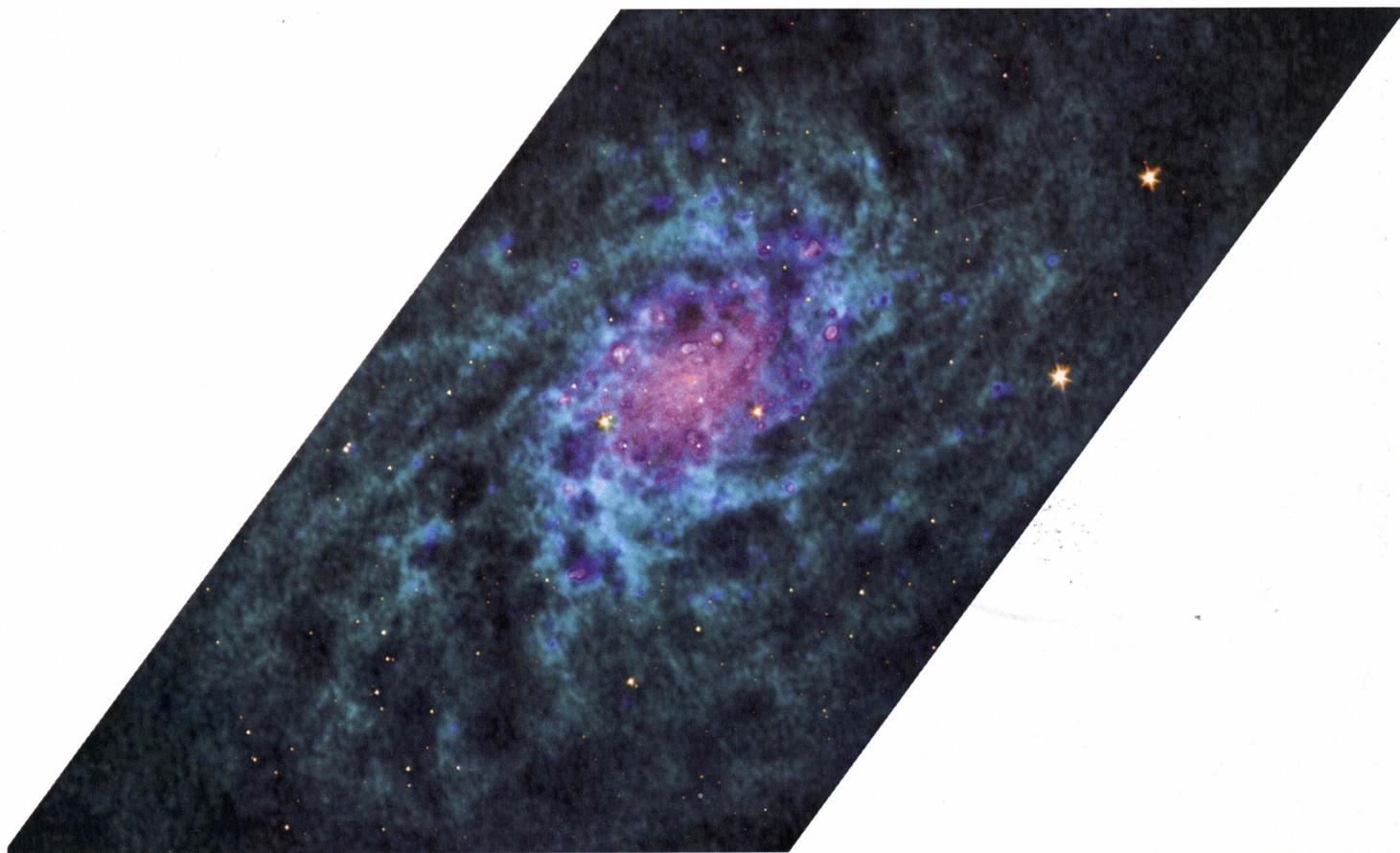


NATIONAL RADIO ASTRONOMY OBSERVATORY



The NRAO Workforce Management Plan

September 1, 2009

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The National Radio Astronomy Observatory is a facility of the National Science Foundation
operated under cooperative agreement by Associated Universities, Inc.

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1.0 Organizational Profile

Under the leadership of Associated Universities, Inc. (AUI), The National Radio Astronomy Observatory (NRAO) is a suite of facilities and instruments with unique and complementary capabilities for observing the Universe at radio frequencies, and a development laboratory that maintains its instruments and others operated by the astronomical community at the cutting edge.

The NRAO suite of research facilities includes the Very Large Array (VLA), the Very Long Baseline Array (VLBA), and the Robert C. Byrd Green Bank Telescope (GBT). Over the next few years, the Expanded Very Large Array (EVLA) and the Atacama Large Millimeter/submillimeter Array (ALMA) will become fully operational, bringing, respectively, ten-fold and hundred-fold improvements in sensitivity to the international research community. By 2013, four forefront telescopes – ALMA, EVLA, GBT, and VLBA – will provide greatly improved scientific capabilities. They will operate synergistically with other next-generation astronomical research facilities and cover a range of resolution and sensitivity that will image the Universe from sub-milliarcsecond to degree scales, and from sub-millimeter to meter wavelengths.

AUI operates the NRAO under a cooperative agreement with the National Science Foundation (NSF). AUI has corporate management policies and procedures to effect oversight of program planning functions, scientific staff policy, facility and administration management, human resources, contracts and procurements, internal and external audits, budgets, submission of reports, and management of regulatory compliance.

The development and operation of world-class user facilities and the conduct of frontier research requires a staff of the highest caliber. AUI's personnel policies, designed to attract and retain such individuals, are guided by the following principles:

- Maintain employer/employee relationships based on mutual respect
- Select and/or promote the best qualified candidate(s) for open positions
- Enable employees to pursue their professional goals in the context of the goals of AUI and the NRAO
- Compensate employees fairly and consistently
- Comply with all applicable laws and regulations; and
- Adhere to the terms of all contracts

The NRAO Workforce Management Plan (WMP) outlines policies and processes that will assure that the workforce is:

- Aligned to support the Observatory vision, mission and strategy
- Optimized for capability and capacity
- Motivated and provided opportunities for professional development; and
- Provided a safe, inclusive, and positive workforce climate

The WMP defines the current NRAO workforce environment, articulates the NRAO workforce environment of the future, and outlines planned transition activities necessary to move from the present to the envisioned future. The NRAO WMP is inclusive and broad, and each section has been deemed important to meeting the NRAO workforce plans consistent with best practices. The WMP provides the structure for moving from the current staffing profile to the future. As an addendum to this document, an Observatory Staffing Plan (OSP) is under development. The OSP will identify current staff demographics and critical skills and will outline staffing profile scenarios necessary to achieve the Observatory mission and vision for the future. Staffing numbers can be found in two complimentary documents, the Long Range Plan (LRP), which highlights staffing changes for the five-year period, and in the Program Operating Plan (POP) which outlines specific full-time-equivalent (FTE) staffing profiles for a one-year period. The activities specified by the WMP are scoped to current budgeting guidelines for the period FY 2010 - 2015.

