The goal of the PyGacq project is to produce a new acquisition tool to replace the current IRAF CL acquisition tool, gacq. With IRAF in an end-of-life status, dependencies must be eliminated. This has been an ongoing effort, now formally established as a new project.

**Table 5.1: Milestones in SUSD**

Activity	FY2019		
	Q2	Q3	Q4
DRAGONS Science Quality Imaging for Users	1,2		
PyGacq: Development of a Python version of the Gemini Acquisition tool	3	4	5
User Committee & Operations Working Group Meetings	6	7	
Support at Partner User Meetings <sup>11</sup>	8	9,10	
Milestones and major deliverables: 1. Complete documentation on DRAGONS infrastructure and instruments support (imaging modes) 2. Public release of DRAGONS for imaging modes 3. GMOS IFU acquisition completed 4. NIFS IFU acquisition completed 5. All instruments supported by PyGacq; preparing for acceptance testing 6. Operations Working Group Meeting 7. The 2019 User Committee Meeting will be held in Hilo in August in conjunction with the OpsWG meeting for NGOs 8. User support at AAS 233 9. User support at Korean user's meeting 10. User support at CASCA 2019 11. Argentina, Brazil, and Chile are holding a combined 2019 LARIM meeting in November 2019, which is in FY20Q1			

## 6. Instrumentation and Facility Development

Gemini's Instrument and Facility Development efforts focus on three distinct programs: the Facility Instrument Program brings new, Gemini-sponsored instruments to the observatory; the Instrument Upgrade program provides upgrades to existing instruments to extend their capabilities and productive lifetimes; and finally, the Visiting Instrument Program provides a wide range of short-term to long-term capabilities that community members sponsor and bring to Gemini for their and our community's use.

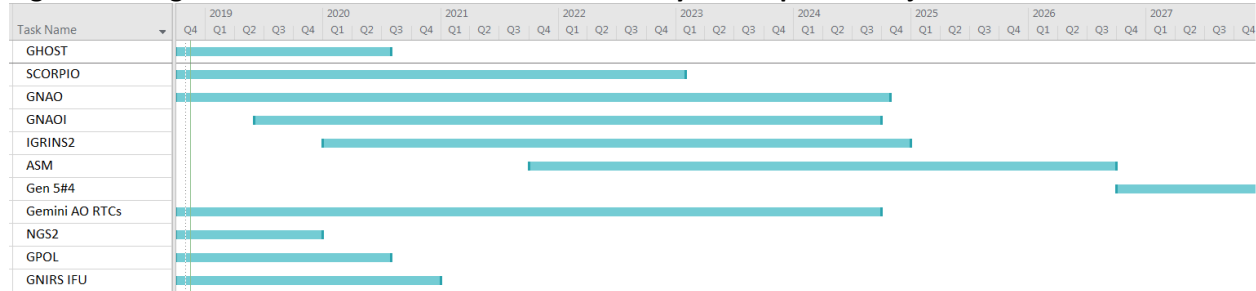
In the Facility program, are continuing efforts involve GHOST and SCORPIO. In 2019, we will also begin planning for IGRINS-2, a temporary name for a new facility instrument coming to Gemini as part of Korea joining the Gemini partnership. Additionally, we will continue work on GNAO, a new adaptive optics system for Gemini North made possible by a late 2018 award from the NSF that funds its development.

The Upgrade program includes the possible relocation and upgrade of GPI from Gemini South to Gemini North, a new natural guidestar wavefront sensor and deformable mirror for GeMS, and continuing work

from our previous community-lead upgrade projects including commissioning a GPOL unit for use with NIRC and delivering new IFUs for GNIRS.

The Visitor Instrument program continues with the number of instrument visits driven by demand via the TAC allocation process, the expected commissioning of MAROON-X at Gemini North, and collaboration with the GIRMOS team as it continues its design work.

**Figure 6.1: High-level Gant Chart of Gemini Observatory Development Projects**



Milestones in Gemini Development are collected into Table 6.1 below, except for anticipated Visiting Instrument Milestones, which are highlighted in Table 6.3 in Section 6.10. This separation is made because many of these Visiting Instrument Milestones are the responsibility of the Visiting Instrument teams, not of Gemini Development. The Gemini Visiting Instrument program is intentionally flexible and works closely with Visiting Instrument teams to provide the best possible capabilities to Gemini users.

## 6.1. GHOST

GHOST, the Gemini High-resolution Optical SpecTrograph is the next Gemini facility instrument and will provide world-class, high-resolution spectroscopic capabilities to the Gemini community. GHOST is fiber fed with a Cassegrain fiber feed unit mounted on the instrument cube and the spectrograph unit housed in the pier lab underneath the telescope. GHOST will provide a wide simultaneous wavelength coverage at high observational efficiency, enabling astronomers to investigate a broad range of science from the composition of the first stars to the characterization of exoplanetary systems. GHOST is currently in the build phase. GHOST is destined for Gemini South. The Cassegrain fiber feed unit has already been received and tested on sky at Gemini South while we await the completion of the spectrograph. We are currently expecting to complete the build phase in 2019 and receive the instrument in 2019 FYQ4.

