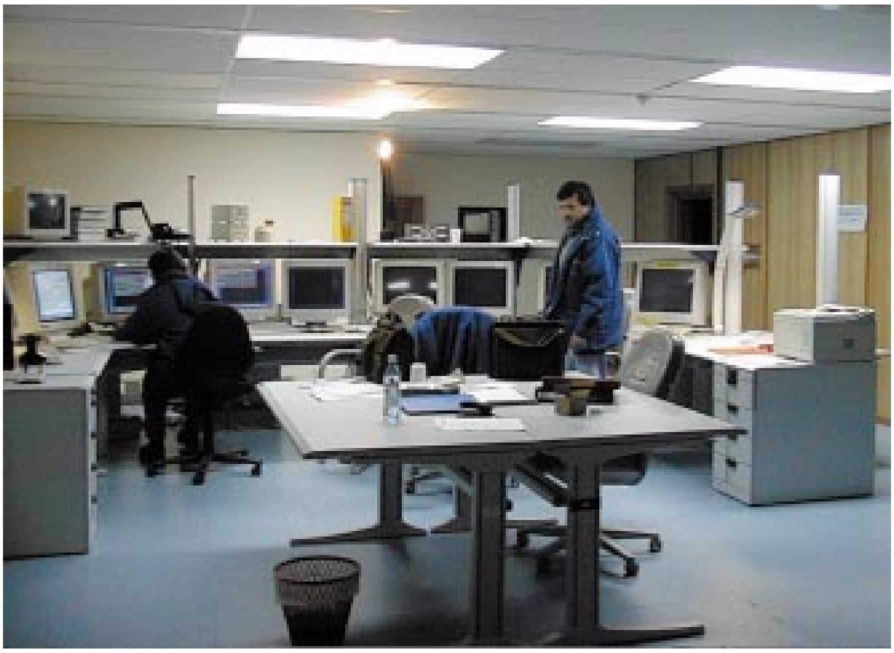
A New Control Room for the 3.6-m Telescope

M. STERZIK



The 3.6-m telescope team started the year 1999 with the move of the control room. Our new control room is now located in the third floor of the telescope building, in a spacious room that has been freshly refurbished for this purpose. The general design is kept modern and functional, but a warm and friendly atmosphere in the room is generated by wooden panelling and wooden doors.

The central area of the room is dominated by the huge operations console. We decided to use the same U-shaped desk that is well known from the NTT and VLT control rooms. The VLT-compliant operation of the telescope control system, adapter and autoguider, and the instruments require the extensive use of workstations and X-terminals in order to monitor and control all subsystems. One wing of the desk is dedicated entirely to telescope operations. The other wing is assigned to the visiting astronomers, allowing them to perform all necessary tasks from the preparation of observations to a first online data inspection and analysis. All our instruments can be operated from the new control room except the CES, which is still in the "old" CAT control room until its new VLT-compliant instrument control system becomes available later this year.

The size of the room allowed us to separate the generic control room from a more private area (for the few relaxed moments with music, tea or coffee) with a long bookshelf.

I am convinced that our users will enjoy, and benefit from this qualitative enhancement of their working environment.

On the technical side, I am glad that we can now offer a significantly improved telescope pointing behaviour as compared to the past year. Tightening the M2 mirror support structure allowed us to eliminate several high order harmonic terms in the pointing model. At present, we achieve about 8 arcsec rms pointing accuracy, a figure that is expected to decrease further once the new "Heidenhain" strip encoders can be used for axis control.

VLT DATA FLOW OPERATIONS NEWS

The NTT Service Observing Programme: On the Efficiency of Service Observing

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Abstract

A number of articles have recently appeared in the ESO Messenger reporting on the past experience of the NTT service observing programme in Periods 58, 59 and 60 (Silva and Quinn 1997, Silva 1998). In this paper, the third in this series, we report on the results of a statistical analysis of the efficiency of service observing during Period 60. We have compared service observing (SO) with the classical 'Visitor' Mode (VIS), and with the other main programme executed at the NTT during this period, the ESO Imaging Survey (EIS). To obtain an insight into the efficiency of service observing, we examined the Period 60 NTT observing logs in detail. We have only compared nighttime operations, and do not include pre-observing preparations into our analysis.