1.1 Key Factors

Several foundational and unique organizational factors influence the NRAO WMP approach and deployment. The NRAO must ensure its scientific instruments are maintained and enhanced to assure cutting-edge science can be performed, and also assure optimal use of funding to enable transformational science. Funding comes primarily from the National Science Foundation (NSF), but also from other agencies and from grants generated by scientific proposals. The NRAO is subject to the rules and regulations of its funding agencies regarding use of funds and reporting requirements.

The NRAO must also provide the expertise to plan, construct, and commission, operate, develop, and close as necessary all facilities under its purview. This requires maintaining a sustainable long-term mix of scientific staff skills and expertise, including the capabilities to conduct transformational research, to intelligently push the operational envelopes of scientific instruments, and to provide the highest quality user support to the astronomical community

1.2 Key Performance Indicators

Key Performance Indicators (KPIs) are used to evaluate an organization's progress towards its vision and strategic goals. To assure that the NRAO is aligned to meet its strategic needs through its WMP, several KPIs will be assessed:

- The NRAO demonstrates the distribution of the workforce by critical skills and capabilities
- Individual performance objectives, determined via the performance appraisal process, are clearly aligned with and support achievement of the NRAO strategy and organizational objectives
- The workforce understands the organization's position on, and is actively engaged in, career opportunities and growth process, succession planning, training and development
- The workforce understands the organization's position on, and actively participates in, organization initiatives to enhance inclusion, diversity, and vitality

- Periodic employee satisfaction surveys reflect a match or improvement from the baseline

1.3 Workforce Groups and Segments

Job roles and responsibilities, performance baselines, and career planning and growth strategies can differ depending upon employee background and their employment role. By identifying the major workforce groups, the NRAO ensures that its workforce management processes and metrics for assessing efficiency and effectiveness are appropriate. By identifying the segments within those groups that further differentiate the workforce based on their needs and long-term goals within the context of the Observatory’s strategy, the NRAO can tune its long-term approach to building the capability and capacity of the workforce.

The NRAO has a defined career track and process for scientific staff (tenure track astronomers and non-tenure track scientists). For non-scientific staff, career progression varies dependent on job grouping. The workforce groups and segments that have been used to form the WMP are:

Table 1: 2009 Skills Mix

Group	Segments	Description
Scientific	Astronomers/Astrophysicists/ Astrochemists/Astrobiologists/other	Tenured and non-tenured scientists who advance the science of the NRAO telescopes for the world-wide astronomical community.
Technical	Engineers/ IT/ Technical	Enable the NRAO telescopes to perform at the level required to achieve the advanced science.
Operations	Craft/Maintenance/Service	Maintain the NRAO’s ability to operate its facilities as designed and upon demand.
Administrative	Professional/Administrative/Clerical	Enable the NRAO to meet its operational, legal, contractual, financial, and human capital needs.
Management	Directors/Managers/Supervisors	Provide the NRAO with the leadership necessary to develop and execute its operational and strategic plans.
Contributors	Students/Fellows/Adjunct	Open the NRAO to future and non-NRAO scientists and engineers.

2.0 Workforce Capability and Capacity

The NRAO employs a workforce that is diverse in its breadth and depth of education, experience, skill, culture, and geography. It also employs a mature workforce as a result of its longevity and ability to retain employees. The Observatory’s diversity is expanding due to specific initiatives, its international growth and exposure from ALMA, and the development of the next generation of scientists.

With 50+ years of experience in developing and maintaining its workforce, the NRAO project and management leaders are very knowledgeable in this area. To ensure that this knowledge and capability is retained, processes are being developed to formalize this capability.

2.1 Needs Assessment

A formal job description process is being institutionalized within the NRAO to identify, assess, and document the workforce needs of the organization, which includes the following competency-based model.

2.2 Identifying, Designing and Eliminating Positions

A systematic process for identifying when new positions are required, designing a position within the strategic context of the Observatory, eliminating positions, and filling positions is fundamental to the NRAO operations. This section describes these processes, and how they support the operations of the Observatory.

Each position hired by the NRAO must be systematically planned so that the position, accurately reflects the specific needs of the organization; fits within the approved staffing plan and budget; and complies with the NRAO hiring policy, diversity plan, Affirmative Action Plan and Action Plan for Broadening Participation. A job that is designed inappropriately, based simply on the need for more help, can result in a poor hiring decision. Undesirable outcomes can include hiring over- or under- qualified employees, inefficient use of financial resources, turnover, grievances, and low morale. The key factors of the organization that impact the way the NRAO creates and fills positions are: clearly defining the job based on specific needs; accurately evaluating the job level and salary; reaching out to a broad pool of candidates; selecting people with an open mind to diversity.

The following values guide the process of position design at the NRAO:

- Identifying skills required for the position and how those skills map to the critical skills required by the NRAO, in terms of immediate needs as well as developing key capabilities for future projects
- Ensuring that the funding is available to meet the financial obligations of the position
- Determining the long term viability of the position based on program funding
- Accurately defining the requirements of the position to effectively find qualified candidates
- Determining how the position fits within the organization's job and salary structure to attract qualified candidates and preserve pay equity within the NRAO

The responsible manager works directly with both Human Resources and Administration to create new positions or reevaluate and/or eliminate existing positions. Together they assess the needs of the organization for the positions and financial impact of the action. The elimination of a position involves a thorough review of the legal and employee relations implications of the action. When resources are not available to fund positions desired, Human Resources and Administration work with the responsible manager to develop alternatives that

identify and support critical functions and cut, or redistribute secondary functions. It is the ultimate responsibility of the manager to determine critical functions.

2.2.1 Establishing Positions

New positions are established by the NRAO based on needs requests from construction or operations projects, to strategically build capabilities for the future, or to maintain the NRAO compliance with legal, regulatory, safety, or financial obligations. Job categories and salary structures are determined through an internal job analysis, benchmarking jobs and salaries to comparable jobs utilizing independent third-party salary surveys, and developing an internal job hierarchy that accommodates the NRAO's organizational needs. The appropriate division head and hiring manager work directly with the NRAO's compensation professional to develop an accurate job description from which the job title, responsibilities, qualifications, grade and salary are determined.

Before filling a position, Human Resources must ensure that the job description was approved by the compensation professional and that the hiring manager accurately completed the job requisition form in the online application system. All jobs are managed through the online application system which requires HR approval at key steps in order to ensure that the hiring process is followed. Key steps include job description completion, requisition approval, salary recommendation, interview selection, candidate selection, and the offer decision. See Figure 1 Compensation Process flow.

