



# Hawai'i Island Astronomy Workforce Opportunities 2010-2023

Hawai'i County Workforce Investment Board and Mauna Kea Observatories'  
Hawai'i Island Astronomy Workforce Survey

August 11, 2010



An electronic copy of this report can be found at:

<http://www.hawaii-county.com/ohcd/2010AstronomyWorkforceReport.pdf>

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## **Executive Summary**

Technical and administrative staff comprise a sizeable majority of an astronomy observatory's workforce. A 2007 University of Hawai'i survey showed that only 18% of the astronomy observatories' technical and administrative staff based on the island of Hawai'i were born on the island. Including those born on Hawai'i Island, only 27% were born in the State. Another 33% were residents of the State when hired, but not born there.

Despite significant costs, a full 40% of the observatories' technical and administrative staff have had to be recruited and relocated from overseas locations, primarily because the pool of qualified applicants on Hawai'i Island was insufficient to fill the observatories' needs. It would be very beneficial to both the local island community, and the observatories, if there were an adequate local pool of qualified candidates to fill these positions as they become available.

Based on the requirements of the current observatories and creation of new positions planned for the Thirty Meter Telescope, together with ordinary job turnover, projections show that some 482 observatory jobs will come open in technology and administration from 2010 through 2023. That averages more than 34 jobs a year over the 14-year period.

A collaboration is proposed between the Hawai'i County Workforce Investment Board, the observatories, and the educational and training resources that already exist within the local island community to take steps to provide an adequately trained labor pool. This collaboration would address the larger issues of K-12 STEM education, and develop programs for grade-levels 13-16 that support the technology and administration knowledge and skills needed by the observatories.

This effort would include gaining hands-on experience through a coupling of current and future internship and practicum opportunities provided by the observatories. The same skills they need would also be suitable for a wide range of other high-technology enterprises that might enhance the local economy and provide even more jobs for future generations on the island.

As a first step, the Workforce Investment Board and the Mauna Kea observatories have been working together to identify opportunities within the current and future workforce. A new survey has been completed that identifies the technical and administrative disciplines needed by the observatories, the entrance-level educational requirements for these positions, and the expectations for both workforce growth, and the number of future job openings.

Over 330 job openings in technology and nearly 150 openings in administration are expected through 2023. Most of these jobs require either a two-year Associate's degree or a four-year Bachelor's degree. The delivery of the required educational and training programs should be well within the capabilities of the local community.

The Workforce Investment Board and the observatories are seeking other partners in developing plans and resources to move forward in this direction. The longer-term goal is to use this mechanism to ensure that Hawai'i Island can succeed in a future with a more diversified economy that also includes other forms of high technology and other advanced eco-friendly enterprises.



# Hawai'i Island Astronomy Workforce Opportunities

## Introduction

The confluence of dry air above the tropical inversion layer, a very high site, gradual slopes, steady winds, fair weather, dark skies, and access to modern communications and transportation capabilities has led to the summit region of Mauna Kea being widely regarded as one of, if not the, world's best site for visible light, infrared, and submillimeter-wave astronomy. As a result, the US and many other nations have made capital investments of \$1-billion or more on Mauna Kea, and future investments of comparable magnitude are anticipated.

Contrary to what many may believe, the staff of a typical observatory is *not* overrun with working scientists. In fact, more than 80% of the jobs are in some discipline other than research. These "other" fields are dominated by technology and administration (Fig. 1).

