

# **New facilities, new challenges: the Telescope and Instrument Operators Evolution at ESO**

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## **ABSTRACT**

Observatories and operational strategies are evolving in connection with the facilities that will be built. For those new facilities, the strategy for dealing with the telescopes, instrumentation, data-flow, reduction process and relationship with the community is more or less handled from its conception. However, for those Observatories already in place, the challenge is to adapt the processes and prepare the existing people for these changes. This talk will show detailed information about current activities, the implemented training plan, the definition of the current operational model, the involvement of the group in projects towards improving operational processes and efficiency, and what new challenges will be involved during the definition of the strategies for the new generation instruments and facilities to be installed.

**Keywords:** Observatories, Operations, Science Operations, Telescopes Operators, Future, Facilities, E-ELT, European Southern Observatory

## **1. INTRODUCTION**

The first light of ESO Paranal Observatory was achieved on May 25<sup>th</sup> 1998 - more than 18 years ago. At that time, the operational strategy was tested and prepared using the experience at La Silla Observatory and in particular with the operations at the NTT (New Technology Telescope) which started around 1998.

Implementing Service and Visitor mode observations was then a challenge, especially for improving and consolidating the concept of the Service Mode but also for assuring best possible data (as it was conceived) by using the right match of the constraints and the proper prioritization of the different approved programs while also providing best data and calibration products in a consolidated package for the community.

Most of the pressure was then focused on the data quality but also on the services provided at the Observatory for the visiting astronomers and consortia teams in charge of the installation and commissioning of the new facilities and instruments. La Silla Observatory was the best place for preparing the strategies to cope with the requirements and expectations of the community, but the scale and parallel activities to be handled at Paranal was a new and major challenge.

In this sense it was clear that astronomers would be the key people to ensure the process (operations, data quality and certification of observations) and finally we succeeded in this matter by consolidating the operational model.

The Telescopes and Instruments Operators Group was conceived to provide assistance for the operations of the facilities while also using their professional background for helping in problem solving. Part of the requirements of the position were changing over time because of the technological changes and the technical requirements, and at the same time they started to be deeper involved in the different connected processes.

## **2. HISTORICAL BACKGROUND OF TELESCOPE OPERATORS**

The telescope operator (also called night assistant / nighttime operator) is a position born when professional facilities started in operations. First interactions were mainly devoted to helping in the mechanical control of the telescope and helping in the handling of the images plates and the setup of the instruments (optics, alignment) for the different applications. At that time,

no special requirements with regards to professional background were requested, but technical studies with a suitable level of English for the task was appreciated.

During the following years, and with the incorporation of electronics to the control system of the telescopes, there was a realization that these operators could improve their services if someone with technical/engineering background could be hired. New requirements in this sense modified the professional profile of the applicants. The interaction with the newer systems and the new professional background of the operators, helped in improving their involvement and contribution to the day-to-day work.

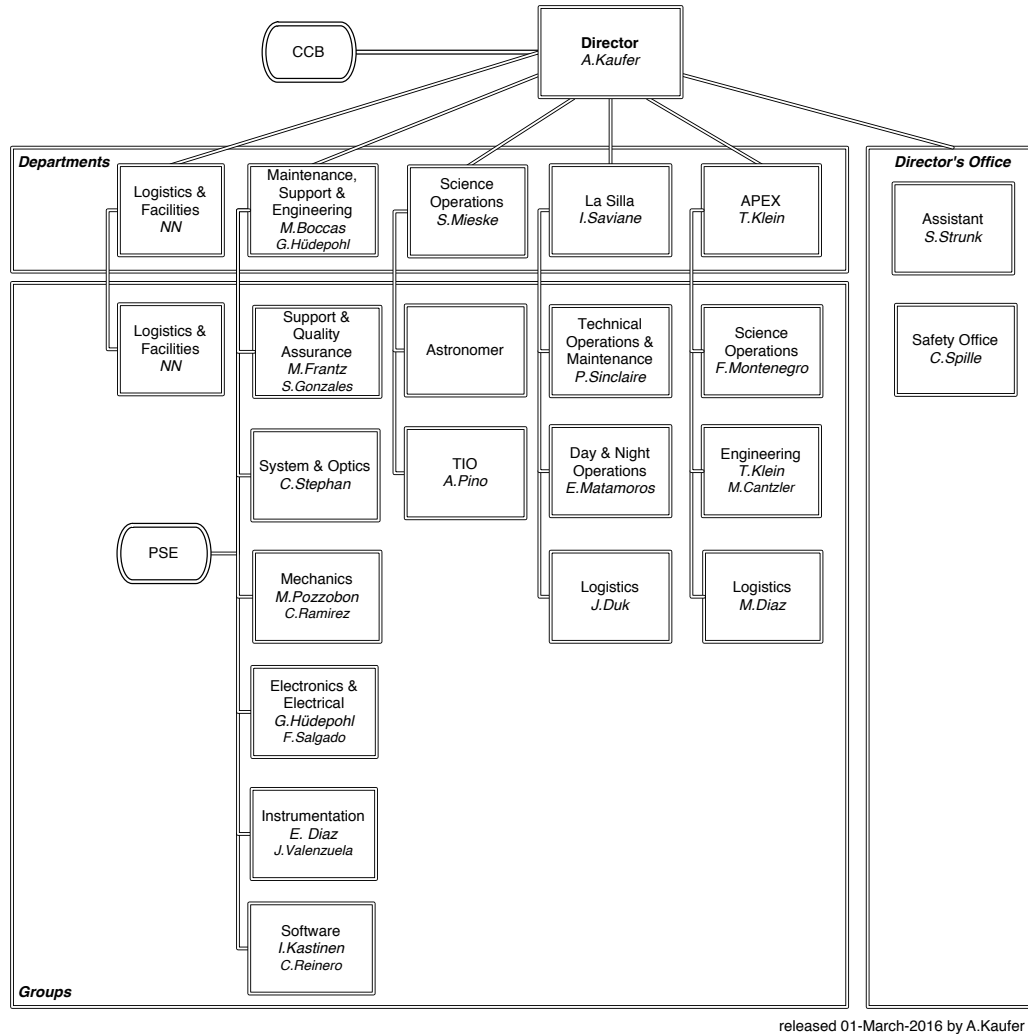
A third change in the professional requirements came when the newer electronic system and main machine interfaces were added as an integral part of the operations. The operator was located in a control room, separated from the telescope facility, and the control of the different devices had to be remotely performed. Technically dedicated matters on the telescopes and Instruments started to be fully performed by different people (engineers, technicians). The working conditions changed by being almost exclusively working in the control room except for opening and closing routines. This is the current situation at Paranal and this analysis will be done based on this experience.