The observations in Service Mode suffered significantly more from adverse weather conditions at La Silla than both the VIS and EIS observations. On average, the down time during Service Mode (both weather and technical down time) is more than double the down time during either the VIS and EIS Mode, 23.7% versus 10.9% and 10.4% respectively. Irrespective of these adverse weather conditions during Service Mode, it can be

maintained that service observing is an efficient way of managing telescope time.

Introduction

Briefly stated, it has been argued (e.g. Silva 1998) that service observing has three main advantages over classical observing:

Science efficiency is maximised. Execution priority is given to the programme with the highest OPC rank that matches the current observing conditions. This scheme maximises the likelihood that the highest ranked programmes will be fully completed during the current ESO Period, i.e. complete scientifically useful datasets are efficiently produced.

Operations efficiency is maximised. Operations efficiency can be optimised by sharing calibration data between similar science observations, and by having experienced staff observers obtaining the data.

Data re-use is maximised. By acquiring uniform datasets with adequate calibration, data can be re-used efficiently in the future for projects other than the original OPC approved project.

Silva (1998) concluded that most of these objectives were achieved during the Period 60 NTT Service Observing Programme. However, what conclusions can be drawn by comparing Period 60 NTT Visitor Mode and Service Mode operations? In particular, what were the relative scientific and operations efficiencies of these two observing modes, and what lessons can be applied to the VLT service-observing programme? These questions are addressed and answered in this article.

Observing at the NTT During Period 60

During Period 60 at the NTT, 37.5 nights (= 21% of all the available time) were allocated to service observing, 27.5 nights (= 16%) were allocated to the ESO Imaging Survey (EIS) and 52 nights (= 29%) were given to observers executing their programme in Visitor Mode. The remaining 60 nights (= 34%) were used for various tests, e.g. testing the pointing model of the telescope, or for the commissioning of new instruments such as SOFI and SUSI2.

In order to analyse and compare all the different observing modes in an unbiased way, we have taken the NTT observing logbook[1] as the basis for the current discussion. All the records required, such as starting time, exposure time, the nature of the exposure, i.e. calibration, focus se-

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[1]Unfortunately, for a few nights (2 nights in Visitor Mode) the logbooks were incomplete. These nights have been totally excluded from the current analysis. A further 4 nights in Visitor Mode were not included as they were scheduled in April 1998 and night logs were not readily available. For both the EIS and SO Mode, we have retrieved 100% of the night logs, for Visitor Mode we based our analysis on 88% of all the VIS programmes.