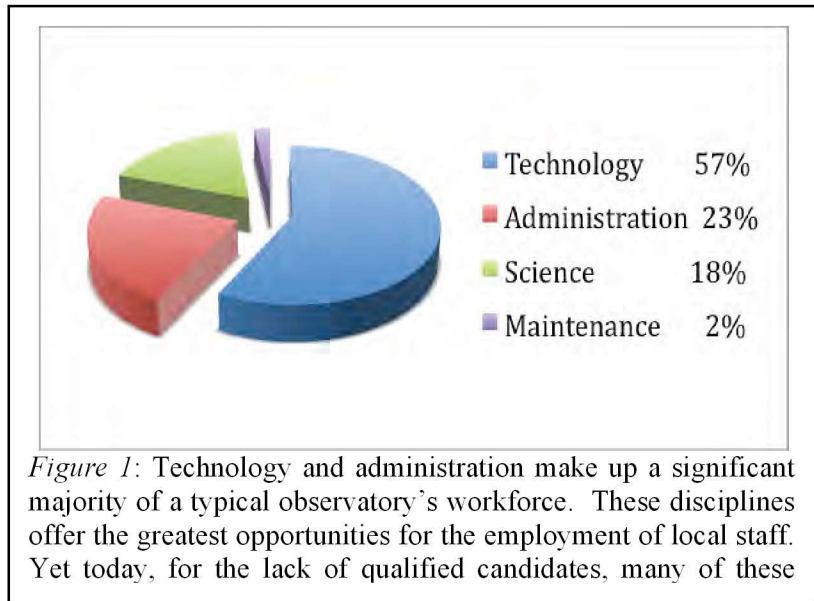
A 2007 survey conducted by the University of Hawai'i Institute for Astronomy showed that the Mauna Kea observatories had a total staff of 610 people based on the Island of Hawai'i. It also showed that

only 27% of the *technical* and *administrative* staff employed by the observatories were born and raised in Hawai'i, while another 33% were living in the State when hired, though *not* born there.

***A total of 40% of the technology and administration staff were recruited and relocated from overseas locations. This amounts to 136 jobs in 2010 and 164 jobs in 2023.***

At the same time, the observatories have discovered that, in the first three years, the turnover rate for *newly relocated* staff is about twice that for locally hired staff, leading to significant added costs as the observatories continue to recruit and relocate in order to refill these positions, and have to deal with the loss of continuity and productivity that inevitably occurs in such situations. As a result, the observatories have long recognized that it is in their interests to hire qualified local staff whenever possible. The larger Hawai'i Island community would benefit greatly from having a larger fraction of these positions filled by local people, socially, economically, and culturally.

***The challenge facing both the local community and the observatories is that there are relatively few qualified local people available to apply for these positions.***



The Hawai'i County Workforce Investment Board (WIB) and the Mauna Kea observatories are collaborating in an effort to first understand the realities of the workforce composition and then to engage with local community resources to find solutions that will be of long-term benefit to both the people of Hawai'i Island and the local astronomy community.

This effort began with a new staffing survey focused on understanding the current and future size of the collective observatories' technical and administrative staff and the required educational qualifications for these positions. The intention is to use this information as a starting point for a program to empower more local people with the educational and the experiential background to successfully participate in the astronomy workforce<sup>1</sup>.

## **The Survey**

In October 2009, the Directors of the Mauna Kea observatories joined with the WIB by having their human resources staff assist in this survey to establish the number of current and future technical and administrative staff positions, and their entry-level educational requirements.

### ***Categories and Subcategories***

The positions were broken down by discipline, first into two large categories, and then each of those was further broken down into five narrower subcategories:

Engineering and Technology ("Technology"),

- Mechanical
- Electronic-Electrical
- Optical
- Software
- Information technology

Administration and Support ("Administration"),

- Accounting-Bookkeeping
- Contracting-Purchasing
- Financial Services
- Human Resources
- General Support

In each subcategory, the observatories identified the number of positions according to their *minimum* educational requirements, in terms of a:

- High school diploma or GED,
- Associate's degree,
- Bachelor's degree, or an
- Advance (post-graduate) degree.

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<sup>1</sup> It should be noted that Hawai'i already has high-quality, in-place, dedicated programs for those students interested in becoming *research* astronomers. UH Hilo offers a BS degree program in Astronomy, while UH Manoa offers graduate programs through the PhD and post-doctoral fellowships. There are just many more jobs available in technology and administration.



## Long-Term Models

The observatories provided snapshots of staff numbers for early 2010 and provided estimates for 2014. These data, and known or anticipated future changes, including the addition of new facilities, like the proposed Thirty Meter Telescope (TMT), and the closure of older facilities, such as the Caltech Submillimeter Observatory (CSO), were used to produce estimates of the staffing and job availability picture for 2010 through 2023.