### **3. PARANAL SCIENCE OPERATIONS DEPARTMENT**

#### **3.1 ESO La Silla Paranal Observatory**

The Paranal Science Operation Department (PSO) is part of the ESO's La Silla Paranal Observatory Division (LPO). The other Departments based in Paranal are MSE (Maintenance, Support and Engineering Group) in charge of different technical support areas of the Observatory (System Engineering, Instrumentation, Software, Optics, Mechanics and Quality Assurance) and Paranal Logistics (in charge of coordinating all logistical aspects of Paranal Observatory).

The other LPO departments outside Paranal are: La Silla site and APEX, each with a site manager, in charge of all operational aspects of their particular Observatories.



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Figure 1. ESO La Silla Paranal Organigram Chart.

### 3.2 Role and core activities of PSO

Paranal Science Operations Department (PSO) is in charge of producing astronomical data of the highest quality, and maintaining (and whenever possible improving), the scientific and operational performances of the instruments. On a daily basis, PSO works in close collaboration with Paranal's MSE department to deliver all instruments and telescopes to nighttime operations. It also validates the set of science and calibration data in terms of quality and completeness. PSO also supports the commissioning of new instruments, or their upgrades, as well as their integration into the operations of Paranal Observatory [1].

External stakeholders in partnership with PSO are located in Garching (Germany). Those are mainly the Instrumentation Division and the Departments from the Data Management and Operations Office (DMO), in particular its Departments of User Support (USD) and Data Product (DPD), the latter holding two key groups working closely with Science Operations: the Data Processing/Quality Control and Science Data Product group (SDP) groups.

### 3.3 PSO Staffing

Currently Paranal Science Operations includes 26 Staff Astronomers, 15 Fellow (Postdoc) Astronomers (twelve of them based in Chile, sharing 50% of their duties with Chile Science Office and others three in Garching with 25% of their time assigned to PSO), 24 Telescopes and Instruments Operators (TIOs) and one Senior Executive Assistant.

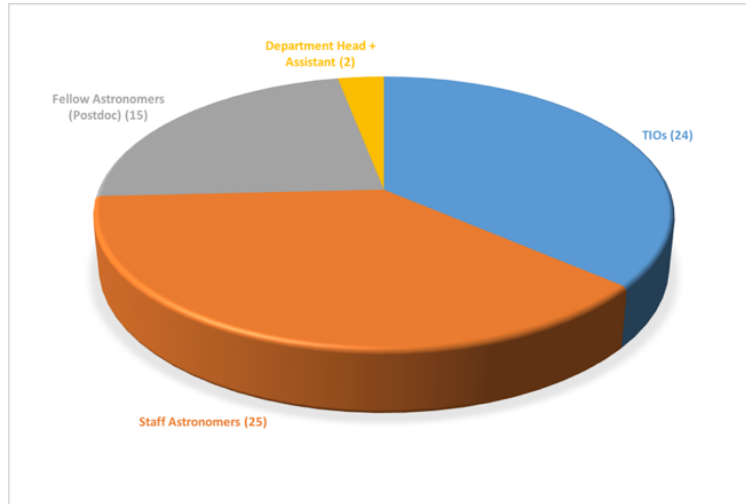


Figure 2. Paranal Science Operations Staffing

### 3.4 Operations Scheme

In the current operations scheme (SciOps 2.0), day and night activities are shared between Astronomers and TIOs.