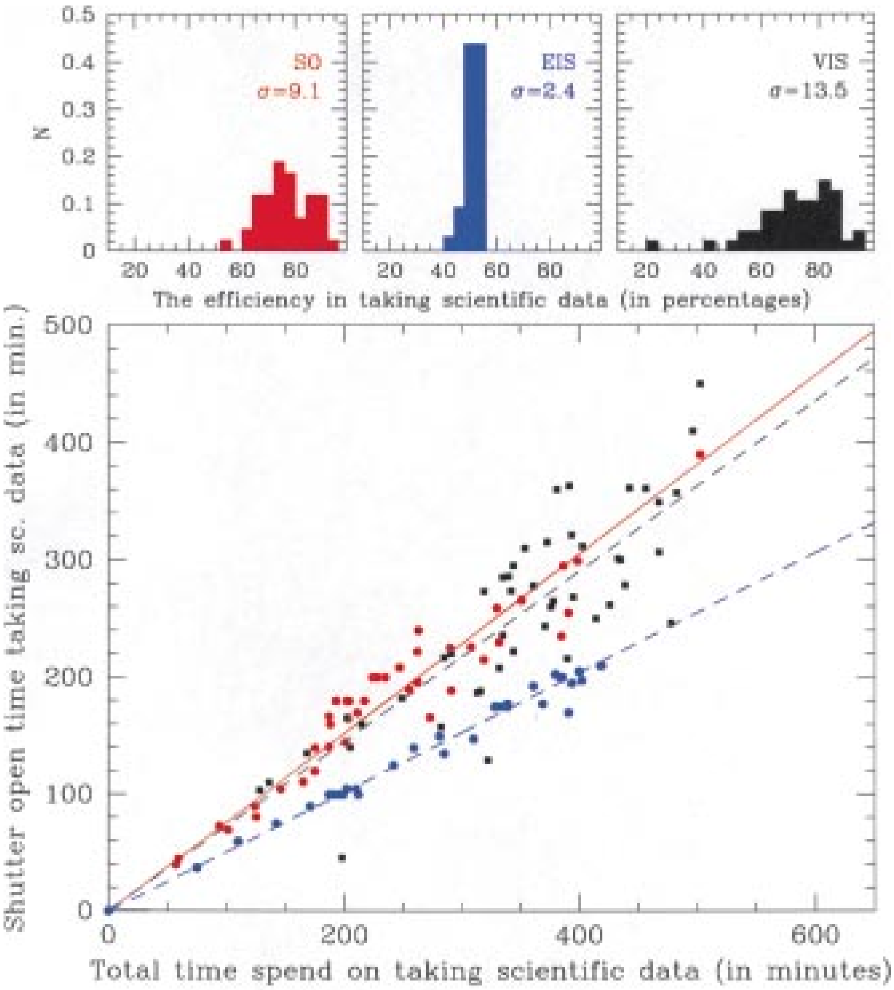

Figure 1: The bottom panel indirectly shows the efficiency of gathering scientific data for each of the different observing modes (SO = black squares, VIS = red dots, EIS = blue dots). If a programme was 100% efficient, i.e. all the time spent on a target was used to gather photons, that programme would lie on the x = y line. The top three histograms show the spread in efficiency as observed for each of the different observing modes.

NGC 4945 in 3 Colours

The picture on the following two pages of this nearby edge-on spiral galaxy was assembled from five 15-minute red-light (printed red), four 5-minute B-band (printed green), and five 1000-second U-filter (printed blue) exposures taken during the Science Verification phase of the Wide Field Imager at the 2.2-m telescope on La Silla. At the recession velocity of NGC 4945 of 560 km/s, the red filter centred at 665 nm with a full width at half maximum of 1.2 nm does still not include the Hα emission line of the interstellar hydrogen. The original resolution of 1 arcsec corresponds to roughly 19 pc at the distance of 3.9 Mpc of the Centaurus group of galaxies, to which this galaxy with a starburst/Seyfert nucleus belongs. East is to the left and North to the top.

In addition to NGC 4945 itself, only a few more distant galaxies can be recognised as such in this reproduction. The vast majority of the point-like sources are anyway stars in the Milky Way. Only around NGC 4945 are a fair number of them that are actually globular clusters belonging to this galaxy.

The applied image processing was on purpose kept to an absolute minimum of sophistication in order to subject the intrinsic quality of the data to the hardest test possible: Mean bias and sky background levels were subtracted as a constant, but separately for each CCD. No flatfielding was applied but all cosmetic defects and the inter-chip gaps were removed by median filtering of the stack of exposures obtained with each filter. The geometric registration of the images was accomplished by translations only, i.e. no rotation or other resampling was applied.

The total number of data points used is about 10^9; their information content corresponds to more than 70×10^9 photons (above the sky background). But only a part of the image corresponding to 28×20 arcmin is shown. It is printed at a scale of roughly 4 arcsec/mm and was rebinned to 0.48 arcsec/pixel to match the resolution of the printer (200 dpi). A similar print of the complete 33 arcmin $\times$ 33 arcmin field of view, that preserves the full 0.24-arcsec pixel sampling, would need to measure 100 cm $\times$ 100 cm, i.e. 8 times more in area.

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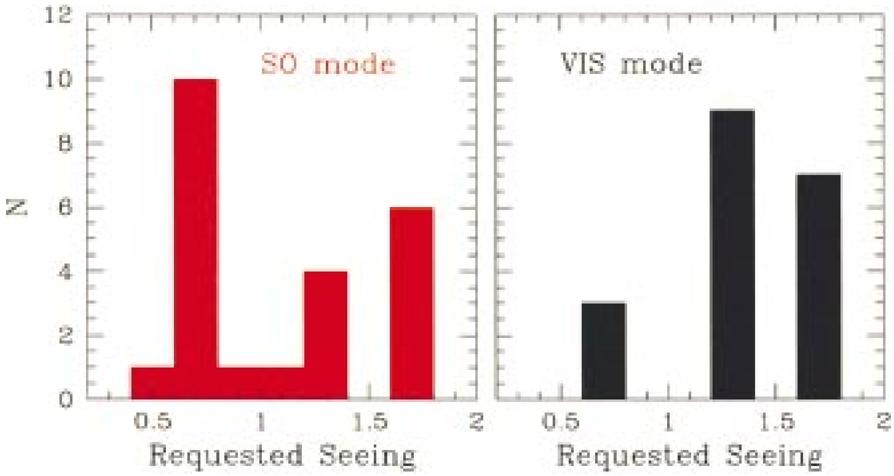