2.2.2 Eliminating Positions

Job positions that become obsolete as a result of changes in functional duties, shifts in work assignments, other structural changes within reporting relationships in the Observatory, changes in methods or procedures, changes in technologies used or workloads will be either removed or reassigned to other areas of the Observatory. Financial hardship may also result in position elimination regardless of the organizational need for positions.

2.2.3 Interim Positions

In situations where a unique skill or additional skilled support is needed for a specified period of time to complete a project, the NRAO hires staff on an interim basis (term appointment). The period in which the position will exist is tied directly to the construction or operation plan being supported. The term is established in the offer letter.

2.3 Recruiting, Hiring and Retention

The key compensation processes are outlined in Figure 1.

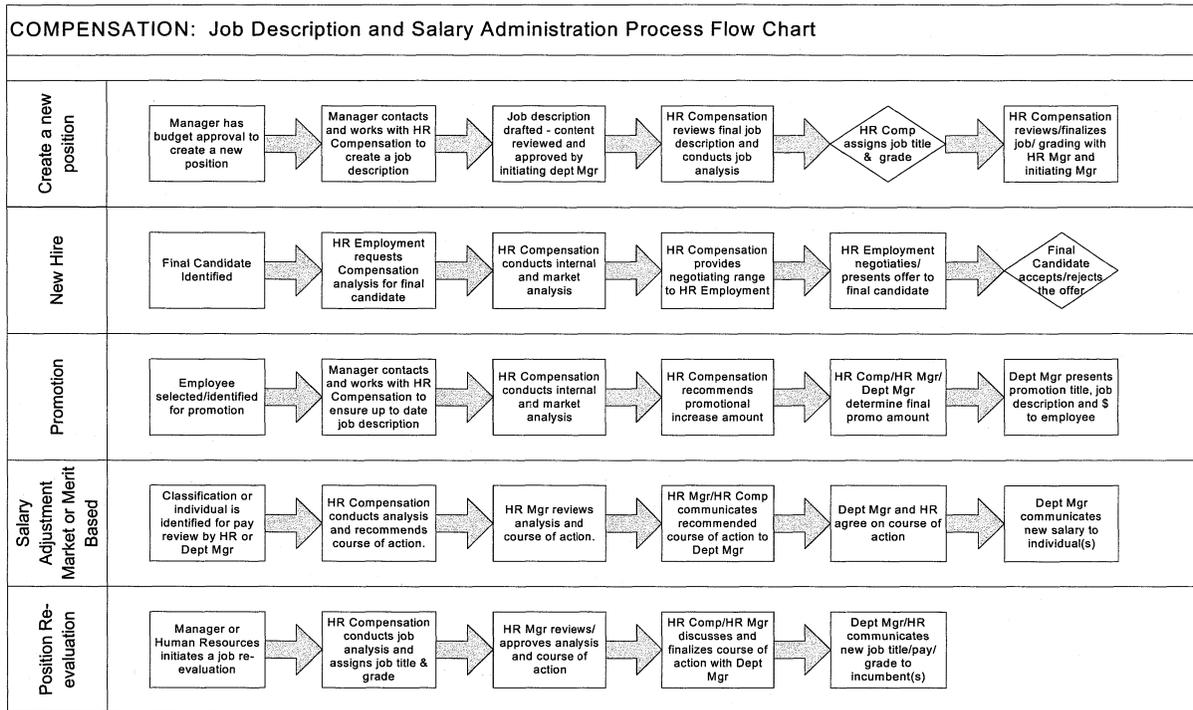


Figure 1: Compensation Process Flow

The organization recruits as openings occur, whether replacements or planned additions, making concerted efforts to attract qualified candidates by using a range of advertising and recruitment sources. In compliance with its diversity plan, Affirmative Action Plan, and Action Plan for Broadening Participation, the NRAO actively recruits minority and female candidates, with specific focus on underutilized job groups such as the Sr. Scientific/Technical Professional job group. Historically, there has been limited turnover in the Sr. Scientific/Technical Professional job group; therefore, particular efforts are being made to attract minorities and females into feeder positions in the two job groups just below the Sr. level. The NRAO has been successful in hiring females and minorities into feeder positions.

The Scientific/Technical Professional job titles and their feeder positions are described in Tables 2 - 4.

Table 2: Sr. Scientific/Technical Professional Job Group Classifications

Scientific/ Tech Prof Title	Functional Designation
Sr. Scientist	Astronomical Computer Science Research Engineer
Astronomer	
Scientist	Astronomical Computer Science Research Engineer
Sr. (Functional) Engineer	Systems Mechanical/Structural Electrical
Engineer I	Systems Mechanical/Structural Electrical
Sr. Software Engineer	
Software Engineer I	
Sr. Systems Administrator	

Table 3: Mid Level Feeder Job Classifications to Sr. Scientific/ Technical Professions Job Group Classifications

Scientific/ Tech Prof Title	Functional Designation
Associate Astronomer	
Associate Scientist	Astronomical Computer Science Research Engineer
(Functional) Engineer II	Systems Mechanical/Structural Electrical
Software Engineer II	
Systems Administrator I	
Senior Research Associate	
Software Engineer I	
Sr. Systems Administrator	
Sr. Web Designer	

Table 4: Entry Level Feeder Job Classifications to Mid Level Scientific/ Technical Professions Job Group Classifications

Scientific/ Tech Prof Title	Functional Designation
Assistant Astronomer	
Assistant Scientist	Astronomical Computer Science Research Engineer
(Functional) Engineer III	Systems Mechanical/Structural Electrical
Research Associate	
Systems Administrator II	
Scientific Associates I , II , III	
Web Designer	

Future openings/planned additions to staff will be limited but will provide some opportunities to recruit minorities and females into Sr. Scientific/Technical Professional jobs. Progress in this area of underutilization will occur through proactively and strategically placing minorities and females into feeder group positions since openings occur with greater frequency at these levels.

2.3.1 Diversity Planning

The NRAO diversity plan was created in June 2007. It includes a clear diversity policy statement, strategic vision, and the metrics for success. Many steps have been taken and are planned to attract diverse candidates. The NRAO participates in diversity-related conferences and job fairs, including the Black Engineer of the Year Awards, the National Society of Black Engineers, and the Society of Women Engineers. The NRAO is also a sponsor of *Diversity/Careers in Engineering and Information Technology* magazine that has often featured NRAO personnel. The NRAO was voted "A Best Diversity Company" by this magazine's readers for three consecutive years (2007 - 2009).

To attract targeted new hires, monetary incentives may be offered in extraordinary circumstances, as well as some relocation assistance. Recruiting and advertising sources include internal posting, the NRAO Intranet/Internet, newspapers, professional journals, Monster, CareerBuilder, DICE, American Astronomical Society (AAS) Register, AAS Women, Physics Today, Society of Women Engineers (SWE), job fairs, word of mouth, community activities, etc. The NRAO advertises prospective job opportunities in publications and media targeted at females, minorities, U.S. veterans, and persons with disabilities.