During daytime, the Shift Coordinator (SC) which is a senior staff astronomer, is in charge of the coordination matters of the observatory activities in close collaboration with the Chief of Engineering (COE) appointed by MSE Department. The core activities of the Department are performed by two (2) either Astronomers (DA) and Operations Specialist (OS). Throughout the year, the rate of coverage of these activities is 20/80 between astronomers and OS.

For nighttime services, three out of four of the nighttime UT support astronomers have their duty starting-time moved earlier into the afternoon (instead of sunset) and the fourth support astronomer remaining in the “old scheme” (sunset to sunrise) becoming nighttime shift-coordinator for the last few hours of the night. As result of this scheme, the operations during the first part of the night are shared between Astronomers and TIOs, while during the last part of the night they are supported by the TIO on-duty at the telescope, with the help of the nighttime shift-coordinator whenever is necessary.

The VLTI (interferometric facility) support astronomer has not yet moved to the new operations mode, due to the higher complexity of the VLTI operations.

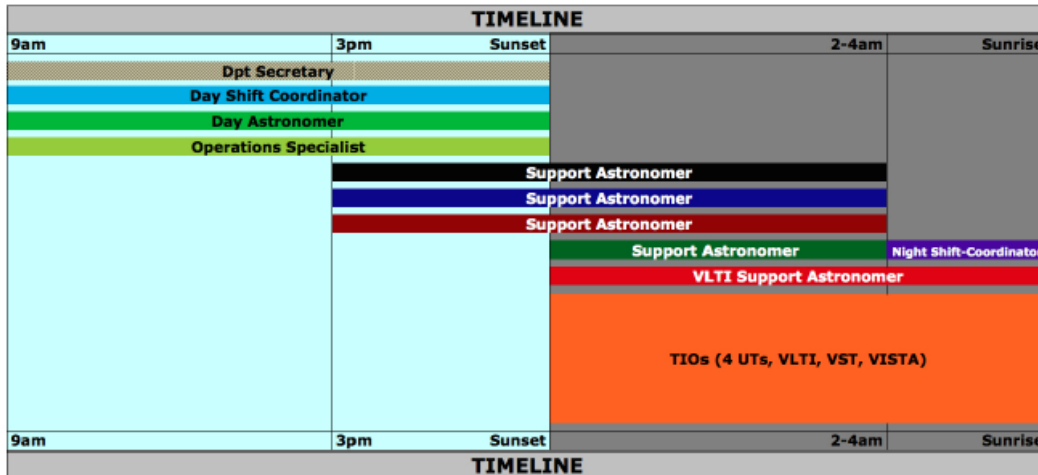


Figure 3. SciOps 2.0 Operations Model and staff distribution [1].

### 3.5 Functional duties

We describe the scheme for functional line responsibilities within PSO. This structure helps in fulfilling the operational requirements of the Observatory while developing administrative and functional duties towards an integral scheme of services and documentation.

PSO staff is periodically appointed to develop and lead these functions which are very important to coordinate the different activities of the department and focus the efforts according the expected prioritization and available human and technical resources.

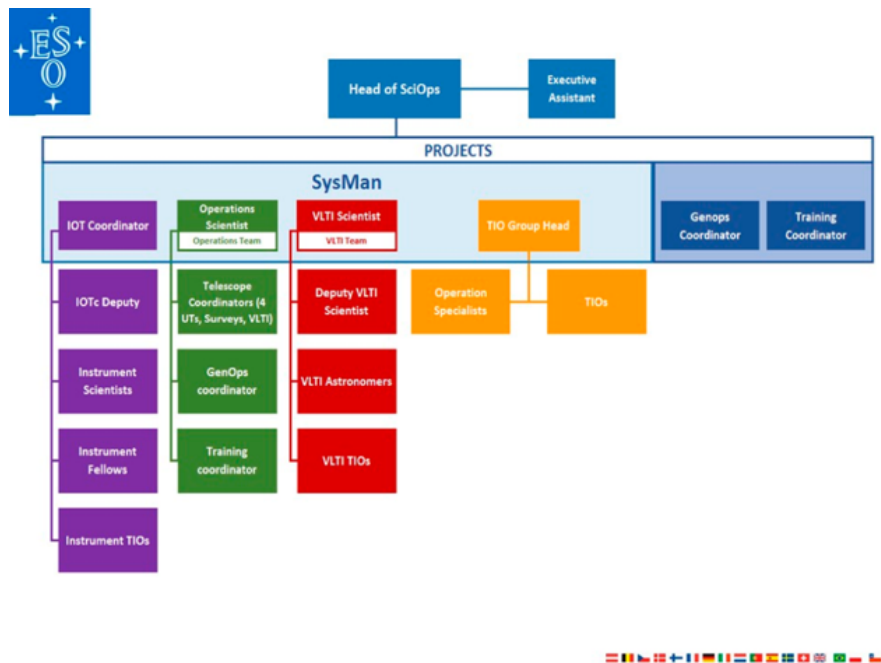


Figure 4. ESO Paranal Science Operations Functional Lines Chart.