## 6.2. SCORPIO

SCORPIO, Spectrograph and Camera for Observations of Rapid Phenomena in the Infrared and Optical, is an 8-channel imager and spectrograph that will simultaneously observe the g, r, i, z, Y, J, H, and Kshort bands in a square field-of-view of 3'x3', or a circular one with a diameter of 4.24'. It will obtain long slit (3' long) spectroscopy with a resolution of  $R \sim 4,000$ , simultaneously covering the range between 0.385-2.35 microns. The project is currently in the design phase. We are in the critical design stage and expect to complete the design phase in Q2 2019. We are expecting the project to complete the Critical Design Stage and to complete all remaining hardware orders in FY19. During the FY19 period there will be the Critical Design Review, Build Phase Kickoff Meeting and a quarterly review meeting in Q3.

## 6.3. GPI Relocation to Gemini North

In order to make room for GHOST at Gemini South, we tasked the GPI team to produce outlining the technical work needed and the science enabled in such a move. The reports, received in late 2018,

conclude the move is technically feasible with modest amounts of effort and risk. The report also concludes that the most compelling science to be done however, is only possible with several upgrades made to GPI in the transition. We plan to explore these upgrades in 2019 and, depending on the result and guidance from the Gemini Board, develop a future plan for GPI, possibly including an upgrade and move to Gemini North.

#### **6.4. Instrument Upgrade Program**

In order to maintain the competitiveness of Gemini's current instruments, and to provide more opportunities for community instrument teams and scientists to work with Gemini, we launched an instrument upgrade program in 2015 that solicits proposals from the community. The baseline plan for this Instrument Upgrade Program (IUP) is to have annual calls for proposals with funding alternating between \$100,000 USD and \$600,000 USD every year. There will not be a 2019 call for proposals in order to allow for completion of the existing IUP projects. As of late 2018 current Instrument Upgrade projects are:

- RAMSES (GMOS Filter) Project: Installation of new narrow band filters O VI, 6835 Å, FWHM = 50 Å, and O VI continuum, 6780 Å FWHM = 50 Å. Led by Denise Goncalves (UFRJ, Brazil). The team plans to submit its completed acceptance report in December, which will close this project out in CY2018. The filters can then be offered to the community in the 2019B Call for Proposals.
- GPOL Project: Project to renovate one of the Gemini GPOL units and commission it with NIRC2. The project is expected to be completed in 2019.
- GNIRS IFU Project: Project to design, build, test and commission two new Integral Field Units to GNIRS. The design phase is currently scheduled to complete in 2019Q3 with the Build Phase completing in early FY20. Commissioning scheduled for Q2 of FY20.

#### **6.5. GeMS**

The purpose of this project is to develop and install a new Natural Guide Star WaveFront Sensor (NGS WFS) for the Canopus adaptive optics bench of the GeMS MCAO system. With improved sensitivity, the new sensor will allow the use of significantly fainter natural guide stars, significantly increasing the sky coverage over which GeMS can perform good correction. The result will be to enable observers to use MCAO on more targets than are accessible now. Assuming the team passes the pre-ship acceptance tests scheduled in FY 2019Q2, we will install FY 2019Q4 and commission the following quarter.

#### **6.6. IR Detector Controller**

The IR Detector Controller project aims to upgrade the detector controller of GNIRS. The initial scope of the project is to demonstrate operation of the GNIRS detector with an ARC 3 controller and Linux based Detector control computer with an engineering software interface only. This work will allow us to determine how many of the current detector issues with GNIRS are due to the existing controller so we can then investigate further any that are not. In addition, this work will allow us to finalize the lower level software interfaces so we can design and build the high-level software accordingly. This is a low priority effort that is advanced on a best-effort basis without any assigned FY19 milestones.

#### **6.7. GEMMA: GNAO & RTC**

Under the CSA of the new NSF Gemini in the Era of Multi-Messenger Astronomy (GEMMA) Award, in 2019 Gemini is embarking on projects to build:

- A new Gemini North Adaptive Optics (GNAO) system, which will include a mastate- of-the-art Multi-Conjugate Adaptive Optics (MCAO) system to make Gemini North the premier site for wide-field high-resolution science.
- A common Adaptive Optics Real Time Controller (RTC) platform, which will be used to implement a new RTC for GeMS, an RTC for GNAO, and provide an RTC platform suitable for use with other current and future Gemini AO systems.

These projects address recent recommendations of Gemini’s Science and Technology Advisory Committee (STAC) to pursue a world-class wide-field AO system for Gemini North, building on previous experience with GeMS at Gemini South. A more advanced and reliable GeMS-like Gemini North AO (GNAO) system will enable detailed investigations of stellar populations, supernova physics, proper motions, and galactic archaeology. In addition, with greater sky coverage than GeMS the proposed GNAO system will be capable of a great variety of other innovative science.

Detailed plans and milestones for the GNAO and RTC projects are described in the GEMMA Program Execution Plan (PEP) submitted separately to NSF.

### **6.8. GNAOI**

The Gemini North Adaptive Optics Imager (GNAOI) is conceived to be a straightforward infrared imager to serve as a first-light instrument on the new GNAO MCAO system. As directed by the STAC in its recommendation 15.5 and the GBOD in its resolution 2018.B.10, in FY19 the observatory will develop the plans and cost estimates for this instrument, culminating in presenting a draft Request for Proposals to the STAC and GBOD at their May 2019 meeting. Presuming the GBOD approves GNAOI, the RfP could then be issued in FY20Q1.

### **6.9. IGRINS-2**

IGRINS-2 is a clone, or potentially improved version, of IGRINS. Korea is building IGRINS-2 as part of its agreement to join the Gemini Observatory International Agreement. The kickoff meeting for IGRINS-2 was held in early FY19Q1. In FY19 Gemini Observatory will work to support Korea in the design phase of IGRINS-2 to ensure that IGRINS-2 can be delivered as a facility instrument. There are no milestones for Gemini Observatory for IGRINS-2 in FY19.