The NRAO maintains a healthy retention rate through a variety of work-life balance policies, programs and jobs that are unique, challenging and enriching. In certain areas, the NRAO also has the advantage of being the preeminent employer. To understand how employees feel about the NRAO as an employer, the Human Resources Division hired an outside consultant in 2007 to survey employees and conduct focus group meetings. The survey results have become the baseline from which the NRAO has worked to improve. Periodic surveys will be conducted to measure changes, with the next survey scheduled for 2010.

2.4 Succession Planning

The NRAO provides middle managers with leadership and developmental opportunities that prepare them for positions at the Assistant Director level and above. Outside leadership development training is available for middle managers. Individuals are not pre-selected for leadership roles; however, the NRAO tries to promote internally where appropriate. The NRAO hires outside of the organization for key positions when no internal candidates are qualified for the job. Often in these cases, the job is new or has been re-evaluated and it has been determined that a different skill set is required. These situations have created opportunities for the NRAO to increase the diversity of its leadership group, which it has been successful in doing.

3.0 Management and Organization of Work

The NRAO builds, operates, and maintains telescope facilities, and provides expertise to the scientists that use them to execute research programs. In addition, the Observatory is involved in the continuous, innovative improvement of telescope facilities to promote scientific discovery.

Unique approaches to managing and organizing this work are applied depending upon the lifecycle stage of the instrument being developed: planning, construction, commissioning/early science, operations, or closure. Each of these is detailed below.

Before a construction project is funded and work begins, there is typically an extensive and iterative up-front planning process. This includes research community and staff discussions, discussions with the AUI Board, discussions with funding agencies, and consideration by the Decadal Survey. The NRAO scientists participate in this process through informal and formal surveys, working groups, scientific workshops, and community meetings (e.g., the American Astronomical Society annual meeting, the International Astronomical Union meeting). Planning and envisioning potential future projects is an ongoing and continuous process involving small teams of the NRAO scientists and managers, the AUI Board, and external teams of scientists from other institutions. Planning work often culminates in the preparation of a formal proposal to a funding agency to support the construction effort.

When funding becomes available for a new instrument, the NRAO must mobilize teams of civil engineers, mechanical engineers, electrical engineers, software engineers, astronomers, other scientists, managers, and administrators to orchestrate and carry out construction. Project plans are created and executed by a project manager, who is responsible for convening and leading a change control team to track adjustments to plan. The project manager also gauges cost and schedule performance, and is responsible for risk planning and mitigation. Design and progress reviews are regularly held to facilitate critical review of the project's technical details, examine management and planning arrangements, and science goals. AUI approves proposals for new projects, and monitors the progress of major construction projects, such as for EVLA and ALMA, and provides specific oversight as with the ALMA Oversight Committee.

With the advent of large international projects, such as ALMA, the construction process for a large new facility can involve coordination between the NRAO and international partners, increased oversight and constraints imposed by NSF's Major Research Equipment and Facilities Construction guidelines, and governance and management entities involving partner organizations or committees not solely within AUI/NRAO (e.g., the Joint ALMA Office, the ALMA Board).

Once the structures, hardware and software are in place to support the collection of data for one or more scientific observing modes on a particular instrument, that capability must be exhaustively tested before regular scientific use. The process of commissioning involves rigorous end-to-end instrument testing and includes the observing process, data collection, data reduction and analysis. This effort is led by commissioning scientists under the leadership of the head of science operations for a particular instrument. Sometimes scientists from the user

community are involved in the commissioning process, which provides the scientists with the opportunity to collect data from a new instrument, while providing the NRAO with assistance in improving the quality and reliability of its instruments, hardware and software prior to general availability. Progress is measured according to schedule performance based on when new capabilities are delivered to the user community.

Once an instrument is in regular use by the scientific community, it is considered to be in the operations phase. Even though the most commonly used observing modes have already been commissioned and are offered to users on a regular basis, new functionality may be developed and released. These new capabilities can be developed and deployed as part of regular operations or with support from non-operations funding that may involve external partners, including universities. Progress in the operations phase of the instrument lifecycle is measured in terms of schedule performance and user satisfaction. Work is managed in the context of regular development cycles, where feedback from the user community plays a significant role in determining the scope and priorities for enhancements.

On occasion, an instrument must be retired. Work is managed and organized in a manner similar to the construction phase as an instrument is moved out of routine operations and taken out of service. Environmental reclamation may sometimes be required. Work is managed using project plans for decommissioning and progress is measured in terms of both cost and schedule performance.

In addition to the lifecycle phase of the instrument, work is also organized along functional lines to take advantage of economies of scale. Examples of these functional lines include proposal submission and handling, planning and execution of community training programs, and construction and operations of Observatory-wide data archival systems. A matrix structure called Observatory Science Operations (OSO), consisting of 12 working groups, ensures that work is coordinated among sites and telescopes. The management and organization of work for these groups follows the needs of the Chair of the working group, and the Chair is selected based on whose needs are most immediate.

3.1 Strategic Staffing

The NRAO business model includes continuous research, development, construction and operations of forefront radio telescopes and thus requires careful planning of its staffing requirements for future years. Leaders from these areas work together with the Human Resources and Administration divisions to identify the skills required to meet the current and future demands of the Observatory based on the lifecycle of the overall set of Observatory activities as outlined in the previous section. This process includes identifying skills that will become obsolete and new skills that must be developed internally or hired from outside of the NRAO. Once the assessment is completed, the NRAO's existing workforce is examined to identify where shortfalls exist and then an action plan is developed to address the shortfalls. The examination includes matching existing staff with future positions while factoring in retirements and turnover, and retention of staff on term appointments as projects come to an end.

3.1.1 Workforce Lifecycle

The NRAO hires the majority of its employees via traditional methods. The NRAO hires limited number of students for summer internships to introduce them to scientific and engineering career opportunities. Employees develop their career through education assistance, training, job progression, transfer and relocation, mentoring, and the annual performance evaluation process. Employees are expected to train new employees with their job skills and managers oversee their career development. The transfer of knowledge to employees is especially important among skilled craftsmen and scientists. The NRAO benefits programs provide employees with the coverage needed to support all phases of the life from high school or college graduation through retirement.

3.1.2 Strategic Staffing Model

The NRAO Strategic Staffing model includes: (a) data collection and information, (b) forecast, (c) reconciliation, (d) action planning, and (e) feedback and evaluation.

Collecting relevant data and information involves examining the Strategic Plan, LRP, and POP for human resources implications, as well as conducting internal and external scanning for limiting factors such as budget variations, internal policies and procedures, and labor market conditions. The forecast phase projects the number of employees with appropriate skill sets currently available to meet Observatory needs. Reconciliation involves identifying gaps between staffing needs, available talent, and pipeline of candidates in the university and industry environments. Action planning includes creating strategies to address gaps and develop specific programs and resources to handle supply-side needs. Finally, the feedback and evaluation phase develops and applies formal measures to assess the impact of action planning on desired results.