Three different models were constructed (Fig. 2). All three models included the TMT development.

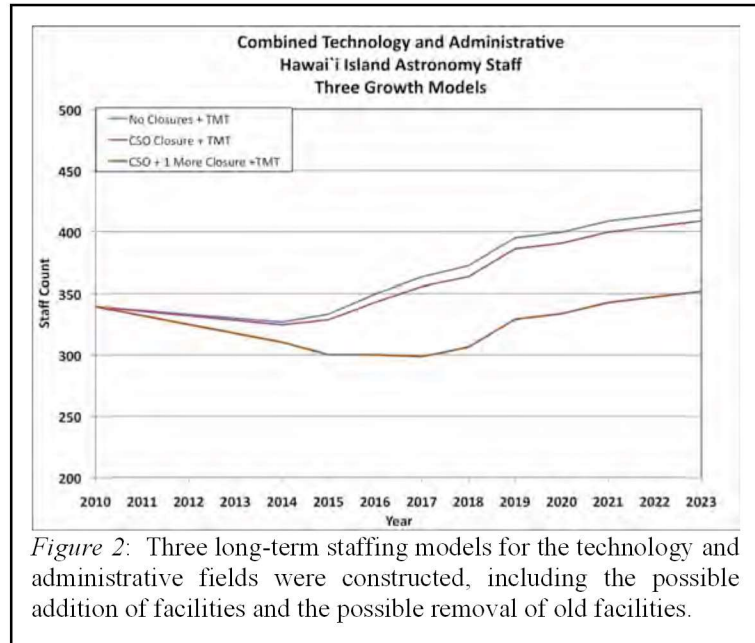


Figure 2: Three long-term staffing models for the technology and administrative fields were constructed, including the possible addition of facilities and the possible removal of old facilities.

The baseline reference model includes only the current observatories and the TMT. The second model adds the planned decommissioning of the CSO (the One-Closure model); while the third shows the possible impact of the closing of a second, generic, telescope.

The One-Closure model is used here as the most likely circumstance. While a second closure is possible, it would not be uncommon for such an event to end up as a change of ownership. (It turns out that the number of jobs *available* to be filled is not terribly sensitive to which of the three models is chosen, so long as the model includes the TMT.)

All the models show a small decrease in positions between 2010 and 2014. This is a result of a modest near-term staff reduction, no doubt resulting from the current global economic situation. The One-Closure model shows a somewhat stronger dip into 2015, reflecting the phasing out of the several staff supporting the CSO facility.

The strong increase from 2015 through 2023 is primarily due to the ramp up of the TMT staff, as the Mauna Kea and Hilo base facilities are developed and made operational.

## Jobs vs. Job Openings

*Available* jobs depend on two main factors: the creation of *new* jobs, and the turnover in *existing* jobs, all as functions of time. Job openings were modeled by first computing the change in the job counts from one year to the next (job creation), using the long-term staffing models. Then, using observatories' real-world turnover experience, computing the fraction of modeled *existing* jobs that would turn over each year. The sum of new jobs and turnover jobs provides the modeled number of job openings from year to year. As shown in Figure 3, turnover alone accounts for more than 20 job openings a year, while the TMT staff ramp up will push the total up significantly from 2015 through 2023.

### 2015 is the Key Date

Even with a concerted effort, it is expected that an organized community effort to facilitate an enlarged local pool of qualified candidates for the astronomy workforce will take some time to realize. Many of the students that would be able to go directly from school to the workforce and take advantage of the sharp job-opening *upturn* beginning in 2015 are currently in *middle school*. The good news is that Figure 3 shows that there is time available to develop a coordinated program to take advantage of this opportunity.