**Table 6.1: Milestones in Development**

Activity	FY2019		
	Q2	Q3	Q4
GHOST	1	2	3,4
SCORPIO	5	6	7
GPOL Commissioning	8	9	10
GNIRS IFU	11	12	
GNAO			13
GNAOI		14	
GeMS NGS2	15		16
Milestones and major deliverables: 1. Start GHOST Test Phase at NRC-H 2. Complete GHOST Pre-delivery acceptance review at NRC-H 3. Complete GHOST Post-delivery acceptance review at Gemini South 4. Start GHOST Commissioning at Gemini South 5. SCORPIO Critical Design Review 6. SCORPIO Build Phase Kickoff Meeting 7. SCORPIO Quarterly Build Progress Review 8. Start GPOL renovation plan 9. Complete GPOL Pre-delivery acceptance review 10. Start GPOL Commissioning at Gemini South 11. Low Resolution GNIRS IFU Module Critical Design Review 12. High Resolution GNIRS IFU Module Critical Design Review 13. GNAO Conceptual Design Review 14. Present GNAOI draft RfP to Governance at 2019A meeting 15. NGS2 pre-ship acceptance tests 16. NGS2 install in GeMS at GS			

### 6.10. Visitor Instruments

Visitor instruments provide a cost-effective means to bring new capabilities to Gemini. A Visiting Instrument is one that was designed and built by another organization and is temporarily made available for use on one or both Gemini telescopes via an agreement between the instrument's owner and Gemini Observatory through the Visiting Instrument Program. This program allows Gemini to provide a dynamic suite of cutting-edge capabilities, some with broad appeal and others that are most appealing to niche areas of science or those that might be high profile for a short time. This account supports the Visiting Instrument Program activities.

Gemini Observatory's 2019 plans for supporting visiting instrument observing runs are summarized in Table 6.2.

**Table 6.2: Visitor Instruments expected in 2019**

Visiting Instrument	2019A	2019B
GRACES (R~67,500 optical spectropolarimeter)	GN	GN
DSSI (Speckle imaging; replaced soon by 'Alopeke and Zorro)	GS <sup>1</sup>	
'Alopeke (Speckle imaging on small fields and 40" field fast imaging)	GN <sup>1</sup>	GN <sup>2</sup>
Zorro (Speckle imaging on small fields and 40" field fast imaging)		GS <sup>2</sup>
POLISH2 (PPM Polarimetry)	GN <sup>1</sup>	GN <sup>2</sup>
Phoenix (R ~50,000-80,000 near IR (1-5 mm) echelle spectrometer)	GS <sup>1</sup>	GS <sup>2</sup>
TEXES (High-res mid-IR spectrometer)		GN <sup>2</sup>
MAROON-X (fiber-fed, high-resolution, bench-mounted optical spectrograph)		GN <sup>3</sup>
IGRINS (Cross-dispersed NIR spectrograph with R=45,000 across H&K bands)		GS <sup>4</sup>
GASP (Simultaneous linear and circular polarization at high cadences)		GS <sup>3</sup>
Notes: 1. Offered in 2019A Call for Proposals. Scheduled observing runs dependent on user demand in 2019A TAC process 2. May be made available in 2019B Call for Proposals, pending confirmation by Instrument PI 3. May be made available in 2019B Call for Proposals, pending commissioning early enough to be included in the CfP 4. May be made available in 2019B Call for Proposals, pending a new agreement between Gemini Observatory and the instrument team. If IGRINS requires additional maintenance before a return visit, then this will move to 2020A.		

The visiting instruments MAROON-X and GIRMOS are being developed specifically for Gemini's Visitor Instrument Program. Below we provide more details on these instruments, as well as IGRINS for which an extended visit is being negotiated for 2019-2021.

MAROON-X is a new visiting instrument in construction at the University of Chicago which is expected to have the capability to detect Earth-size planets in the habitable zones of mid- to late-M dwarfs using the radial velocity method. The instrument is a fiber-fed, high-resolution, bench-mounted spectrograph designed to deliver 1 m/s radial velocity precision for M dwarfs down to and beyond  $V = 16$ . MAROON-X will be located in the pier lab at Gemini North in a thermally controlled enclosure. The MAROON-X Front End (an interface unit designed to fit on the Gemini ISS containing a fiber positioner and ADC) is expected to be commissioned on Maunakea in early FY19. The MAROON-X spectrograph is expected to ship to Hawaii in Feb 2019, with commissioning to follow. Assuming successful commissioning, MAROON-X will be included in the 19B or 20A call for proposals.

GIRMOS is an ambitious project designed to provide Gemini with high performance multi-object adaptive optics, with the ability to carry out simultaneous high angular resolution, spatially resolved infrared spectroscopy of four objects within a two arcminute field of view when used with an adaptive optics system. GIRMOS is fully funded at this time and about to embark on the design phase. The instrument is intended to serve as a technology demonstrator for a larger instrument planned for the Thirty Meter Telescope, but is also expected to yield impressive results as a Gemini Visiting Instrument. The GIRMOS collaboration has independent funding to progress the instrument. They have not requested any additional funds from Gemini, although we do have plans to support them with some labor support.