Figure 2: The distribution of the requested seeing conditions for programmes in Service Mode (left panel) and Visitor Mode (right panel). The programmes plotted in the bin (< 1.8") correspond to programmes without any specified seeing constraints.

(Continued from page 19)

quence, or scientific data, are stored in a uniform way. Records are kept of the seeing at La Silla from the DIMM2 instrument (*http://www.ls.eso.org/lasilla/seeing/html/DIMM2.html*). These records show that on average the ESO Imaging Survey experienced marginally worse seeing, compared to both the VIS and SO Mode (see also Table 1).

Weather and technical down time are verified for each night by comparing the observing logbook with the electronic night reports submitted by the observers (*http://www.ls.eso.org/lasilla/Reports/html/Opreport.html*). In all cases, the down time as observed from the NTT logbook was used in the statistical analysis. For each night, the total available time was subsequently split up into the following categories:

- Image analysis and Focus
- Switching instrument: EMMI ↔ SUSI
- Switching observing mode on shared nights: EIS ↔ SO, or VIS ↔ SO
- Calibration data
- Science data
- Weather down time
- Technical down time
- Target of Opportunity, or telescope tests

With regard to the “Image Analysis”, “Calibration” and “Science” data, one can compare the time spent executing an Observation Block (Silva 1998) with the requested integration time. This will give an idea of the efficiency in executing such an Observation Block, i.e. how much time is spent on pointing the telescope, reading out the CCD, in relation to the shutter open – shutter closed time.

On the Efficiency of Service Observing

The main goal of this study is to determine how efficiently the NTT is used during Service Mode compared to classical observing; to see where time losses occur during the night time operations, how these losses can be reduced, and to find an answer to some frequently asked questions regarding service observing.

- Is service observing at a good meteorological site preferred over classical observing?
- Are visiting astronomers less efficient on their first night of observing?
- How will service observing be different at the VLT?

These questions are at the heart of the current analysis.

• First-night efficiency in Visitor Mode

It is generally assumed that observers in Visitor Mode are less efficient on their first night of observing, i.e. the observer still has to get acquainted with the set-up of the telescope. One argument in favour of service observing is that all the observations are done by observers familiar with the telescope, the instruments and the operations, and hence no valuable time is lost during the night.

From the data presented in Table 2, we find no evidence that Period 60 observers in VIS Mode were less efficient during their first night of observing. This is based on 19 individual VIS programmes out of a total of 23 VIS programmes that were given time in Period 60. The remaining 4 VIS programmes were excluded because the observing log was incomplete. The observed differences between the first night characteristics and the overall averaged performance are statistically insignificant; this is likely due to the high level of experience of the VIS Mode observers at the NTT during Period 60.

We also compared first-night performance for the SO and EIS Mode, and also here no significant changes are observed. Table 2 summarises the difference between first-night and overall performance for each of the individual modes. In Table 2 the difference (in percentages) is given between the first-night characteristics and the overall characteristics, e.g. observers in VIS Mode spent on average 1.9% less (hence the negative sign in Table 2) of the total available time on standards during the first night, compared to the overall observing run. The difference in operational overhead, calibration data, scientific data and down time should add up to zero.

The main difference is observed in the down time for both SO and EIS Mode. These modes have had, on average, better weather conditions during the first nights. This has, logically, resulted in spending more time on taking calibration data. Note that one service observing run (5/6 – 9/10 November 1997) is excluded from this particular analysis, because the first night on this run was totally unusable due to adverse weather conditions.

Summarising, there is no evidence from the NTT Period 60 logs, that observers in Visitor Mode use the telescope less efficiently on their first night. This could, however, be solely due to the high level of observational experience of these observers. Over the last five years, 80% of all the NTT Period 60 visiting astronomers had used one or more of the telescopes at the La Silla observatory, and over the last three years, 30% of the NTT Period 60 visiting astronomers had used the NTT previously.