The NRAO is currently developing an Observatory Staff Plan based on this WMP which identifies the current skill set and critical skills and determines the appropriate skill sets necessary to meet future needs. Full transition plans will be established using the WMP as a guide. As an interim step, transition plans from construction projects to operations in the near term (to 2015) are provided in the LRP.

3.1.3 Skills Identification

The NRAO identifies skills through the job description process as described under 2.2.1. Skills are being inventoried for inclusion in the NRAO Human Resources Information System to better facilitate the strategic staffing process. A skills inventory matrix will be developed that links to specific projects and timelines. The matrix will also support the identification of skill retraining opportunities for future projects.

3.1.4 Career Progression

Career progression varies within different job families and groups. The NRAO encourages employees to develop their careers by supporting continued education and training. Its job structure supports career progression, an example of which is shown in section 2.3.

3.2 Long-Term Staffing Plans and Change Management

The key organizational factors that influence long-term staffing plans and management of workforce change are: maintain and enhance viable NRAO telescopes; assure the optimal use of funding to facilitate science results; assure the appropriate staffing levels are maintained to facilitate performance throughout the lifecycle of observatory instruments. These organizational factors drive change that ultimately affects the workforce and staffing levels.

3.2.1 Scientific Staff Capability and Capacity

The Director's Office and the Office of Science and Academic Affairs are responsible for assuring the appropriate long-term mix of capabilities within the scientific staff. All scientific staff are required to conduct state-of-the-art research, to push the boundaries of the instruments, and to provide high quality user support to the astronomical community through all phases of the observatory lifecycle including the planning, construction, commissioning, operations, development, and closure of any instrument.

3.2.2 Construction-Operations Transitions

The process used to develop the personnel staffing plan for the transition from VLA to EVLA operations focused on identifying the skill sets and workload required by the long-term operation and maintenance requirements. In many cases, such as telescope operations, antenna maintenance, and facilities maintenance, the skills and workload are little different from the VLA; these have been highly optimized by 30+ years of experience in operating and maintaining the array.

The major changes brought about by the EVLA are new technology, an increase in the number of receivers and cryogenic equipment, and more reliance on sophisticated software tools for monitoring antenna performance and science observing. In almost all cases, the skill set requirements will be addressed by retaining some project staff that designed and built the hardware and software. This approach improves operational efficiency because of the existing staff familiarity with the hardware and software, and greatly reduces the training and recruitment expenses that would be incurred with new hires.

For ALMA, the transition from construction to operations will conclude and segue to full operations in FY 2013. The ALMA team will utilize standard NRAO processes to identify critical skills, transition personnel from construction to operations, eliminate positions, and add personnel. The ALMA team will develop their staffing transition plan using standard processes for identifying the skill sets and work load required by the long term science operations and repair of the North American ALMA components. Both of these staffing plans are available in the LRP.

3.2.3 Critical Skills Retention for Future Projects

During a downsizing, careful review of individuals identified with critical skills must occur to assure that skills will not be lost that will be needed in the future. A position will not be created for the individual; however, the supervisor will work with Human Resources to assist

the individual in reviewing and applying for open positions across the Observatory to avoid a destructive layoff-rehire cycle whenever possible. The Human Resources Division will maintain a comprehensive list of all opportunities within the Observatory and will develop processes to facilitate internal transfers Observatory-wide. Internal hires will take precedence over external hires where critical skills retention is a factor. All positions will be staffed based on standard NRAO processes and procedures, with sensitivity to diversity and inclusion objectives.

3.2.4 Students and Early-Career Development

The NRAO supports a diverse and effective portfolio of programs for undergraduate and graduate students, postdoctoral fellows, visitors, and instrumentation support programs.

3.2.4.1 Undergraduate Programs

The NRAO summer student program is a 10–12 week program, founded in 1959, that allows approximately 25 students to work under the supervision of the NRAO staff members in New Mexico, West Virginia, and Virginia, carrying out original research in astronomy, computing, and engineering. The NSF Research Experience for Undergraduates (REU) program funds most summer students; graduating seniors, foreign and graduate students are covered by NRAO operating funds.

The NRAO also runs a co-op program that enables undergraduate engineering students to gain practical, career-based experience as part of their formal academic education. Students from participating institutions work at the NRAO engineering sites for two non-consecutive semesters. The NRAO technical staff supervises the students and engages them in problems on the technological frontier. Typically three students per semester are funded through the NSF Cooperative Agreement.

3.2.4.2 Graduate Programs

The NRAO is committed to training the next generation of scientists in the techniques of radio astronomy, and several Observatory programs address this commitment. Graduating seniors and first- and second-year graduate students are able to participate in the NRAO summer student program (section 3.2.4.1). This gives students radio astronomy research experience early in their graduate careers, allowing them to incorporate these skills into their thesis. Second, the NRAO awards pre-doctoral fellowships to students who have completed their academic course requirements, so that only their thesis research remains for their Ph.D. Such students reside at the NRAO, typically for two years, and collaborate with the Observatory staff scientists who supervise them as they acquire data, analyze their results, and write their theses. Typically there are five graduate summer students and four resident graduate students (“Junior Fellows”) supported each year by NRAO operating funds.

In addition to graduate summer students and resident graduate students, more than 100 Ph.D. students make observations with the NRAO telescopes each year. Travel reimbursement, low-cost accommodations, and computing facilities are provided on-site to assist these students during stays of one to three weeks. The Observatory also supports stays lasting 3–6 months by students who wish to collaborate with the NRAO staff scientists as part of their PhD research.

These internships let graduate students work closely with the NRAO staff and forge valuable long-term links to the university community.

Support is also provided on an as-available basis for students performing thesis observations on the GBT, the VLBA, and large, legacy-type VLA projects. Students at U.S. universities are eligible for the program, which covers salary and miscellaneous expenses, such as computers and travel, to a maximum of \$35,000. This very popular program is funded by the NRAO operations.

3.2.4.3 Postgraduate Programs

The Jansky Postdoctoral Fellowship Program remains one of the top postdoctoral fellowship programs in the world. Jansky Fellows carry out investigations independently or in collaboration with others within the wide framework of interests of the Observatory. In addition to astrophysics research, the NRAO encourages work on radio astronomy instrumentation, computation, and theory. The appointments are made, as resources are available, for two-year terms that can be extended for a third year. Approximately half of these fellows are in residence at the NRAO; the others are non-residents located at U.S. universities or research institutes. Resident fellows are encouraged to spend time at universities working with collaborators during the course of their fellowships, while non-residents are encouraged to make frequent and/or long-term visits to the NRAO sites.

In addition to the Jansky Fellows, the Observatory funds, as resources are available, the NRAO Postdoctoral Fellows. These appointments are similar to Jansky Fellowships, but the NRAO Fellows have responsibilities of up to half time for the operation and support of the NRAO facilities. The North American ALMA Science Center (NAASC) will provide support for four concurrent Jansky Fellows in the steady state, as well as additional funding for several NAASC postdocs.