The Immersion Grating Infrared Spectrometer (IGRINS) is a cross-dispersed near-IR spectrograph with a resolving power  $R=\lambda/\Delta\lambda = 45K$ , covering the entire H and K windows, from 1.45 to 2.5 microns, in a

single exposure. This transformative increase in spectral grasp (instantaneous spectral coverage) at high resolution is enabled by the use of a silicon immersion echelle grating and two 2Kx2K infrared detectors. IGRINS was designed and built as a joint project of the Korea Astronomy and Space Science Institute and the University of Texas at Austin. IGRINS has previously been in use at the McDonald Observatory 2.7m, Lowell Observatory's 4.2-m Discovery Channel Telescope, and at Gemini South in 2018A. In 2018A IGRINS was the most requested instrument at Gemini South, garnering 35% of the time requested on the telescope. Gemini Observatory is in discussions with the IGRINS team to potentially bring IGRINS back to Gemini South for an extended visit starting in 2019B or 2020A.

In 2019 Gemini will continue to be open to discussing with instrument teams opportunities for future visits of both previous and potential new visiting instruments.

### Anticipated Milestones in the Visiting Instrument Program

Most Visiting Instrument Milestones are the responsibility of the Visiting Instrument teams, not of Gemini Development. Gemini works closely with the Visiting Instrument teams, however the plans of individual instrument teams can change on short notice and the anticipated milestones in the visiting instruments program may evolve significantly through the year.

**Table 6.3: Milestones in the Visiting Instrument Program**

Activity	FY2019		
	Q2	Q3	Q4
MAROON-X	1,2	3	
GIRMOS			4
Zorro	5		
Future Visitor Instruments	6		
Milestones and major deliverables: <ol style="list-style-type: none"> <li>1. MAROON-X Front End (an interface unit designed to fit on the Gemini ISS containing a fiber positioner and ADC) is commissioning expected to be completed.</li> <li>2. Shipment of MAROON-X Spectrograph to Gemini North and installation.</li> <li>3. MAROON-X Commissioned and released to users for the 2020A Call for Proposals.</li> <li>4. GIRMOS Conceptual Design Review</li> <li>5. Zorro installation and commissioning tentatively scheduled for March 2019</li> <li>6. Host preliminary visit of GASP team to discuss a possible future visit</li> </ol>			

## 7. Safety

Gemini's safety program is overseen by the Safety Leadership Team. The SLT consists of the Deputy Director, Associate Directors, and CFO. The Deputy Director or their designate will Chair the SLT. At the Director's discretion, additional members can be appointed, e.g. to balance expertise and knowledge between GN and GS. Gemini employs a Safety Professional at each site, who participate in SLT meetings to report and advise on safety policies, practices, and results. The SLT recommends and the Director adopts one observatory-wide set of safety policies, although there may be differences between sites based on factors such as altitude. The responsibility for implementing and enforcing safety flows down the management chain from the Director through the managers. The managers rely on the support of the Gemini Safety Professionals for advice and assistance. Safety supports the managers by tracking staff training and offering the appropriate training to managers and staff. This includes both online and short trainings offered during regularly scheduled meetings, as well as longer courses on

particular topics such as first aid, CPR, and fire extinguisher training that may bring in outside instructors as necessary.

At Gemini South Safety runs an annual multi-day safety workshop for the summit crew focused on a rotating variety of topics relevant to the hazards involved in summit operations, such as use of overhead cranes and fall protection and high altitude rescues. In 2019 Safety will provide for the GN summit crew to maintain their Arc Flash NFPA 70E training with an OSHA-required triennial training class that will bring together summit crew from Gemini, Subaru, Keck, TMT, and MKSS. Gemini is a leader in safety on Maunakea and bringing together the various facilities to share resources. Combined training saves money and builds cohesion amongst the Maunakea summit crews of the various facilities.

#### **Fire detection system improvements at Gemini South on Cerro Pachón**

The purpose of this project is to increase system reliability and enable better remote diagnostics of location of fire detection, which is especially important in Base Facility Operations. Via an external contract the portions of the existing fire detection system at Gemini South on Cerro Pachón will be upgraded and/or replaced.

#### **Build a new Chemical Storage facility at Gemini South on Cerro Pachón**

The purpose of this project is to improve safety and ensure compliance with local regulations by constructing a new chemical storage facility at Gemini South.

#### **Install a new intelligent lock-out system on the dome at Gemini South on Cerro Pachón**

The purpose of this project is to improve safety during routine checks and maintenance on the dome at Gemini South by installing a new lock-out system that blocks unintended dome movement.

**Table 7.1: Milestones in Safety**

Activity	FY2019		
	Q2	Q3	Q4
Fire detection system at Gemini South on Cerro Pachón	1	2	3
Summit Crew Training Workshops	4	5	
GS Chemical Storage	6		
GS Dome Lockout			7
GN Mirror recoating		8	9
Milestones and major deliverables: 1. Complete inventory of current system and inventory of requirements of new system; Meet with potential contractors 2. Finalize project plans and contractor selection 3. Project completed 4. Gemini North Arc Flash NFPA 70E training workshop on Maunakea 5. Annual Gemini South safety workshop and training session 6. Complete new chemical storage area on Cerro Pachón 7. Complete new dome lockout system to improve safety during bogie maintenance 8. Support planning and preparation for GN shutdown and mirror recoating 9. Support GN shutdown and mirror recoating			

## 8. Administration & Facilities

The Finance team delivers financial guidance and information to management to support executing budgets within the Board authorized limits. Administration provides cost-effective administrative support and delivers timely and accurate information to management and governance. The Administration and Facilities Group (AFG) supports in the areas of facilities, infrastructure, fleet, administration, visitor services, and travel services to staff and visitors.