• Various sources of time losses

Time lost due to bad weather conditions is beyond the control of any observer. All observatories try to minimise time lost to other problems. At the NTT during Period 60, there were some reoccurring sources of time loss, which could be avoided, or at least minimised in the future. The two main sources of time loss were the long CCD readout times, and switching from EMMI to SUSI during one night (mainly, but not exclusively, done during SO Mode).

The long CCD readout time of the CCD only became a serious problem when the scientific programme required many short exposures, such that the time spent on

Table 1: A summary of the observing conditions for the three different modes.

	VIS	SO	EIS
Number of nights Average Seeing † > 50 % down time *	52 0.89 ± 0.28 (39) 6.3 %	37.5 0.86 ± 0.18 (16.5) 17.4 %	27.5 1.03 ± 0.31 (17.5) 8.8 %

† In brackets the number of nights is given on which the quoted, average image quality (in arcseconds) is based.

* This shows the percentage of nights when more than half of the night was lost due to either adverse weather conditions, technical problems, telescope tests, or Targets of Opportunity.

Table 2: First-night performance compared to the overall performance for VIS, SO and EIS Mode.

	VIS	SO (Numbers quoted in percentages)	EIS
Operational overhead	–1.9 ± 2.5	+1.0 ± 3.9	+1.1± 1.6
Calibration data	+0.4 ± 2.8	+3.0 ±10.4	+5.3 ±10.0
Scientific data	+1.0 ±11.4	+1.0 ±10.1	+2.7:±16.0
Scientific data (–overhead)	–0.3 ± 9.1	+0.2 ± 6.1	+1.0 ± 8.2
Efficiencycy †	–1.8 ± 3.9	+1.0 ± 6.3	–0.3 ± 1.4
Down Time *	+0.5 ±12.0	–4.9 ±11.8	–9.1 ±17.1

† The efficiency is defined as the fraction of the time spent on taking scientific data excluding the overheads such as pointing and reading out the CCD, compared to the total time taking scientific data.
* The Down Time is defined as the total time that the telescope is not used for the programme in question, either due to adverse weather conditions, technical problems, targets of opportunity, or telescope tests.

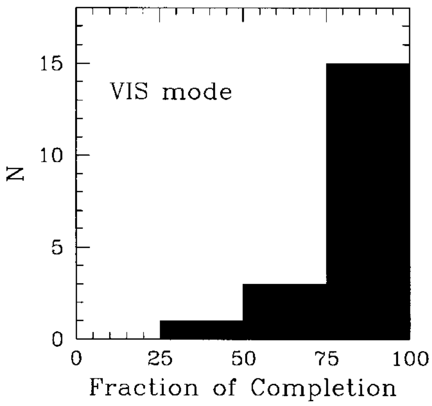

Figure 3: The distribution of the fraction of completion of the programmes in Visitor Mode based on the weather statistics (see text for a more detailed description). Fifteen programmes in VIS Mode lie in the interval of 75% to 100% completion.

gathering photons is equivalent to, or smaller than, the readout time. One programme in VIS Mode suffered severely from this effect. Of all the time spent on taking scientific data (i.e. on target) for this programme, only 43% of the time the shutter was open to gather photons, compared to the overall average of VIS Mode efficiency of 72.5%. This was by far the least efficient programme in this sense, only because of the short exposure times of the science objects. The ESO Imaging Survey also suffered slightly from this effect, with exposure times that were only double the CCD readout time (see also 'the overhead on science observations' for a further discussion). Of course, this problem would have been eliminated if FIERA CCD controllers had been available for EMMI during the EIS project as originally envisioned.

The other main source of time loss was due to switching between instruments during the night (sometimes more than once). Typically, it took between 30 and 40 minutes per switch before data acquisition resumed. A significant fraction of this time was spent on the focussing of the telescope. During Period 60, both EMMI and SUSI were offered until December 1, 1997. After this date, only EMMI was available. During two SO runs before December 1, 1997, the instrument switches took 6.0% and 9.3% of all the available time, respectively. Unless switching to a higher-priority programme, the advantages of reacting to changing weather conditions by switching to a different instrument are often lost due to decreased available science integration time.