The SysMan group includes the Managers (Head of SciOps and Head of TIOs) and the different System Scientists (Operations, Instruments, Telescopes, AO and VLTI) which assist the HoS (Head of SciOps Department) in the decision making process and coordination of activities related to the PSO Department. Project evaluation and follow-up is performed by the SysMan Group together with the GenOps (General Operations) and Training Coordinators. A Senior Executive Assistant provides specific administrative services to the PSO Department and Directors Office.

Other important activities are also performed by the PSO crew including IOT Groups (Instrument Operations Team Group), Instrument Scientist task and Telescopes Coordination.

## **4. TELESCOPES AND INSTRUMENTS OPERATORS GROUP**

### **4.1 TIO Group Staffing**

The Paranal Telescopes and Instruments Operators Group (TIOs) are formed by 24 inter-disciplinary professionals. Their expertise varies from engineering and technical areas (physics, electronics, electric, automation and computing science) to other more exotic such as professional Aircraft Pilots, Air-Traffic Controller and Chilean Navy Officer. In some of the cases they have master degrees not only in their own fields, but also in astronomy.

A TIO is assigned to work in a 7x7 shift during nighttime. Along with the implementation of the SciOps2.0 Operational mode, a new category of duties was conceived for 50% nighttime and 50% daytime support. For these duties, 9 of the existing TIOs were selected to this new position called Operations Specialist.

The process of training for the new operators starts with the operation of the Telescope or the Facility. For UT operations, the training is similar, but for VISTA, VST and VLTi the training is specific for each unit. Senior TIOs are in charge of different training modules (weekly modules). The training and certification for one UT takes around three–four months, for VISTA/VST around two months and for VLTI about six months.

The Instrument trainings start just after the certification on Telescope Operations. The training can be done by an Astronomer on duty or a senior certified TIO, but the certification is given by an Astronomer (ideally the Instrument Scientist-IS or an astronomer with a similar level of experience). The certification for one instrument could be obtained after two - three shifts of interaction with the instrument, while for the whole unit (UT + 3 Instruments + Quality Zero Control – QC0) in general it takes three months.

Starting in 2012, an intensive training plan was also conceived using internal PSO resources. All TIOs attended a series of Astronomical related courses given by Astronomers like Astronomical Observational Techniques, Science done with Paranal Telescopes, Quality Control Workshop, Basics in Optics, Adaptive Optics, VLTI School and others. Also a series of training for soft-skills and team building activities were designed by the Human Resources Department using external consultants.

Additionally, the requests for attending or contributing to other instances like congresses, workshops, etc. are growing, giving us signals of a different connection and ownership of the job.

### **4.2 Expertise Distribution**

Our Observatory has six telescopes and one interferometer array that need to be operated during the night. Four of these Telescopes (8.2m UTs) hold three instruments on the different foci, while two others are for Survey studies (VISTA, VST), with a single instrument each. The interferometer currently holds three instruments and has four 1.8m Auxiliary Telescopes (ATs).

Today Paranal has a total of 17 different instruments and this is the starting point for the analysis of staffing and expertise. As per the SciOps 2.0 definition, the TIO performs the full operations of the whole UT system (Telescopes, Instruments, QCO

assessment) during the night. This requirement implies various steps to be fulfilled. As previously mentioned, additionally VST, VISTA and VLTI systems require a different area of expertise from the UTs.

Another set of important and complex subsystems complement the devices to be controlled: four MACAO (Multi-Applications Curvature Adaptive optics) units, one Laser Guide-star Facility, six delay-line systems, and other sub-systems.

During the next years, an extensive amount of new instruments and facilities will also be part of the operational scheme: GRAVITY is our new four-way beam combination second generation instrument, actually in commissioning phase; the AOF (adaptive optics facility) which will include a Deformable Secondary Mirror for UT4 Telescope (2016), two AO modules GALACSI (2017) and GRAAL (2016) providing GLAO and LTAO corrections for Hawk-I and MUSE and a Laser Guide Star Facility (2016) launching four LGS from the telescope centerpiece used for the GLAO and LTAO wavefront sensing; ESPRESSO (Echelle SPectrograph for Rocky Exoplanet- and Stable Spectroscopic Observations - 2017) is a third-generation, fiber fed, cross-dispersed, echelle spectrograph which is the first instrument (except for the VLTI) where the telescope light is fed to the instrument via a Coude-Train optical system and fibers using single or multiple telescopes combinations.