### 8.1. Budgetary responsibility

The purpose of this project is to finish FY2019 within [-2%; +3%] of the requested O&M Budget (\$28.0M). Continue to promote the accountability among the budget account managers.

	FY 2019 O&M Budget
WAGE & BENEFITS	19,469,515
GENERAL EQUIP-CAPITAL	1,210,235
TRAVEL	1,289,186
OTHER DIRECT COSTS	5,154,461
INDIRECTS	2,570,314
<b>TOTAL O&amp;M EXPENSE</b>	<b>29,693,712</b>

### 8.2. Business Services

The purpose of this project is to implement the NCOA Cost model prior to NCOA's startup in Q1 FY2020.

### 8.3. Business Systems

The purpose of this project is to enable tracking and reporting Gemini O&M expenses by WBS elements in Gemini's FY2020 POP, using Gemini's CONTROL Financial and Reporting system.

**Table 8.1: Milestones in Finance**

Activity	FY2019		
	Q2	Q3	Q4
FY19 Financial Reporting	1	2	3
FY20 Budget Preparation		4,5	6
Business Services			7
Business Systems			8
Milestones and major deliverables:			
1. Deliver final CY2018 annual budget report to stakeholders.			
2. Work with managers to finalize FY19Q2 financial reports; deliver FY19Q2 financial reports to stakeholders.			
3. Work with managers to finalize FY19Q3 financial reports; deliver FY19Q3 financial reports to stakeholders.			
4. Deliver FY20 budget preparation worksheets and instructions to managers.			
5. Work with Directorate and managers to finalize FY20 budget request.			
6. Deliver FY20 budget request to GFC and Gemini Board for final approval.			
7. Implement the NCOA Cost model			
8. Enable expense tracking by WBS elements in Gemini's FY20 POP			

#### 8.4. Facilities Services

Gemini operates and maintains base facilities at two sites:

1. The Gemini Northern Operations Center in Hilo Hawaii (Island of Hawaii) (Hilo Base Facilities – HBF)
2. The Gemini Southern Operations Center in La Serena Chile (Fourth Region) (Southern Base Facilities – SBF).

**Table 8.2: Milestones in Facilities**

Activity	FY2019		
	Q2	Q3	Q4
1. HBF & HBF-X Fire Panels		1	
2. HBF new keyless software and hardware	2		
3. Reposition of GS fleet vehicle	3		
4. Refurbish SBF office space for 4-6 new GEMMA FTEs		4	
5. Replace SBF's AC Chiller			5
<p>Milestones and major deliverables:</p> <ol style="list-style-type: none"> <li>1. Upgrade obsolete HBF &amp; HBF-X fire panels, use FY19 budget of \$31K allocated to this project.</li> <li>2. Update HBF keyless access software and hardware for keeping up the controlled access to HBF &amp; HBF-X premises. The project started FY2019-Q1 and is expected to complete in FY2019-Q2, at a total cost of \$30,000.</li> <li>3. Reposition of one GS fleet vehicle as part of the annual vehicle reposition plan.</li> <li>4. Refurbish SBF offices and adequate office space to host 4-6 new FTEs to be hired in FY19 for the GEMMA program.</li> <li>5. Replace SBF's AC Chiller with the GS CP Chiller that was not installed in the GS summit facilities.</li> </ol>			



## 9. Public Information and Outreach (PIO)

During FY 2019 the Gemini Public Information and Outreach (PIO) effort continues with baseline public/user communications efforts, local outreach programming, and initiation of implementation of the PIO portion of the GEMMA NSF award. Additionally, work is scheduled for completion of a complete redesign of the Gemini website in FY2019 as well as support of library services, summit tours and graphic services – all of which will all continue operating at full capacity.

Public and user communications will include our regular development of press releases (targeting a minimum of 6 during the 3-quarter “year”), regular webfeatures, monthly e-newscasts, the quarterly GeminiFocus newsletter, social media and participation in the American Astronomical Society’s winter meeting(s). Concurrently, local outreach in our host communities continues with a celebration of the 15th year of Journey Through the Universe in Hawai’i and Viaje al Universo in Chile (while Viaje al Universo happens in Q1 of 2020, planning of the program will occur in FY-2019 but not reflected in FY-2019 milestones. Additional activities such as coordination of AstroDay Chile, the StarLab portable planetarium programming in Hawaii and Chile, and participation in dozens of community events in Chile and Hawaii throughout the year round out our community outreach/educational programming.

Finally, FY 2019 presents Gemini with an opportunity to celebrate 20 years of science operations at Gemini North, and then in 2020, 20 years at Gemini South. While there aren’t resources allocated for a celebration in FY 2019, if it is decided to celebrate a 20 year “average” of GN and GS in FY 2020 planning will need to be completed in FY 2019 and the PIO group will play a major role in this work.

### 9.1. Digital Governance Implementation

Gemini’s digital presence is nearly two decades old and no longer serves well in the fast-evolving digital environment. There is a need to establish a formal digital governance for all Gemini web-based communications. The goals of this project are to create a digital governance framework and written Implementation Plan that will assure effective and timely communications with our primary audiences by establishing:

- A digital strategy that is mapped to relevant observatory goals;
- A model that explicitly details the digital team, with representation from across the Observatory and collectively manages our digital presence life-cycle;
- A management structure to maintain appropriate representation within the digital team, financial resources, and overall coordination among departments;
- Development of procedures for authorship and stewardship of policies that manages risk to Gemini from Gemini’s digital presence;
- Development of procedures for authorship and stewardship of standards that comply with industry best practices (astronomy/research) for future collaborations or consolidation.

