

# Completion, Success, and Execution rates in HSC Queue mode

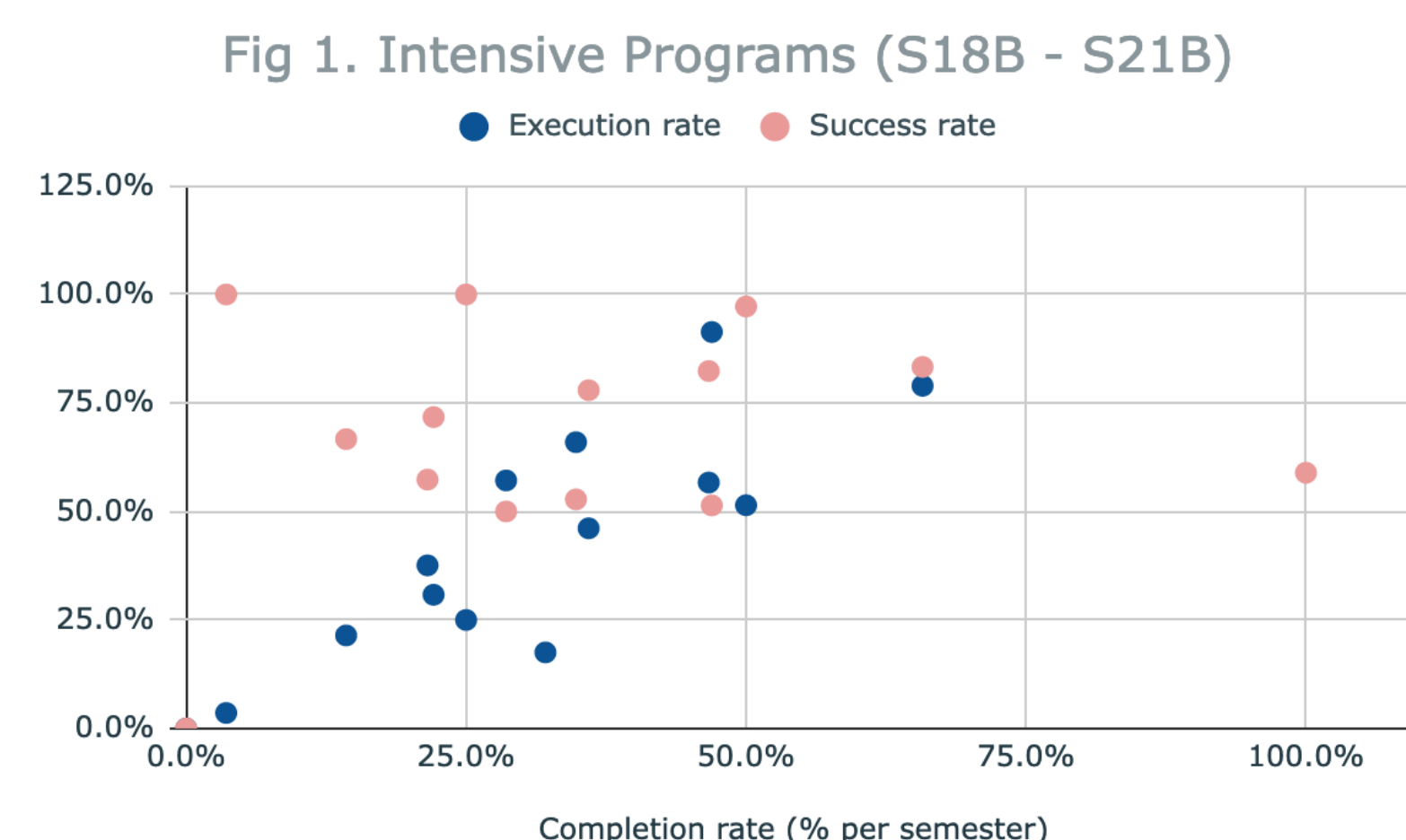
-Consideration of the low completion rate –

Tae-Soo Pyo, Sakurako Okamoto, and Tsuyoshi Terai  
 On behalf of the HSC Queue mode operation working group

Conclusion: The low completion rate of HSC Queue mode has long been a problem: showing ~ 50% or less completion rate for the intensive programs. We analyze the completion rate, execution rate, and success rate of all Grade A & B HSC Queue mode programs from S18B to S21B to understand the cause of the low completion rates. The current low completion rate (~ 42.5 %) is explainable given ~ 40% downtime including bad weather, cumulative distribution of seeing (>1", 70%), 75% success rate. As a countermeasure, we need to reduce the telescope/instrument downtime and increase the observation execution rate itself with the relaxation of the observation conditions based on the cumulative distribution of seeing and secure sufficient observation time considering necessary all overheads and weather factors. In addition, we need to establish a system to speed up the actual measurement and prediction of seeing and atmospheric transparency.