The expertise is spread among the different systems of the Observatory between the operators group (TIOs and OSs) using the following scheme:

|             | Operations Assignments |     |     |     |         |     |      | Subsystems     |       |      | Instruments Certifications |             |             |          |          |
|-------------|------------------------|-----|-----|-----|---------|-----|------|----------------|-------|------|----------------------------|-------------|-------------|----------|----------|
|             | Telescopes             |     |     |     | Surveys |     | Intf | Units<br>Total | Macao | LGSF | VLTI                       | Sc 2.0 (12) | Surveys (2) | VLTI (2) | Total    |
|             | UT1                    | UT2 | UT3 | UT4 | VSA     | VST | VLTI |                |       |      |                            |             |             |          |          |
| TIO1        | 1                      | 1   |     | 1   |         |     | 1    | 4              | 1     |      | 1                          | 6           |             | 0        | 6        |
| TIO2        |                        |     | 1   | 1   | 1       | 1   | 1    | 5              | 1     | 1    | 1                          | 6           | 2           | 2        | 10       |
| TIO3        | 1                      | 1   |     | 1   | 1       | 1   |      | 5              | 1     |      |                            | 6           | 2           |          | 8        |
| TIO4        |                        |     | 1   | 1   | 1       | 1   |      | 4              | 1     | 1    |                            | 6           | 2           |          | 8        |
| TIO5        |                        | 1   | 1   |     | 1       | 1   |      | 4              | 1     |      |                            | 6           | 2           |          | 8        |
| TIO6        |                        |     | 1   | 1   | 1       | 1   |      | 4              | 1     | 1    |                            | 6           | 2           |          | 8        |
| TIO7        | 1                      | 1   |     |     | 1       | 1   |      | 4              | 1     |      |                            | 6           | 2           |          | 8        |
| TIO8 (new)  | 1                      | 1   |     |     |         |     |      | 2              |       |      |                            | 3           |             |          | 3        |
| TIO9        | 1                      | 1   |     | 1   |         |     | 1    | 4              | 1     | 1    | 1                          | 9           |             | 3        | 12       |
| TIO10       | 1                      |     | 1   | 1   | 1       |     |      | 4              | 1     | 1    |                            | 9           | 1           |          | 10       |
| TIO11       |                        | 1   | 1   |     | 1       | 1   |      | 4              | 1     |      |                            | 6           | 2           |          | 8        |
| TIO12       | 1                      |     | 1   | 1   | 1       |     | 1    | 5              | 1     |      | 1                          | 6           | 1           | 0        | 7        |
| TIO13       | 1                      |     | 1   | 1   |         |     |      | 3              | 1     | 1    |                            | 9           |             |          | 9        |
| TIO14       |                        | 1   | 1   |     | 1       | 1   |      | 4              | 1     |      |                            | 6           | 2           |          | 8        |
| TIO15 (new) | 1                      | 1   |     |     |         |     |      | 2              |       |      |                            | 0           |             |          | 0        |
| OS1         |                        | 1   |     |     |         | 1   | 1    | 3              | 1     |      | 1                          | 3           | 1           | 2        | 6        |
| OS2         |                        |     |     | 1   | 1       | 1   | 1    | 4              | 1     | 1    | 1                          | 3           | 2           | 2        | 7        |
| OS3         | 1                      |     | 1   |     |         | 1   |      | 3              | 1     |      |                            | 6           | 1           |          | 7        |
| OS4 (new)   | 1                      | 1   |     |     |         |     |      | 2              |       |      |                            | 0           |             |          | 0        |
| OS5         | 1                      | 1   |     |     | 1       |     | 1    | 4              | 1     |      | 1                          | 6           | 1           | 2        | 9        |
| OS6         | 1                      | 1   |     |     |         |     | 1    | 3              | 1     |      | 1                          | 5           |             | 2        | 7        |
| OS7         | 1                      | 1   |     |     | 1       |     | 1    | 4              | 1     |      | 1                          | 6           | 1           | 2        | 9        |
| OS8         |                        |     | 1   | 1   | 1       | 1   |      | 4              | 1     | 1    |                            | 6           | 2           |          | 8        |
| OS9         |                        |     |     | 1   | 1       | 1   | 1    | 4              | 1     | 1    | 1                          | 3           | 2           | 0        | 5        |
|             | 14                     | 14  | 11  | 12  | 15      | 13  | 10   | 3.7            | 21    | 9    | 10                         | 5.3         | 1.6         | 1.5      | 7.1      |
|             | UT1                    | UT2 | UT3 | UT4 | VSA     | VST | VLTI | Units Average  | Macao | LGSF | VLTI                       | Sc 2.0 Av   | Surveys Av  | VLTI     | Total Av |
|             |                        |     |     |     |         |     |      |                |       |      |                            |             |             |          |          |
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Figure 5. TIO Group assignments and expertise distribution

### 4.3 Certifications

The current workforce gives us full coverage for the existing facilities and gives us up to 136 nights available for contingencies or special activities including training, commissioning, projects, etc. (5.6 nights per staff).