3.2.4.4 University–NRAO Programs

Beyond educating and training future generations of radio users through its undergraduate, graduate, and post-graduate programs, the NRAO works to maintain an active U.S. radio-astronomy community. This is accomplished in a variety of ways including staff community service, visitor programs, organizing scientific meetings, and funding university-led hardware and software projects.

The NRAO scientific and engineering staff serve on advisory committees and review panels, serve as AAS Officers and on its committees, teach university courses, serve as editors and referees for professional journals, and present colloquia and invited talks at international meetings. This interaction is further enhanced via the NRAO-organized scientific meetings and workshops through which all scientists have an opportunity to reflect on the current direction of astronomical research and the state of instrumentation and techniques. The Observatory also supports visits by outside Ph.D. scientists and engineers to any of its sites so that they may interact with the NRAO staff. The length of a visit is optional, ranging in duration from weeks (summer research visits) to months (sabbatical visits).

3.2.4.5 University Instrumentation Support

The NRAO supports university-based instrumentation development programs, as resources are available. These programs create training opportunities for students and postdocs, as well as the opportunity to develop science and technology pathfinder instruments.

3.3 Employee Performance Management System

A systematic approach to evaluate employee performance and managing compensation is an essential part of managing the Observatory workforce and is described in the sections below.

3.3.1 Performance Evaluation

Employee performance is formally evaluated annually and is required for full and part time staff working more than 500 hours per year. Employees begin the process by submitting a self evaluation relating to their goals and accomplishments. Managers receive the self evaluations and further develop them into the employee evaluations where performance is rated, training objectives are set, and goals are established for the coming year. Employees then meet with their managers to review and discuss their evaluation.

3.3.2 Compensation

The NRAO annual salary (merit) review process follows the performance evaluation process. The annual salary increase budget is established from an analysis of market-based and geographically-appropriate salary budget surveys. A merit increase pool is assigned to each organizational unit, and managers are instructed to distribute their division's merit pool based on employee's performance.

As part of the NRAO annual salary (merit) review process, the AUI President, with the advice of the AUI Board of Trustees Compensation Subcommittee reviews and approves the NRAO Director's recommendations for salary increases for Assistant and Associate Directors and those employees whose salaries are in excess of \$125,000 per annum (including employees whose salary increase will move their salary above \$125,000).

Maintaining market-based compensation levels for critical jobs is essential to recruiting and retaining the NRAOs workforce. The NRAO maintains a variety of salary survey sources in order to determine the appropriate market compensation levels for the diverse mix of jobs across the Observatory.

4.0 Employee Professional Development and Motivation

Employee professional development and motivation include: (1) needs assessment, (2) key staff development needs, (3) workforce and leader development, (4) workforce enrichment, and (5) evaluation and reinforcement.

4.1 Needs Assessment

Assessing the developmental needs of the workforce begins with strategic planning, understanding what knowledge, skills, experience, and diversity are required to meet the future demands of the NRAO workforce. It then cascades down to the employee performance appraisal process where employee-specific training and development needs are assessed and addressed. Organizational-wide development needs are identified through the strategic planning process. Division heads are required to assess developmental needs relative to the specific knowledge, skills, experience, and diversity of the positions in their division. Progress is gauged via performance evaluations, surveys, employee relations complaints, attendance, and turnover.

4.2 Key Staff Development Needs

Key organizational development needs are driven by the NRAO's move into international operations, by fiscal constraints which have forced revised priorities and renewed attention to skill retention. These have significantly increased the complexities of managing the Observatory. The challenges of hiring, managing and supporting staff internationally while working directly with international business partners require skills or experience that many managers and staff lack. Each of the primary development areas is outlined below.

International Relations – Managers and staff must learn to work effectively with people from different countries and cultures. The challenges are magnified because the ALMA business model is new to all partners and brings together many people from different countries and organizations that have to work together as one organization. Misunderstandings related to cultural differences and competing business needs should not occur. It is critical to the long-term success of the Observatory to develop the skills so that its workforce supports its international operations.

Change Management – In addition to the significant impact international operations has placed upon the organization, material fiscal constraints are challenging the NRAO operations at every level. At the strategic level, the NRAO must manage its future, moving from being reactive to being proactive in clearly and effectively demonstrating what is needed to fulfill its mission. Adapting to these challenges requires the ability to question its work and efficiency at every level, and to understand and prioritize those activities that best impact science results.

4.3 Workforce and Leadership Development Programs

The NRAO uses formal and informal programs to support workforce development.

Informal programs include training and development that is delivered at the division level based on needs assessment conducted through the annual performance evaluation process. Each division supports employee mentoring among its junior and senior staff.

The formal workforce development program includes annual manager and employee training, delivered through NRAO Human Resources, focusing on topics that support the strategic plan

and ongoing needs assessments. Topics have ranged from writing effective performance evaluations to employee rights and responsibilities under the Family Medical Leave Act.

4.4 Workforce Enrichment

Workforce enrichment programs attract and retain high quality employees by creating a positive work environment and work/life balance. The enrichment policies and programs in place at the NRAO include a comprehensive employee benefits package with a retiree medical plan, supportive leave policies, flexible work arrangements, scientific staff tenure, an ombudsman program, performance awards, service awards, monthly birthday recognition events, annual picnic and holiday parties, a daily coffee/snack break event, subsidized wellness programs, diversity committee, employee benefits/morale survey, and periodic all-hands meetings.

4.5 Evaluation and Reinforcement

Assessing organizational success in meeting its objectives against the capabilities of the workforce is the principal measure of the effectiveness of the NRAO workforce programs. Observatory objectives can be measured by examining the success rate in meeting project and assignment completion dates along with deliverables quality. Employee absenteeism, employee complaints, turnover, and difficulty filling vacancies are all indicators of possible training and developmental issues with employees and/or managers. Progress on employee development can be tracked and assessed annually through the performance evaluation process. Employee surveys are also used to evaluate employee concerns and needs. The NRAO uses a variety of communications methods to educate employees and managers about the policies and programs available. This includes email, home mailings, posting in high traffic areas, Intranet, face-to-face meetings (retirement, personnel, and benefits counseling), and group meetings. When shortfalls are identified, NRAO Human Resources works with the appropriate people within or outside the Observatory to develop and recommend solutions to the NRAO Director.

5.0 Employee Well-Being and Workforce Climate

AUI and the NRAO work to assure employees' well being and to provide an appropriate workforce climate by: paying careful attention to and investing in the work environment; providing employee support, satisfaction and engagement; and supplying services, benefits, and policies. The NRAO has clear policies and methods for periodically assessing employee well being and the workforce climate, and has established methods and policies that promote and guide improvements.

5.1 Work Environment

The creation and maintenance of a safe and supportive work environment is an AUI and NRAO priority.