The project is now in its implementation phase with Core Team and Community of Practice meetings each quarter.

### 9.2. Creation of a New Public Website

The goals of this project are to develop an overriding philosophy, approach, and architecture for the Gemini public website, and then implement these in a new version of the Gemini Public Website in order to improve our users’ experience, support efficiency, and provide a structure for the long-term maintenance of Gemini’s website.

The project involves restructuring the website at all levels, so that it better addresses the needs of our stakeholders. The scope of the project does not include significant development of new content or graphical elements. Planned work for FY 2019 includes user testing, new policy and standards development, HTML programming, limited graphic design, template creation, content migration, phased deployment in Q3 and troubleshooting.

A major driver of this project is the goal of better supporting Gemini's users and, while the project is listed here in the PIO section of the POP, this is a cross-department effort and significant work on the new website is being done by the Science User Support department (Section 5).

### **9.3. Support of July 2019 Total Solar Eclipse in Chile**

The July 2, 2019 total solar eclipse which passes directly over the Gemini South telescope is presenting many challenges as well as opportunities for the Gemini South PIO effort. In FY 2019 engagement in community programming (in a partnership with CTIO) will continue by providing school and public eclipse talks, eye safety, eclipse photography tips and a media workshop. On the week preceding the eclipse Gemini staff will provide tours for educational and student groups and on the day of the eclipse will support activities on Cerro Pachón and/or at CTIO. It is expected that the eclipse will dominate our activities for the first half of the year at Gemini South, and Gemini's annual AstroDay Chile will also focus on eclipse education targeting students and families in the La Serena area.

### **9.4. GEMMA: Public Information and Outreach**

Under the CSA of the new NSF Gemini in the Era of Multi-Messenger Astronomy (GEMMA) Award, in 2019 Gemini is embarking on work to address the broader societal impact of Multi-Messenger Astronomy in a multi-faceted manner. The key requirement of GEMMA's broader impact is to convey the concepts of multi-messenger and time-domain astronomy (MMA & TDA) and the role of Gemini and other facilities in this new astronomical discovery space. Ultimately, the story told is of a new era in astronomy and space exploration – enabled by cutting edge technologies, instrumentation and methodologies supported largely by NSF funding. In FY19 Gemini will plan and execute the MMA-TDA Communications Summit (MTCS) that will convene scientists, communications and education professionals to work together over a period of two days with the goal of developing a roadmap for effectively communicating the concepts of MMA & TDA to non-scientists. The Summit will target participants who are leaders from major MMA & TDA facilities such as Gemini, LSST, LIGO etc. The event is planned for 2 days at a central location (possibly NSF headquarters) and is nominally scheduled for the FY19Q4. Additionally, Gemini will begin planning for the production of a planetarium program focusing on era of MMA & TDA and the new discovery space these fields present. Finally, in FY19 Gemini will commence development of materials for K-12 and university classrooms on MMA & TDA.

Detailed plans and milestones for the PIO aspects of GEMMA are described in the GEMMA Program Execution Plan (PEP) submitted separately to NSF.

**Table 9.1: Milestones in PIO**

Activity	FY2019		
	Q2	Q3	Q4
Support and Exhibit at Partner Science/User Meetings <sup>3</sup>	1		2
Creation of a New Gemini Public Website	4	5	6,7,8
2019 Chile Eclipse	9	9,10	10,11
Public Information and Outreach regular operations	12,13,14,18	15,16,18	17,18
Milestones and major deliverables: 1. Participation and exhibiting in January 2019 AAS meeting 2. Advance preparations for January 2020 AAS meeting 3. Argentina, Brazil, and Chile are holding a combined 2019 LARIM meeting in November 2019, which is in FY20Q1 4. Creation of the structure and coding of the pages 5. Migration of the PIO and governance content 6. Migration of the SciOps content 7. Maintenance plan (with Standards and Procedures) 8. New website online 9. Eclipse presentations to local schools/public and planning for eclipse week activities 10. Eclipse media workshop 11. Cerro Pachón educational tours and execution of eclipse week/day activities 12. January Gemini Focus published 13. Journey through the Universe events in Hawaii, March 2019 14. Execution of AstroDay Chile 15. Delivery of educational assessment results from Journey Through the Universe 16. April Gemini Focus published 17. July Gemini Focus published 18. Monthly e-newscasts			

## 10. Risk Register

Gemini's Risk Management Plan is designed to identify, assess, track, and mitigate risks that could negatively affect the Observatory's goals. In this section, Gemini Observatory's high risks as of 01 December 2018 are presented. GEMMA Program risks are described separately in the GEMMA Program Execution Plan.

### 10.1. Methodology

The risk probability and risk severity are assessed on a scale of 1 to 5, as shown in the Table below, leading to a 5x5 matrix. Risk with an aggregate of 15 or more are considered high risks, 4 to 12 medium risks, 3 or less low risks.

**Table 10.1 Risk Probability and Severity Ratings**

Rating	Probability	Severity
1	Highly unlikely to occur, has never occurred (0-5%)	No measurable impact
2	Has occurred in the past, but with rarity (5-10%)	Impact at the nuisance level
3	Reasonable likelihood of occurring (10- 25%)	Mitigation actions deemed necessary
4	Will occur with high degree of likelihood (25-50%)	Substantial impact on the Center
5	Will occur with certainty based on experience or analysis (>50%)	Threatens the viability of the enterprise, including AURA as an organization

Gemini’s Risk Management Plan is supported by an on-line internal Gemini Project Management Knowledge Base that includes training modules and detailed process documents. Mitigated risks remain in the Knowledge Base but are moved the “closed” tab and reviewed at the post mortem as part of lessons learned.