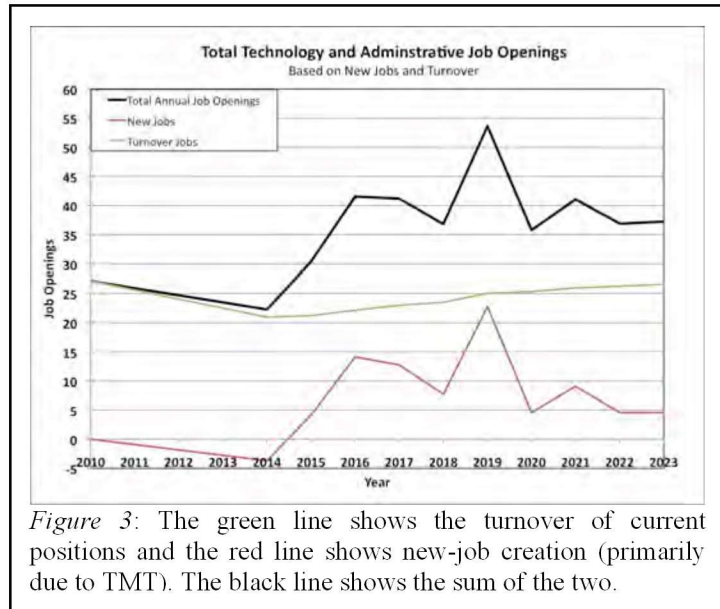


Figure 3: The green line shows the turnover of current positions and the red line shows new-job creation (primarily due to TMT). The black line shows the sum of the two.

*Now is the optimal time to address this issue for the maximum community impact.*

### Survey Results Overview

The survey data were used to search for a suitable set of highly leveraged opportunities for investment actions. It was anticipated that some discipline subcategories *and* some educational levels would naturally lead to greater practical benefits to greater numbers of people. The assumption was that these areas would be the most likely avenues to begin making the fastest and most beneficial progress.

While perhaps not a surprise, one immediate finding was that the total Technology job pool is about twice as large as the Administration pool (see Fig. 4). This gap appears to be growing as time goes on.

It is important to recognize that, while an important means to the end, the object of this study is *not* really about estimating the size of these workforce segments, but rather estimating the number of *available jobs* that will result over time. That is to say, it is about the number of *job openings*, not just the gross number of jobs.

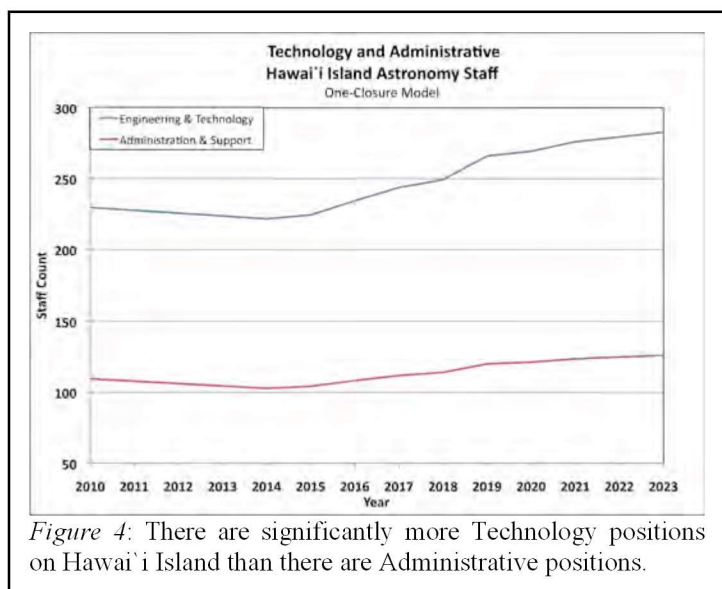


Figure 4: There are significantly more Technology positions on Hawai'i Island than there are Administrative positions.

Like the total number of jobs, Figure 5 shows that a major fraction of the future job *openings* will be in the Technology fields. What is more important is that the number of upcoming job possibilities is growing at a higher percentage rate than the total number of jobs, especially in the 2015-2023 period, during which a total of 355 job openings are predicted over all categories considered.

Aside from the observatories' innate reliance on many sophisticated technologies, there are at least two other likely causes for the Technology-Administration difference. The first is the fact that many of the observatories are parts of larger organizations with remote administrative headquarters, for example at an overseas university or research institute. The second factor is that a number of the observatories also outsource some fraction of their administrative functions, such as human resources, benefits, and payroll to other entities, such as the Research Corporation of the University of Hawai'i.