One additional problem that arose during service observing in Period 60 was the lack of OPC-approved bright-time programmes. This problem presented itself in a nasty way during the fifth SO run in Period 60 (1/2–7/8 January 1997). There were time slots during the night for which no SO programme was available. Although this time was used for calibration observations and technical tests, it could have been used for science if programmes had been available. Therefore, it was not scientifically productive. This problem did not re-occur during Period 60.

The technical down time is generally very low, 2.9%, 1% and 4.3% of all the available time during VIS, EIS and SO Mode observing, respectively. In addition, a small fraction of the time was made available for the Targets of Opportunity, mostly during service observing (1.5%, 2.7% and 3.9% of all the available time during VIS, EIS and SO Mode observing respectively). In Table 3, a summary of these numbers is given. From Table 3[2], one can see most clearly that one of the main differences between the various observing modes was the time lost due to bad weather conditions. On average, service observing has suffered 10% more from bad weather, whereas both EIS and VIS modes suffered similar weather losses.

[2]In Figure 4 of Silva (1998), four nights that were completely lost due to bad weather conditions were by mistake not included in the pie diagram. The numbers quoted in Table 3 are the correct ones for Service Mode at the NTT during Period 60.

• The overhead on science observations

In Column 9 of Table 3, we present the efficiency in executing an Observation Block. This efficiency is defined as the fraction of the time requested by the observer for executing an Observation Block over the time actually needed to gather the data (including moving the telescope on target, reading out the CCD).

In the lower panel of Figure 1, the efficiency is indirectly plotted for each night of observing in each of the individual modes (black squares correspond to Visitor Mode, red dots represent the Service Mode and the blue dots show the results of the EIS Mode). The solid and dashed lines correspond to the efficiency listed in Column 9 of Table 3. The efficiency of the EIS Mode lies below that of both the VIS and SO modes. This is solely due to the precept goals of the EIS, namely large areal coverage, rather than going deep to faint magnitudes. In other words, although the EIS project achieved its main technical goal (areal coverage), it came at the cost of high operational overhead caused by old-generation CCD controllers. The original plan, of course, was to eliminate this overhead by using FIERA CCD controllers and a drift-scan technique. Alas, new CCD controllers for EMMI were not available in time for use during the EIS project.

From Table 3 and Figure 1, it can be

Table 3: Splitting up the night

I.A. (1)	S.I. (2)	S.M. (3)	Ops. (4)	Cal. (5)	Sci (6)	Sci-o (7)	Sci ov. (8)	Elf (9)	Wea (10)	Techn (11)	ToO (12)	Test (13)	Down (14)	
ALL	6.3	0.9	0.4	7.6	10.6	63.5	43.1	20.4	67.9	12.1	3.0	2.6	0.6	18.3
SO	7.0	1.5	0.4	8.9	9.7	52.1	39.7	12.4	76.2	19.4	4.3	3.9	1.7	29.4
EIS	7.4	0.0	1.0	8.5	12.3	66.1	33.7	32.5	51.0	9.1	1.3	2.7	0.0	13.1
VIS	5.0	1.0	0.0	6.0	10.3	71.2	51.6	19.6	72.5	8.0	2.9	1.5	0.0	12.5

(1) Image analysis, (2) Switching instruments, (3) Switching observing mode, (4) Operational overhead, (5) Calibration data, (6) Science data, (7) Science data minus overhead, (8) Overhead on the science data, (9) Fraction of time needed over time used for science data, (10) Weather down time, (11) Technical down time, (12) Target of Opportunity, (13) Tests of the telescope, (14) Total fraction of "down time" (= column 10+11+12+13).

maintained that service observing minimises the time to move to a target and gather the data, and in this sense it is the most efficient way of observing, closely followed by the Visitor Mode observing. Moreover, the spread in efficiency in Service Mode observing is much smaller than the spread observed in VIS Mode efficiency, as can be seen in the top panels of Figure 1 (2.4%, 9.1% and 13.5% for EIS, SO and VIS Mode, respectively). The histogram of the Service Mode efficiencies shows a close to Gaussian distribution, whereas the VIS mode histogram displays a clear non-Gaussian distribution, with a long tail towards lower efficiencies. The lack of this tail in the Service Mode histogram, and the smaller spread, indicate that service observers acquire the data in a more consistent way. Naturally, the EIS project has the smallest distribution because of their uniform observing strategy.