5.1.1 Environment, Health & Safety (EH&S)

A process is in place that requires annual high-altitude safety exams to ensure that all the NRAO personnel working at such elevations are sufficiently healthy.

The NRAO refers to its corporate manual guidelines for the basic programs specified by OSHA as “high risk” including Electrical Safety, Elevated Work Safety, Fire and Life Safety, Hazard Communication, Overhead work (Cranes, Hoisting and Rigging safety), etc. OSHA specifically called out each of these, and each is complete in our program. Full access to the corporate safety manual and to the individual Safety Officers and Representatives is maintained online for all employees.

The NRAO ES&S programs include staffing, support & maintenance of Fire & Rescue Brigades at each of our large, remote locations (VLA and GBT), as well as at the JAO facility in Chile.

5.1.2 Emergency Preparedness

Each remote site (VLBA excepted) maintains a full complement of fire brigade and rescue personnel. The teams are provided training with regional professional and volunteer emergency teams in all aspects of emergency response from fighting wild fires to high altitude rescue.

Two Operators who are trained in basic first aid and have access to a complete first aid kit staff each VLBA site. They have access to telecommunications equipment to summon additional aid should that prove necessary (radio, telephone, pager, email, etc.).

The NRAO works closely with the JAO and the other executives in Chile to ensure the special safety requirements appropriate to the ALMA site are addressed. The ALMA project (Chile) has been provided with the funds, expertise, and management support to develop rescue teams similar to those of the EVLA. These include high altitude rescue training, transport equipment and also an ongoing relationship with emergency medical service providers. Two ambulances are present at the Chilean Operations Support Facility/Array Operations Site with 24/7 paramedic support to ensure rapid transport and effective case management for any employee or contractor who requires treatment.

Additional activity includes supporting development programs for our Site Safety Officers to continue their training and obtain professional certification.

5.2 Employee Support, Satisfaction and Engagement

AUI and the NRAO support employee satisfaction and engagement by providing multiple avenues for employees to obtain guidance support or voice their concerns.

Human Resources – The NRAO Human Resources manager reports to the Director, thereby providing the Director with direct access to employee issues that come to the attention of HR. The HR Manager is also the primary employee relations person within the Observatory.

Ombuds Program – There are times when an employee may feel uncomfortable discussing a work related issue with Human Resources. The NRAO Ombuds program supports these employees, and ombuds-trained staff are present at each facility. All matters are kept in strict confidence, except that employees are informed that serious issues such as sexual harassment must be reported to the NRAO.

Grievance Policy – In situations where the employee is not satisfied with the outcome of a manager’s decision, the employee may file a formal grievance that can be appealed up to the NRAO Director.

Employee Assistance Program (EAP) – To provide confidential, professional assistance to employees and his or her families on personal and work matters, each employee and family member has free access to the EAP program run by CIGNA Behavioral Health.

Health Advocate – To assist employees and their family members with their medical care, flexible spending accounts (FSA), dental and vision needs and their use of the NRAO medical plan benefits, the Observatory provides free access to trained nurses and health care experts through Health Advocate.

Diversity Committee – The NRAO Diversity Committee is expanding to support local affinity groups at each of the NRAO sites. It will also sponsor employee surveys and discussion groups to assist NRAO in improving employee satisfaction and engagement. AUI’s Diversity Officer is a member of the NRAO Diversity Committee.

5.3 Services, Benefits and Policies

AUI and the NRAO support a wide range of services, benefits, and policies that support its workforce. Its Human Resources, Administrative, and Science and Academic Affairs offices oversee the majority of the NRAO-wide services, policies, and benefits that support its workforce. These policies and programs are maintained by the responsible division on the NRAO internal website. The Supervisors Manual and Employee Handbook are available online.

AUI provides a core set of benefits to all eligible NRAO employees as summarized below.

AUI Medical Plan – Employees and their eligible dependents may participate in the Group Medical Insurance program, an Open Access Plus (OAP) Plan. Networks of health care providers have been established to provide quality care at negotiated rates.

Group Dental Insurance – Employees may subscribe to dental insurance coverage for themselves and their eligible dependents. This insurance provides comprehensive coverage for preventive, major, and restorative dental procedures.

Group Life Insurance Plan – Employees are provided a basic life insurance plan at no cost. The coverage is equal to the basic annual salary rounded to the next \$1,000. Coverage for eligible part time employees is based on their part-time annual salary. Optional additional coverage, in amounts equal to one or two times the basic insurance amount may also be purchased.

Travel Accident Insurance – The Observatory maintains travel accident insurance for all employees. The plan covers loss from accidental bodily injury, total permanent disability, or death sustained during travel on official NRAO business. The plan is provided at no cost to the employee and carries a death benefit equal to five times the employee's basic annual salary, subject to a minimum of \$100,000 and a maximum of \$500,000.

Long Term Disability Insurance – The Observatory provides Long Term Disability Insurance to guard against complete loss of income due to lengthy periods of disabling illness or injury. The monthly income benefit payments provided are equal to 60 percent of the employee's basic monthly earnings less any benefits received from Social Security or Workers' Compensation. Eligible employees age 30 and over are required to participate in the Long Term Disability Plan. Participation is optional for employees under age 30. The employee premium for this coverage is 0.25 % of base salary each pay period.

Accidental Death And Dismemberment Insurance – Each employee is provided with accidental death and dismemberment insurance equal to his/her basic life insurance amount at no cost. If the employee purchases optional additional life insurance coverage, he or she may purchase an equal amount of accidental death and dismemberment insurance.

Workers' Compensation – The Observatory maintains workers' compensation in accordance with the applicable state laws where it conducts operations.

Reimbursement Accounts – Employees may establish reimbursement accounts, also called flexible spending accounts, which allow them to withdraw tax-free dollars that have been set aside by salary reduction to pay for out-of-pocket health care, dependent care, or commuting expenses. By paying such expenses through reimbursement accounts, the net cost is reduced because of the savings in income and FICA taxes. Minimum contributions of \$100 are required. Maximums are \$5,000 for health care accounts and \$5,000 for dependent care accounts.

AUI Retirement Plan – The Retirement Plan provides defined contribution accounts for employees. The Observatory contributes an amount equal to 10 percent of each participant's base salary per year. No contributions are required of the employee. The Observatory begins making contributions for regular full-time and eligible part-time employees who are over age 21 after the completion of two years of service, or after 3 months of service if they are age 30 or more.

AUI Supplemental Annuity Retirement Plan – In addition to the AUI Retirement Plan, the Observatory provides employees with the option to add to their retirement savings through 403-B tax deferred investment options. Regular full-time or eligible part-time employees may divert a percentage or set dollar amount of their annual base salary to one or more Voluntary Tax-Deferred Retirement Program options. Employees may choose funds from TIAA-CREF and/or Fidelity for both retirement plan options.