## Technology Analysis

Table 1 shows a total of 247 Technology job openings during the 2015-2023 period that result from the combination of newly created positions and staff turnover.

As before, the five fields considered here are:

- Mechanical,
- Electronic-electrical,
- Optical,
- Software, and
- Information technology.

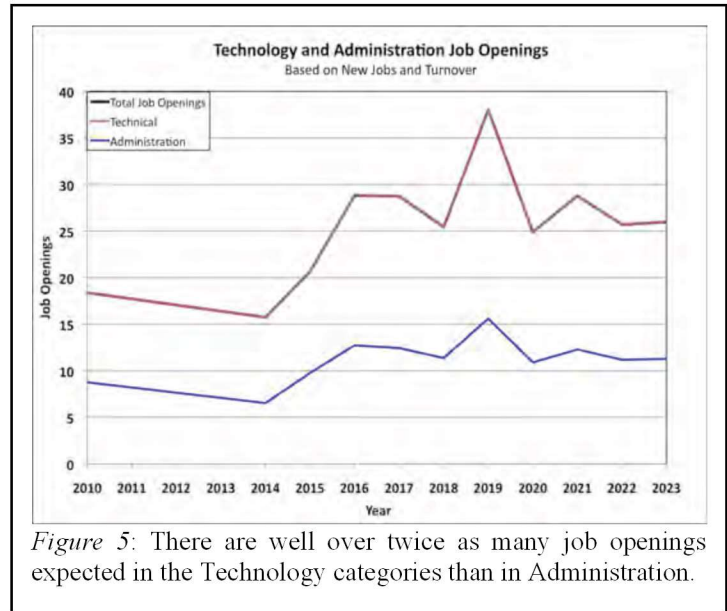


Figure 5: There are well over twice as many job openings expected in the Technology categories than in Administration.

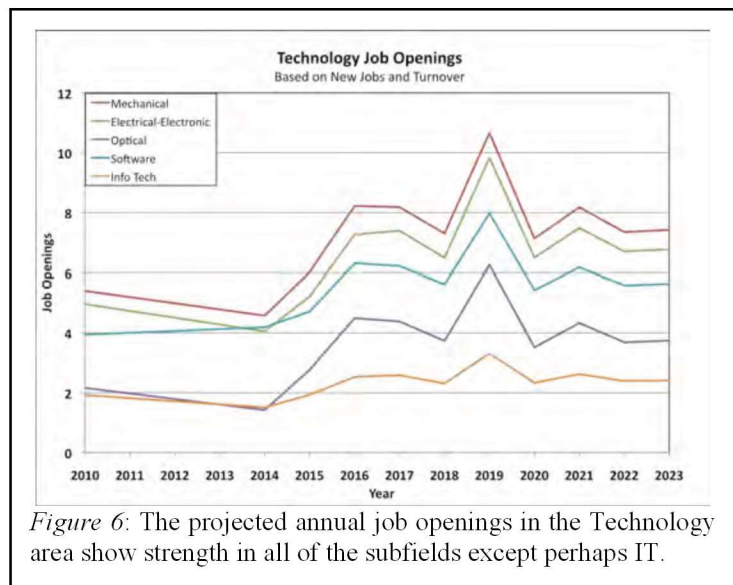


Figure 6: The projected annual job openings in the Technology area show strength in all of the subfields except perhaps IT.

## Job Openings and Requirements

While there is a clear plan for the number, skills, and educational requirements for *new* staff over 2015-2023, the plan does not detail which exact year each position will be filled. So the *average* yearly job openings are a stronger indicator.



Figure 6 shows that the mechanical and electronic-electrical areas are dominant. Software and optics are in the second tier, and information technology is in the third tier. These all strongly show the signature of the TMT staff ramp up.

Focusing on the two-year and four-year college levels *only*, Table 1 indicates that the mechanical and electronic-electrical fields will each provide an average of six to seven jobs a year, with the educational requirements about evenly split between the Associate and Bachelor levels.

The optical field is predicted to provide about three jobs a year with the majority at the Bachelor's level, though there are opportunities at the Associate's level as well.