• Completion of the programmes

In a report on service observing at the NTT, Silva (1998) showed (Fig. 5) the fraction of completed programmes during service observing in Period 60. Completed means that the data passed the quality control and that all the requested observing Blocks have been successfully executed. Unfortunately, the data gathered in Visitor Mode are not subjected to a quality control and it becomes very difficult to judge from our current analysis if an observer in VIS Mode is satisfied with the quality of the obtained data. We estimated the Visitor Mode completion in two ways:

• Seeing. Does the image quality during the observing run (seeing on the DIMM2 telescope) conform to the image quality requested by the observer?

• Down time. What is the fraction of (weather) down time?

It turns out that the seeing requirements of the visiting astronomers were not so strict, and hence this parameter becomes a poor indication of the completion of a VIS Mode programme; 86% of the programmes experienced better seeing than requested and for the remaining 14% the seeing was comparable to, or marginally worse than, the initial request. In Figure 2, it can be clearly seen that the OPC-approved programmes in Service Mode (left panel in Figure 2) have a much more stringent seeing requirement, e.g. 10 programmes requested a seeing better than 0.8″, compared to their classical counterparts (right panel in Fig. 2). It shows that those programmes requiring good observing conditions have generally been assigned to be completed via service observing.

The fraction of down time is a much better indicator for the completion of visitor programmes, assuming that the initial time requested is sufficient to complete the entire programme. Figure 3 shows the fraction of completion of the VIS programmes. It cannot be directly compared to Figure 5 of Silva (1998) because of the lack of quality control, but does give an idea of the success rate of the Visitor Mode observing.

• In the long term

One final way of comparing the different observing modes and their respective efficiencies is to look at the scientific output. Has service observing resulted in making the astronomer more productive? What is the scientific impact of the NTT as a result of service observing? This, of course, can only be monitored over a larger time span, and it might still be too early to answer this question.

Out of all the programmes executed at the NTT during Period 60 (VIS and SO Mode), two papers have appeared to date in refereed journals, presenting data gathered at P 60. One paper is (partially) based on data taken during Service Mode (Sollerman et al. 1998), whereas the second paper presents data taken during Visitor Mode (Reimers et al. 1998).

Lessons Learned Redux

Silva (1998) ended with a review of lessons learned from the NTT service observing experience and how applying these lessons could improve service observing at ESO in the future. The additional analysis here reveals several new lessons.

It is obvious to all observers that, on any given night, minimising instrument-configuration changes minimises required calibration overheads and therefore maximises the amount of science acquisition time. The analysis presented here suggests that this paradigm can be extended to instrument switches. Although rapid instrument switching is possible at the NTT and will be possible at the VLT UTs, it is not clear whether this is the most efficient use of nighttime hours. During Period 60 service observing, instrument switching frequently consumed 10% or more of the night. The lesson is clear: unless the science priority is very high, switching between instruments on any given night should be avoided.

It is equally clear that the benefits of service observing become most significant for programmes that need special observing conditions (e.g. exceptionally good seeing or water vapour content) or have special scheduling constraints (e.g. rapid follow-up of transient events like gamma-ray bursters). Programmes that require worse than median conditions (as all the NTT Period 60 VIS programmes did) can typically be efficiently executed in Service or Visitor Mode. Nevertheless, it is important to schedule enough loosely-constrained programmes in Service Mode that the entire range of observing conditions delivered on nights dedicated to service observing can be used efficiently.

Acknowledgements

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"First Light" of UT2 !

Following the installation of the main mirror in its cell and a 20-hour working session to put the complex secondary mirror and its support in place, the UT2, now Kueyen, achieved (technical) first light in the morning of March 1, 1999, when an image was obtained of a bright star. It showed this telescope to be in good optical shape and further adjustments of the optical and mechanical systems are expected soon to result in some "astronomical" images.

The announcement of this important event was made by the ESO Director General during the opening session of the VLT Symposium that was held in Antofagasta during March 1–4, 1999.

(Excerpt from ESO Press Release 06/99 – http://www.eso.org/outreach/press-rel/pr-1999/pr-06-99.html)