In addition to the above listed core set of benefits, NRAO provides the following benefits to employees as summarized below:

Direct Deposit of Payroll – To enhance the security and timely distribution of payroll checks the Observatory requires all employees to participate in payroll direct deposit to a financial institution(s) of their choice. Direct deposit can be made to multiple accounts.

Vacation – Regular full-time monthly employees and bi-weekly employees in positions in pay schedule I accrue vacation credit at the rate of 16 hours for each full month of service up to a maximum of 288 hours. Schedule II accrues vacation hours based on years of service. A day of accrual equals eight hours of vacation credit. Eligible part-time employees accrue vacation credit as above, but prorated according to their official work schedules. Vacation is credited at the end of the first full month of employment and each full month of service thereafter.

Holidays – The NRAO observes twelve paid holidays each year: New Year’s Day, Martin Luther King Day, Presidents’ Day, Memorial Day, Independence Day, Labor Day, Veterans’ Day, Thanksgiving Day, Friday after Thanksgiving, Christmas Day, and two floating holidays. Holiday pay for eligible part-time employees is prorated according to their official work schedules.

Doctor or Dentist Visits – Regular full-time employees are given 32 hours of doctor or dentist visit absences per year. This leave is to be used when doctor or dentist visits cannot be scheduled outside working hours. The minimum charge will be one hour. Once 32 hours have been used, subsequent visits are charged to accrued vacation, sick leave as appropriate, or leave without pay.

Sick Leave – Regular full-time employees accrue ten hours of sick leave each month, up to a maximum credit of 108 days. Eligible part-time employees accrue sick leave as above, but prorated according to their official work schedules.

Vision Plan – Employees may participate in our voluntary vision program. This program provides coverage discounts at participating network providers.

AUI Trustee Scholarships – At least three college scholarships are awarded each year to rising high school seniors of regular NRAO employees and retirees. Up to two additional scholarships may be awarded to NRAO employees' children who are African American, Hispanic, or Native Americans. These scholarships are awarded on merit and provide each recipient with up to \$3,500 for each of four academic years to help defray costs of tuition, lodging, board, etc. The student must attend an accredited college or university and selects a course of study leading to a degree. A third party organization, the Educational Testing Service/Scholarship and Recognition Programs, administers the selection process and program.

The NRAO Tuition Reimbursement Policy – This policy supports all regular full-time employees. To qualify, the degree/courses must be related to the employee’s job, or required for a degree that is related to the employee’s job. The percentage reimbursed depends upon the degree level achieved by the employee. Undergraduate level courses are reimbursed at 75% of the tuition cost upon completion of each course. When the associate or baccalaureate degree is completed, the employee will receive reimbursement for the remaining 25% of tuition costs for courses completed in the last five years prior to the receipt of the degree. If the baccalaureate degree has been completed, the employee will receive 100% reimbursement for

tuition costs of approved graduate courses successfully completed while in the Observatory's employ. Tuition advances are available to assist employees in funding their education.

5.4 Assessment Methods

Internal benchmarking among our sites is possible with a common audits format. In addition, routine and frequent small audits enable the Observatory to better compare itself to similar NSF facilities that are not under the management of AUI. The NRAO will use categories such as People Observations (count data), Unsafe Practices, Unsafe Conditions/Behaviors, etc., and examine any differences. Leading indicators are often easy to create but they sometimes do not generate useful information until they have been considered in identical cultural contexts. This is difficult within the NRAO given that our sites are remote from one another and sometimes the rest of the world.

Changes to date have included shifting the audit/inspection frequencies from the EVLA and GBT to more frequent but smaller inspections. We are using the NSF audit protocol to monitor progress at the Operations Support Facility in Chile. The protocol used by NSF in October 2008 will be revisited by November 2009.

5.5 Identifying Priorities for Improvement

The NRAO is examining the historical list of injuries to determine how they occur. This process is lagging so we are also driving the sites to a common inspection/audit format to provide us with leading indicators.

The NRAO is also focusing on examining improvement items based on likely severity and probability of occurrence. Those items that are high severity and likely to occur are prioritized at the high end of the list. The schedule and capabilities of the resource owning the problem is evaluated and the project or scientific community's activity is dovetailed with the larger Observatory-wide efforts. Dangerous fixes and regulatory requirements are always first priority. The next priority would be development of staff and systems to monitor, predict and prevent incident.

6.0 WMP Management and Continuous Improvement

Ensuring that organizational learning based on workforce management outcomes is integrated into strategic and operational plans is an NRAO priority. To facilitate organizational learning, Key Performance Indicators (KPIs) (see section 1.3) are assessed on a recurring basis. These KPIs are evaluated by key Observatory personnel from three distinct perspectives: local operations, global operations, and strategic impacts.

6.1 Local Operations

From the local operations perspective, workforce management is the responsibility of the Assistant Director who determines staffing needs and explores strategic staffing requirements with Division Heads on a quarterly basis. These groups, which meet on a quarterly or semi-annual basis, operate as "quality circles" and recommend opportunities for improving the

workforce management plan to the Observatory at the global level. To meet the changing needs of the NRAO workforce, this information is supplemented by surveys and other informal mechanisms for diagnosing the effectiveness of workforce management initiatives from their perspective (e.g., training effectiveness), as resources allow.

6.2 Global Operations

Because the NRAO recognizes that it is important to ensure alignment between day-to-day practices and the workforce management strategy, these KPIs are discussed regularly at the NRAO Operations meeting led by the Deputy Director. This meeting provides a forum for Observatory staff at the most senior levels in the operations organizational structure to describe progress, resolve conflicts, identify opportunities for coordination and collaboration, and integrate feedback from metrics and reports into operations procedures.

6.3 Strategic Impacts

The strategic aspects of workforce outcomes are considered by the Director's Office, in conjunction with the NRAO Human Resources Manager, and AUI. These individuals and groups are responsible for examining the outcomes of the workforce management plan in the context of the NRAO readiness for future long-term projects, and ensuring that the funding is available to build organizational capabilities as necessary.

In addition to KPI reviews at the NRAO Operations meetings, trends are reported in each Quarterly Status Update (QSU). The results from this process contribute to the strategic planning cycle in which specific initiatives are formulated to mobilize the Observatory to collectively meet workforce management goals. Evaluation and application of these results is aligned with the annual budget cycle to ensure that feedback mechanisms are sound.

ACRONYMS

Acronym	Definition
AAS	American Astronomical Society
AUI	Associated Universities, Inc.
FSA	Flexible Spending Accounts
FTE	Full-time Equivalent
GBT	Robert C. Byrd Green Bank Telescope
KPI	Key Performance Indicator
LRP	Long Range Plan
NRAO	National Radio Astronomy Observatory
NSF	National Science Foundation
OAP	Open Access Plus Plan
OSP	Observatory Staffing Plan
POP	Program Operating Plan
REU	NSF Research Experience for Undergraduates program
SWE	Society of Women Engineers
VLA	Very Large Array
VLBA	Very Long Baseline Array
WMP	Workforce Management Plan

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