Surprisingly few openings show up in the information technology area. Most are at the Bachelor's level, with some at the Associate's level. Evolving Federal information-security mandates may well lead to rather larger numbers by 2015.

## Administration Analysis

Table 2 shows a total of 108 Administration job openings during the 2015-2024 period, resulting from the combination of new positions and turnover. As noted, this is considerably smaller than the Technology area.

The five fields considered here are:

- Accounting-Bookkeeping
- Contracting-Purchasing
- Financial Services
- Human Resources
- General Support

## Job Openings and Requirements

Figure 7 shows that the general support area stands head and shoulders above all the other areas. By contrast, each of the remaining areas average about one job per year.

A closer view of the General Support category, as shown in Table 2, suggests that it is a very mixed bag. On the one hand, nearly half of the group requires only a high-school diploma or GED, while nearly another half is fairly evenly divided Associate's and Bachelor's levels – suggesting that these two groups may well be very different populations. This is further confused by the fact that another four positions in this category require *post-graduate* degrees.

**TABLE 1**  
**Technology: Job Openings and Educational Requirements**

Technology	2015 - 2023	Annual Mean
<b>Total</b>	247	27.4
<b>Mechanical</b>	70	7.8
HS Diploma/GED	11	1.2
AA/AS	31	3.5
BA/BS	27	3.0
Advanced	1	0.2
<b>Electronic-Electrical</b>	64	7.1
HS Diploma/GED	1	0.1
AA/AS	25	2.7
BA/BS	31	3.5
Advanced	7	0.8
<b>Optical</b>	37	4.1
HS Diploma/GED		
AA/AS	10	1.1
BA/BS	19	2.1
Advanced	8	0.9
<b>Software</b>	54	6.0
HS Diploma/GED		
AA/AS	2	0.2
BA/BS	47	5.2
Advanced	5	0.6
<b>Information Tech</b>	22	2.5
HS Diploma/GED		
AA/AS	6	0.6
BA/BS	17	1.8
Advanced	0	0.0



This situation appears to be a technical shortcoming of the survey process itself, and not the human resources collaborators. It's likely that the survey instructions were unclear, or that the range of offered survey categories was insufficient to allow a more usefully detailed classification of at least some of these positions.

It seems reasonable to assume that the high-school and GED group probably include clerks, secretaries, facility staff, and other essential support staff. Beyond that it is difficult to say.

With the exception of the General Support group, the remaining areas don't seem to contain any surprises and they each account for a little over one job opening per year.

## Summary and Conclusions

The WIB and the Mauna Kea observatories would like to join with various educational providers in the public and private sectors as well as other public and private organizations to develop a plan of action to take advantage of coming events to enhance the participation of local Hawai'i Island people in the workforces of the Mauna Kea observatories.

There will be numerous opportunities for job openings, not only now, but especially in the 2015-2023 period, for properly qualified local people to apply for these openings. About half of these prospective jobs arise from ordinary turnover of existing jobs. The other half will come from the creation of new positions, primarily as a result of the TMT.

While some fraction of these resulting job vacancies may well be above the entry level, generally there is a trickle down effect. Higher-level positions are more likely to be filled by *promotion* of *existing* staff (even existing staff from another observatory). This often results in

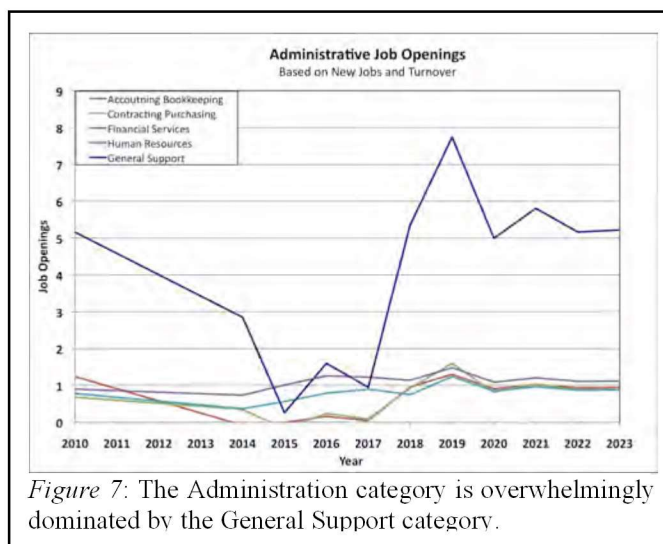


Figure 7: The Administration category is overwhelmingly dominated by the General Support category.