## 10.2. Gemini Observatory Risks

Gemini Observatory’s highest risks, as of 1 December 2018, are presented in Table 10.2.

**Table 10.2 Gemini Observatory High Risks**

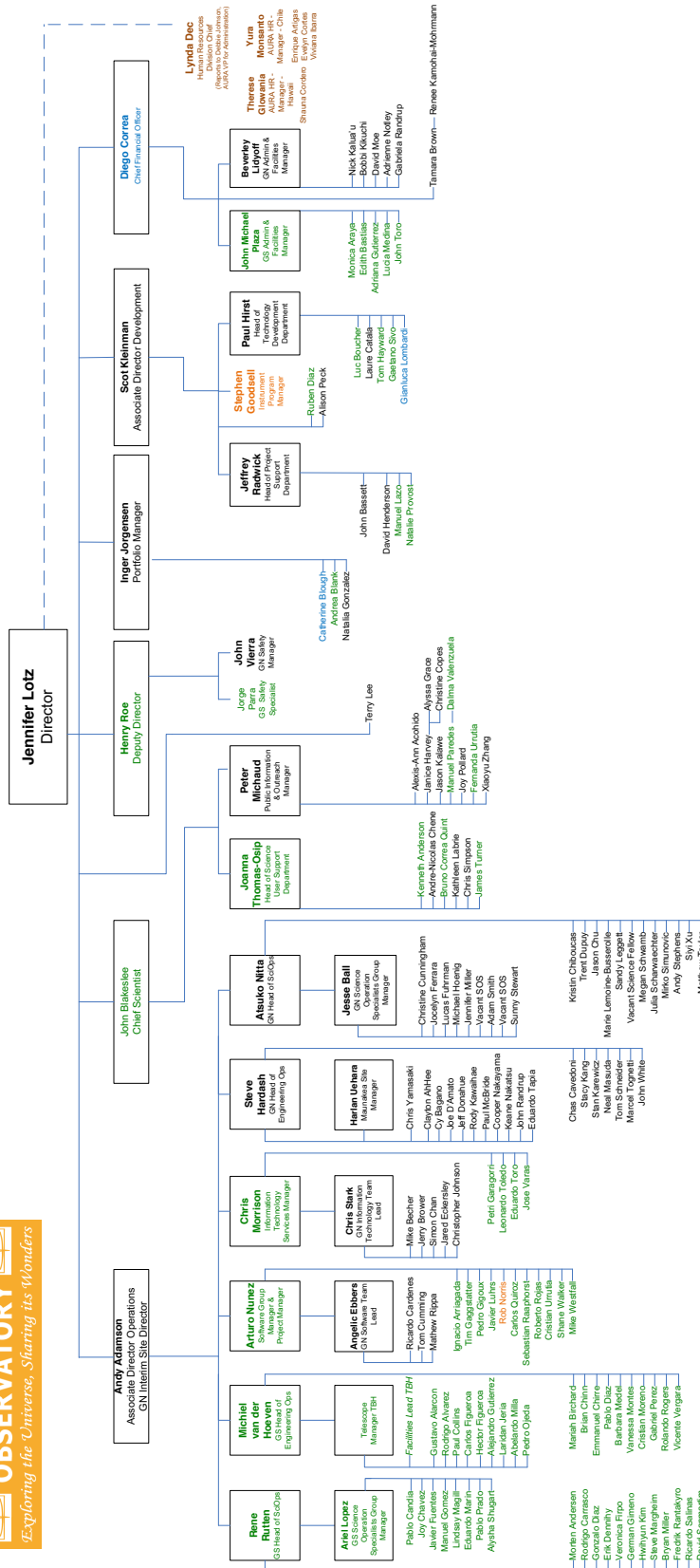
Risk & Mitigation	Probability (1-5)	Severity (1-5)	Aggregate Risk Score
<b>GHOST Delivery &amp; Commissioning Delayed Further</b> Mitigation: Continue to work closely with contractors, offering internal Gemini resources to help prevent additional delays.	5	3	15
<b>Personnel issues: retaining and recruiting personnel</b> Maintain a retention plan for critical personnel. Maintain a succession plan that identifies backup people for all critical positions and skills.	4	4	16
<b>Staff/Manager Disengagement during the Transition to NCOA</b> Develop and follow internal communications plan to keep staff as fully informed and engaged as possible	4	4	16
<b>IDF Funding Reduction</b> Demonstrate the importance of best-effort IDF contributions by continuing to deliver new highly-desired capabilities to users with existing IDF funds. Work with partnership to develop new non-IDF methods of bringing new capabilities to Gemini users, e.g. IGRINS-2, GIRMOS, Visitor Instruments, GEMMA.	4	4	16
<b>Major Sub-systems Obsolescence</b> Build and maintain a comprehensive obsolescence management plan and ensure that each year progress is made on reducing the number of projects in the plan portfolio.	4	4	16

## Appendix A: Tenets of Gemini Working Culture



# Appendix B: Organizational Chart

## Exploring the Universe, Sharing its Wonders



**Legend:**  
 Black = Gemini North Employees  
 Green = Gemini South Employees  
 Blue = Gemini Teleworkers  
 Bronze = AURA HR Support  
 Red = Long term visitors  
 Orange = Contractors