The situation of nighttime operation certifications for the TIO Group permit us to cope with the current operational requirements by having an average operational availability of 3.7 units per staff (either UTs, Surveys or VLTI Facility). In terms of certifications for subsystems, we have 88% certified for MACAO operations, 38% certified for LGSF operations and 41% certified for VLTI Operations.

On average, every TIO is already certified for five instruments (including newer ones) for running SciOps2.0 observations at UTs, while including the operations for the Survey Telescopes and the VLTI, we have a general average of 7.1 Instruments per staff. At the end of the current year we expect that all training processes will be finished, providing an average of 8.2 Instruments per staff.

#### **4.4 TIO Nighttime Support**

For any given night, each TIO is assigned a given telescope. The TIO operates that telescope and its instrumentation, in order to maximize their efficiency, while maintaining the safety of people and equipment. The nighttime TIO schedule goes from sunset to the complete shutdown of the telescope at the end of the observations, which must happen no later than 20min before the official time of sunrise.

In normal operations, the TIO fully performs the observations selected in the execution sequence (SM), or by the visitor (VM), and at the end of the night (02:00-04:00 onward), performs the full operations of the whole system (except for VLTI since a Night-Support Astronomer remains at the console in this case).

The certification level determines the telescopes and instruments that a TIO can operate. After the Night Support Astronomer leaves the control room, between 2-4 am, the TIOs continue executing SM Observing Blocks (following the Observatory's priorities) that have been prepared in separate queues (for two sets of meteo conditions) by the UT Support Astronomer and discussed together. The TIOs then have the full responsibility to provide a grade to the executed OBs based on a zero order quality assessment (image quality and/or rough estimation of SNR with regard to goals set by the PI and ambient conditions). The TIO applies the calibration plan for the corresponding instrument and mode.

In Visitor Mode (VM), the TIO executes the OBs selected by the Visiting Astronomer (VA). In case of any doubts regarding acquisition, target identification, OB execution priority or data quality, the TIO can then request the advice/support from the nighttime shift coordinator. In case of persisting doubts with regard to an OB grading, the relevant information should be included into a PSO ticket so the daytime team can finalize the grading.

At the end of the night, the TIOs are responsible to put the instrument in calibration mode, execute the telescope and dome closing procedures, launch the calibration sequence for the instruments and send the night-report.

##### **4.4.1 Weather Officer (WO)**

Every night one of the TIOs is appointed as Weather Officer (WO) for being in charge of monitoring the weather (and logging the corresponding data in the Night-Report), and to issue the weather-related instructions (weather change warnings, dome closure, domes in safety position, re-open domes) following the corresponding guidelines. The Weather Officer is also in charge of operating the ASM (Astronomical Site Monitor). The weather officer is on duty while the telescopes are under SciOps responsibility (from evening to morning twilight). The WO is identified in the TIO schedule. A second WO (WO2) is also appointed for helping WO during the night in the decision making process when weather conditions changes and become a risk for the facilities.

The WO training, coaching and certification process is done by other(s) Weather Officers. WO certification is expected for all TIOs with a few years of experience.

##### **4.4.2 Nighttime Safety Officer (NSO)**

Additionally, another TIO is appointed as Night Safety officer, in charge of monitoring the safety of people and equipment at night, and coordinate with the Observatory Emergency Brigade/ Safety Officer in case of emergency or accident. In particular, the SciOps Night Safety Officer coordinates and enforces the evacuation of the buildings in case of fire, earthquake, etc.

#### **4.5 Daytime Support - Operations Specialist (OS)**

The Operations Specialist shares his/her time (according to turnos) between the functions of TIOs (see above) and that of daytime operations support. The ratio of both duties (day-night) should be balanced (50% each) for a given period of time (usually three-four months). Their day shift working schedule goes from 09:00 until handover to the nighttime operations team.

The daytime tasks are the same than those of the Daytime Astronomer, exception made of all activities requiring a unique astrophysics expertise (such as support of VAs in preparing the observing strategy for their program). The OS is responsible for the completeness and quality certification of the data acquired during the previous night. This includes also the calibration frames acquired in the morning. The OS also validates the content of the night report, and can request or implement corrections as necessary.

OS is also responsible for delivering the system to the night astronomers at the beginning of the night. This includes making sure the required instrument set-up has been performed (mask manufacturing and insertion, special filters installed, etc.) and verified; making sure the observation queues have been updated, the special observations (e.g. ToOs) are ready. As the OSs are also certified for night operations, they use their knowledge of the night procedures to make sure everything is ready.