**TABLE 2**  
**Administration: Job Openings and Educational Requirements**

Administration	2015 - 2023	Annual Mean
<b>Total</b>	108	12.0
<b>Accounting-Bookkeeping</b>	12	1.3
HS Diploma/GED		0.0
AA/AS	2	0.2
BA/BS	10	1.1
Advanced		0.0
<b>Contracting-Purchasing</b>	12	1.3
HS Diploma/GED	4	0.4
AA/AS	3	0.3
BA/BS	6	0.6
Advanced		0.0
<b>Financial Services</b>	11	1.2
HS Diploma/GED	2	0.2
AA/AS	3	0.4
BA/BS	5	0.6
Advanced		0.0
<b>Human Resources</b>	8	0.9
HS Diploma/GED		0.0
AA/AS	1	0.1
BA/BS	6	0.6
Advanced	1	0.1
<b>General Support</b>	65	7.3
HS Diploma/GED	31	3.5
AA/AS	17	1.9
BA/BS	13	1.4
Advanced	4	0.5

a chain of promotions to fill the subsequently vacated spots, ultimately leading to the opening of an entry-level spot.

The observatories have a sound economic interest, and a keen desire to support the community, in hiring local staff. Given the time required to create programs to target these opportunities and the time frame of the surge in job openings, this is the ideal time to act.

### ***Technology***

There will be many opportunities in the technical areas. In addition to nearer-term 85 jobs during 2010-2014, the model shows that there will be about 247 more such job openings from 2015 through 2023. These will be in the mechanical, electronic-electrical, software, optical and information technology areas, mostly at the Associate's and Bachelor's degree level.

### ***Administration***

While fewer in number, there will also be a number of job opportunities in the traditional administrative areas, including accounting and bookkeeping, contracting and procurement, financial services, human resources, and general support. There will be about 40 openings during 2010-2014, and about 108 from 2015 through 2023. About half of these will be at the high school or GED level. It may well be useful to further clarify the General Support category.

### ***Sensitivity to Different Models***

It is reasonable to explore the best and worst cases of the models proposed here. In the 2015 through 2023 era, the No-Closure model predicts 367 job openings, the One-Closure model, which is the basis for most of the values quoted here, is 355, and finally the Two-Closure model predicts 274 openings. The range between all three cases is from 30 to 39 job openings per year.

### ***After 2023***

While this call to action and the resulting plan must address reasonably predictable events over the next thirteen years or so, it is more difficult to foresee what comes after that in the astronomy world. However, with good stewardship, Mauna Kea will remain a highly desirable location for ground-based astronomy.

Though not explicitly modeled beyond 2023, if the 2024 and beyond staffing levels are held constant, the turnover factor will remain constant at more than 27 job openings a year, just in the Technology and Administration area discussed here. As a separate matter, one would hope that over time a higher percentage of local people would have also found their way into the ranks of the research astronomers in residence here, using the programs already available in Hawai'i.

### ***A Longer Range View***

While the current effort is focused on the astronomy workforce itself, there is a broader view that may be even more important in the long run. There are many high-technology enterprises that are, or can be, very eco-friendly, and provide good paying jobs for local people who have the education and skill to support careers in those areas.

Drawn by the capabilities of Mauna Kea, the observatories have been at the forefront on many of those technologies on Hawai'i Island for more than four decades. This attraction to the

Mountain has overcome the economic impact of having to import a substantial high-tech workforce. However, for industries that must be driven by the realities of economic success, the absence of a qualified high-tech workforce is a major impediment that outweighs the attractiveness of the Island's beauty and life style.

The longer view is to use this opportunity to improve the educational capabilities on Hawai'i Island over the next decade, taking advantage of the common needs of the local community and observatories. This would create a longer-term pool of local high-tech enabled workers, and local tech-savvy business people, as an ongoing attractant to allow further investment in the Hawai'i Island community by other clean high-tech industries, both local and external.