Gemini Observatory  
 Effective as of December 1, 2018

## Appendix C: Acronyms

A&G	- Acquisition and Guiding units
AAS	- American Astronomical Society
AFG	- Administration and Facilities Group
ALTAIR	- ALTitude conjugate Adaptive optics for the InfraRed
AO	- Adaptive Optics
APD	- Avalanche PhotoDiodes
API	- Application Programming Interface
AURA	- Association of Universities for Research in Astronomy, Inc.
BTOOB	- Beam Transfer Optics Optical Bench
Canopus	- Adaptive Optics optical bench for GeMS MCAO
CASCA	- Canadian Astronomical Society/ Société Canadienne d'Astronomie
CFHT	- Canada-France-Hawaii Telescope
CFO	- Chief Financial Officer
CLP	- Chilean Peso
CSA	- Cooperative Support Agreement
CSDC	- Community Science and Data Center
CY	- Calendar Year
DRAGONS	- Data Reduction for Astronomy from Gemini Observatory North and South
DSSI	- Differential Speckle Survey Instrument
EPO	- Education & Public Outreach
ESPaDOnS	- Echelle Spectro-Polarimetric Device for the Observation of Stars
F2	- FLAMINGOS-2
F2-MOS	- F2 Multi-Object Spectroscopy
FLAMINGOS-2	- FLoridA Multi-Aperture Imaging Near-Infrared Grism Observation Spectrometer-2
FT	- Fast Turnaround
FTE	- Full-Time Equivalent
FY	- Fiscal Year
gacq	- Gemini Acquisition tool
GASP	- Galway Astronomical Stokes Polarimeter
GBOD	- Gemini Board of Directors
GEMMA	- Gemini in the Era of Multi-Messenger Astronomy
GeMS	- Gemini Multi-conjugate Adaptive Optics System
GEN5#1	- Future Gemini facility class instrument (Generation 5, #1)
GFC	- Gemini Finance Committee
GHOST	- Gemini High-resolution Optical SpecTrograph
GIRMOS	- Gemini Infrared Multi-Object Spectrograph
GMOS	- Gemini Multi-Object Spectrograph
GN	- Gemini North
GNAO	- Gemini North Adaptive Optics
GNAOI	- GNAO Imager
GNIRS	- Gemini Near-Infrared Spectrograph
GPI	- Gemini Planet Imager
GPOL	- Gemini Polarization Modulator
GRACES	- Gemini Remote Access to Canada-France-Hawaii ESPaDOnS Spectrograph
GS	- Gemini South
GSAOI	- Gemini South Adaptive Optics Imager



HBF	- Hilo Base Facility
IDF	- Instrument Development Fund
IFU	- Integral Field Unit
IGRINS	- Immersion Grating INfrared Spectrometer
IGRINS-2	- Korean project to provide a clone or upgraded clone of IGRINS as a facility instrument
IR	- Infrared
IRAF	- Image Reduction and Analysis Facility
IT	- Information Technology
ITAC	- International Time Allocation Committee
ITS	- Information Technology Services
IUP	- Instrument Upgrade Program
LARIM	- Latin American Regional IAU Meeting
LIGO	- Laser Interferometer Gravitational-Wave Observatory
LLP	- Large and Long Program
LSST	- Large Synoptic Survey Telescope
M2 CEM	- Secondary Mirror Central Electronics Module
MAROON-X	- A 500 – 900 nm, high-precision radial velocity (0.5 m/s) spectrograph
MCAO	- Multi-Conjugate Adaptive Optics
MKSS	- Maunakea Observatories Support Services
MMA	- Multi-Messenger Astronomy
MSO	- Mid-Scale Observatories
MTCS	- MMA-TDA Communications Summit
NCOA	- National Center for Optical-Infrared Astronomy
NGO	- National Gemini Office
NGS2	- new Natural Guide Star WFS for GeMS MCAO
NIFS	- Near-Infrared Integral Field Spectrometer
NIRI	- Near Infrared Imager and Spectrometer
NMOC	- AURA's NCOA Management Oversight Council
NOAO	- National Optical Astronomy Observatories
NRC-H	- National Research Council of Canada, Hertzberg Institute for Astronomy
NSF	- National Science Foundation
O&M	- Operations & Maintenance (budget fund)
OCS	- Observatory Control Systems
OpsWG	- Operations Working Group
OT	- Observing Tool
PCS	- Primary Control System
PEP	- Program Execution Plan
PIO	- Public Information & Outreach
PIT	- Phase I Tool
POLISH2	- A high sensitivity, optical polarimeter
POP	- Program Operations Plan
PyGacq	- Python version of the Gemini Acquisition tool
QPT	- Queue Planning Tool
RTC	- Real-Time Computer platform for Gemini AO systems
RTEMS	- Real-Time Executive for Multiprocessor Systems
SBF	- Southern Base Facility

SCORPIO	- Spectrograph and Camera for Observations of Rapid Phenomena in the Infrared and Optical
seqexec	- Sequence Executor
SLT	- Safety Leadership Team
SOAR	- Southern Astrophysical Research (Telescope)
STAC	- Science and Technology Advisory Committee
STEM	- Science, Technology, Engineering, and Mathematics
STRAP	- ALTAIR's tip-tilt wavefront sensor
SUSD	- Science User Support Department
SwRI	- Southwest Research Institute
TAC	- Time Allocation Committee
TCC	- Telescope Control Console
TDA	- Time Domain Astronomy
TEXES	- Texas Echelon X[C]ross Echelle Spectrograph
TOM	- Target Observation Manager
UV	- Ultraviolet
VIP	- Visitor Instrument Program
WBS	- Work Breakdown Structure
WFS	- WaveFront Sensor