Another significant responsibility of the OS is to monitor the instruments through the various QC systems, and investigate possible deviations. The OS is at the front-line in case of instrument problems: they use their knowledge, the knowledge database (problem tickets, documentation, etc.) and that of their colleagues to diagnose most issues arising with the instruments. The rest of the time can be used on activities such as contributions to IOT and/or Operations group projects.

#### **4.6 The iTIO. A new member for the IOT (Instrument Operations Team)**

##### **4.6.1 The IOT Members and duties**

The Instrument Operations Team maintains and updates the operational environment of the instrument to ensure the delivery of optimal quality science and calibration raw data, and science grade data products whenever possible, with the ultimate goal of maximizing the quality as well as the quantity of its scientific output. In a nutshell, the Instrument Scientist (IS) leads each Instrument Operations Team and the IOT defines and implements common calibrations procedures and tools to secure the production of science graded data product as well as the stability of the performance of the different VLT-(I) instruments.

The IOT members are composed of personnel from Paranal (instrumentation engineer responsible, software engineer, instrument fellow, any astronomers or TIOs/Operations Specialists willing to participate) and Garching (Garching IS, QC scientist, USD astronomer, pipeline developer, ETC specialist).

##### **4.6.2 Evolution of the TIO group**

The start of the SciOps 2.0 operation scheme has significantly increased the involvement of TIOs and OSs in the operation of instruments and their contribution to nighttime operation processes. It therefore makes it possible and even desirable to involve them at a higher level in the work of Instrument Operation Teams: indeed, feeling directly involved in improving and solving problems increases the feeling of ownership of the system.

The experience and involvement of the TIOs/OSs on his/her instruments provides a valuable source of information and expertise, which can help the Instrument Scientist (IS) when facing problems. An increase in the involvement of TIOs/OSs in IOTs corresponds to a move from first troubleshooting of problems during day-to-day operations to addressing long-term issues and contributing to the quarterly report by helping to prioritize problems significantly affecting operations.

##### **4.6.3 The Instrument Operations Team TIO (iTIO)**

The iTIO is a TIO who identified the Instrument to be involved with and express their wish to participate as IOT member and directly contribute within the group with the experience and time for having a closer follow-up of the different instrument activities.

Beyond this basic involvement, there is a range of possibilities for in-depth involvement depending on TIO expertise, availability and instrument specificities:

- to help the diagnosis of a technical problem and to collaborate in the search for a solution. When a problem is detected, the IS can ask the TIO to take additional data (or even lead the activity of solving the problem), comment PPRSs, provide additional information gathered during operations, etc.
- to propose improvements in instrument operations and participate to or lead the implementation of those improvements
- to be responsible for the writing and maintenance of the instrument survival guide, e.g. by discussing possible specific shortcomings of the guide with other TIOs/OSs and the IS on the side;
- to help in assessing completion and clarity of the operation pages (in particular, troubleshooting pages) and discussing their content with the IS;
- to help in making sure that problem reports (PPRS) regarding instrument and operation are complete;
- to help in assessing quality problems and to discuss them with the IS and the IOT Team;

More than 80% of the TIOs requested their assignment to one of the IOT and many of them already had an early interaction with the Instrument Scientist together with an introductory meeting about the whole path of the scientific data (from the proposal to the publication) of some particular science case. These clarify doubts and improve the awareness with regard to the different stages where the data is processed. In some particular cases they are already involved in investigation groups or developing projects towards improving instrument performances.

#### **4.7 TIO Contribution**

The implementation of SciOps 2.0, paved a new interaction among PSO staff. For most of the TIOs, the different cross training activities gave them the possibility to access valuable information, which added to the extensive experience in operations and their technical background, allowing not only a different working interaction with the astronomers but also a different level of contribution in operations.

In connection with these activities and because of the new responsibilities of the TIOs, other groups in partnership (especially USD and QC Garching) started to have direct interaction with the group. This also represented another important milestone since they had to adapt some of their information to be understood for non-astronomers in a “more-engineering” language.

Additionally, many of the projects evaluated by PSO are generated by the TIO group, and some of them are also fully developed by TIOs in a successful way. In this sense, being involved in projects also helped to relieve the pressure felt by TIOs that they are performing duties that are not directly related with their expertise or professional background.

With respect to the seniority and despite being one of the biggest groups in Paranal, the TIO group shows one of the lowest turnover rates. Over the last 16 years, only seven people left the group voluntarily and three contracts were not extended after the fixed term period (0,62 in average per year). The average experience of the group in telescope operations is 9.33 years, including the newer staff (hired less than a year ago). This is an important potential of the group because a large amount of deep know-how is available on the mountain and thanks to the continuous training programs in different units (Telescopes and Instruments), helps in sharing this information and consolidating the different troubleshooting and decision making processes.