### ***An Example Program Outline***

It remains for a broader group to translate these data and subsequent creative thinking into a consensus plan of action. However, the following is an example of how these data might be used, considering the data excerpt in Table 3<sup>2</sup>.

#### **Overlapping Skills**

It is important to recognize that, in an observatory, there is an intrinsically high level of overlap in the practical applications of electronic, mechanical, and optical systems.

Adding *across* these three fields shown in Table 3, there are expected to be 143 job openings at the Associate's or Bachelor's levels from 2015 through 2023 – of these 66 are at the Associate's level and 77 at the Bachelor's level. These correspond to a total of 16 job openings every year, on average; seven at the Associate's level, and nine at the Bachelor's level.

#### **Length of the Pipeline**

Another important consideration to address in the design is how far back into the educational system one might effectively reach.

If one assumes that the lowest education level for any of these positions is the high-school diploma (or GED) and if one is targeting jobs in 2023, then an 18-year-old graduate is currently five years old and in kindergarten. A 22-year-old Bachelor's level graduate is now nine years old and likely entering the fourth grade in the Fall of 2010.

#### **Formal Education**

In view of these considerations, one approach would be to consider a program that enhances STEM education in the K-12 system for the longer term.

**TABLE 3**  
**Selected: Job Openings and**  
**Educational Requirements**

<b>Technology</b>	<b>2015 - 2023</b>	<b>Annual Mean</b>
<b>Mechanical</b>	58	6.5
AA/AS	31	3.5
BA/BS	27	3.0
<b>Electronic-Electrical</b>	56	6.2
AA/AS	25	2.7
BA/BS	31	3.5
<b>Optical</b>	29	3.2
AA/AS	10	1.1
BA/BS	19	2.1
<b>Software</b>	47	5.2
BA/BS	47	5.2
<b>Information Tech</b>	23	2.4
AA/AS	6	0.6
BA/BS	17	1.8

<sup>2</sup> Extracted from Table 1.

Then, in parallel with K-12, address the near and long term needs by providing perhaps a single Associate's degree program that includes a sound grounding in one or more of these three fields, and then provides elective courses in each of the other two.

As a final step, one could provide a Bachelor's level program built around the same concepts, and articulated to accept, as an option, the Associate's degree graduates into the third year either immediately or later. This would provide an immediate upward path for the recent Associate's graduate, and also the opportunity for working Associate's-level staff, within or outside the observatories, to move up to Bachelor's level at a later time.

As an additional note, Table 3 also suggests there could be value in a suitably focused Bachelor's-level software curriculum, and Associate's-level and Bachelor's-level programs in Information Technology, particularly since these two fields already have much broader industrial audiences than just the observatories.

### **Experience and Access**

Again, this is a matter for broader discussion, but it is envisioned that the academic programs that would evolve from this effort would be linked directly to a more formal structure that would coordinate and enhance the currently existing observatory internship and practicum programs. These enhancements might well come from joint proposals to a number of Federal and State agencies, not only in the astronomy area, but also in the more general workforce area as well.

It is envisioned that this would be augmented by a "one-stop" web site that would allow students to explore and apply for internship and summer-job opportunities across all the observatories and any other partners. In the same spirit, it is envisioned that there would be a one-stop website for searching all the astronomy jobs at all the observatories at the same time.

### ***Acknowledgements***

The Task Force deeply appreciates the efforts of Dr. Colin Aspin, of the University of Hawai'i Institute for Astronomy, who serves as the Mauna Kea observatories' Directors representative to the Task Force. Likewise, the Task Force acknowledges the efforts of Dr. Jim Kennedy who served as the WIB's representative to the Task Force during the survey process.

The efforts of the administrative representatives of the observatories were essential and invaluable in compiling the labor force information for the survey. They are:

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Sandra Miyata	University of Hawai'i Institute for Astronomy
Michele Mulkey	Joint Astronomy Centre
George Nystrom	Submillimeter Array
DeeDee Warren	Canada France Hawai'i Telescope



## **Appendix - The Survey Instrument**

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