## 5. FUTURE FACILITIES

### 5.1 Current situation

Following the above analysis and because of the complexity of future systems and installations, at some point we request more and better expertise (higher professional qualifications). However, since this is not connected with a direct career path or career development (strengthening their experience/curriculum about their own specialty), it could lead to demotivation. Most of the people that currently choose to stay working as a TIO for a long period of time, show detachment from their own professional career which leads to an outdated background. This becomes obvious when trying to apply for an engineering-related position. We need to understand if we are hiring over-qualified people or under-exploiting their potential. Discussing this situation with colleagues of others Observatories based in Chile, we find that they are experiencing similar situations.

The new facilities need to offer a different professional perspective for Operators, not for increasing their mobility, but for offering an activity more connected with their expertise towards a better use of their capabilities.

### 5.2 The eTIO

As experienced during the last years in other fields of industry when facing the situation of selecting people for operations of delicate and advanced equipment, requesting Engineers for supporting the operational tasks allows them to share these activities of direct operational support with complementary work in engineering or maintenance. This sharing of activities and dependency can be 50/50 or similar following operational requirements.

This scheme implies Operations people going to Engineering groups will have direct contact with the hardware and the software of the facility, and bring timely, fresh and deep know-how and diagnosis of the systems, instead of waiting for a detailed report of failure that in most cases is not fully self-explanatory.

In the case of the current facilities, it could be implemented by sharing time between operational duties and activities related with professional expertise (Electronic, Electrical, Software, Optics). For the Operators with astronomical background, a fraction of time for science/operations project development can be established (already implemented at other Observatories). Offering this scheme could also be extended to engineers/technicians currently working in daytime for a cross experience and for boosting their proficiency and professional background.

Changing from a TIO to an “eTIO (Engineering TIO) looks like a natural path for future facilities. The benefits are many, because sharing both activities will help in this various situations:

For the operations and maintenance of the systems:

- Hands-on experience and feedback
- More and real Engineering/Maintenance support at night
- Less dependence to daytime Engineers for testing changes/improvements during the night
- Decrease of technical calls at night
- Improve the quality of the troubleshooting and technical support

For the staff:

- Not feeling detached from their professional background
- Keep up-to-date of the current technology and methods
- Contribute in a more dedicated way
- Give and exploit their expertise and background
- Boost their job satisfaction
- Engagement with the Observatory

### 5.3 Implementing a new career path as eTIO at Paranal

The new concept of eTIO could be implemented for future facilities if the original organization foresees from the beginning this new position. In the case of ESO in preparation for the E-ELT and the arrival of the third-generation of instruments during the next years, we could also consider testing it already in the existing Paranal scheme.

Implementing this new scheme for Paranal implies modifying some of the existing paradigms. The current scheme of operations offers limited space for TIOs to excel since the major part of their duty assignment is the operation of highly standardized systems. The main source of non-operational actions, is to develop projects or be proactive in detecting, reporting and performing operations at the highest expected standard. Currently the assigned projects are developed using spare time of the group on top of the core operation activities but this is affected when staff contingency arise, lowering the priority of this activity and re-assigning back the time to operations duties.

In this particular case, the Engineering-TIO (eTIO) position should then have the time devoted to the engineer/project task clearly defined and the contingency has to be faced with the operational resources available from the group instead. Since this is maybe difficult to control when the resources are assigned to a single department, it should be worth considering for those engineering activities FTE's, the assignment, evaluation and control of the scheduling of the activities, to be done directly for MSE (or Engineering/Maintenance Department). Similar interdependency already is experienced at ESO for some other particular positions (i.e. Fellow Astronomers). For a possible testing phase in Paranal, natural candidates for such positions could come from the pool of the most engaged iTIOs.

Implementing this idea at Paranal, would benefit both SciOps and MSE Departments, in particular if the option of temporary transfer between their members is an integral part of this new scheme. These could be triggered by some specific achievement (a joint project) or for a period of time (i.e. one or two years) after identifying available resources which could be useful for both departments.

Having in mind the seniority of the group, offering this position as a long-term duty with a clear connection to the existing career-path will clarify expectations and expected development in time. This career path should also include the possibility of a complete reassignment to some of the Departments (SciOps or MSE) in the future by request of some of the Departments in agreement with the staff.

Finally, we could also consider to open these TIO positions for international staff, which would dramatically change the scope of candidate selection and would offer to the whole community the possibility to apply and contribute in the best way to the science of the new era.

## 6. REFERENCES

- [1] Dumas C., Boffin H., Brillant S., Hau G., Ledoux C., Merand A., Mieske S., Pino A., Rivinius T., Smette A., Whright A., "SciOps2.0: an evolution of ESO/VLT's science operations model," Proc. SPIE 9149, 91491G