## 1. Intensive Programs (S18B-S21B)

Fig. 1 shows the correlation between the completion rate and success and execution rates for all intensive programs from S18B to S21B. The completion rates of the intensive were below 50% for all programs except two programs, showing a proportional relationship with the execution rate. The success rates show a distribution of 75±25% regardless of the completion rates.



## 2. All grade A and B programs (accepted programs)

Fig. 2 shows the correlation between the completion rate of grade A and B programs and the execution rate and success rate. completion rate shows a stronger correlation with execution rate than success rate. Looking at the fit line of the regression analysis, the expected completion rate at the execution rate for the allotted time (100%) is around 75%, indicating a 75% success rate. When the execution rate exceeds 100%, that is, a program that uses more time than the allotted time for observation shows a 100% completion rate. The success rate depends on weather conditions and is generally less than 100%. It should be noted that the total time allotted to queue mode is limited, so spending more than 100% of the time on one program observing is equivalent to losing time on another program, resulting in an average execution rate of is unchanged. Issues with completion rates lower than 30-40% have lower execution rates and success rates more spread out from 100% to 20%.

Fig 2. Completion vs Execution and Success Rates (A&B)



## 3. Execution (Observation) hours.

Fig 3a shows the time lost for each semester's observation hour and total allocated hours of HSC queue mode. Fig 3b shows the relative percentage of total allocated hours. The percentage exceeding 100% in the S20B term was due to the cancellation of the TSC engineering observation at the beginning of the October run and the problem of Top-Unit exchange work at the end of the run, which resulted in an additional HSC nights of 2+3 nights. Among the semesters other than S20B, the percentage of the execution hours for grades A & B is 49.5 ± 12.8%, and for grades C & F in bad weather is 11.6 ± 6.6%. Completely lost observation hour is occupied ~ 38.9±12.6% in the allocated time. Thus, more than 50% of the time was lost due to bad weather and equipment/telescope troubles.

Fig 3a Observation hours in each semester

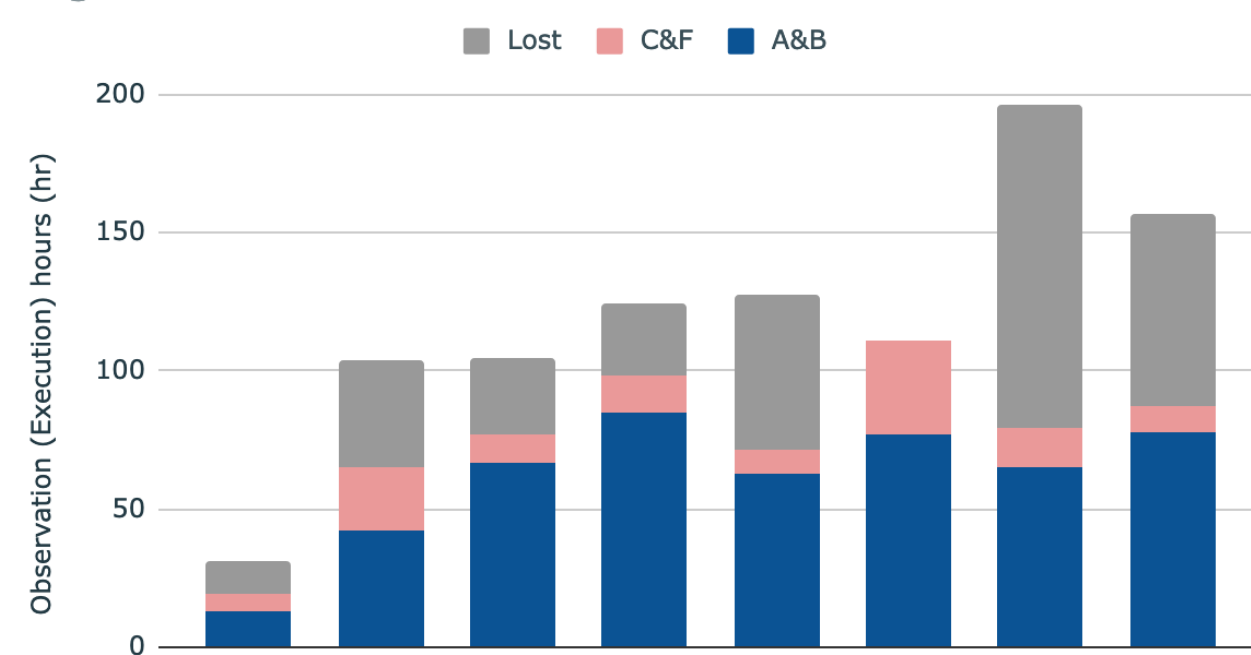
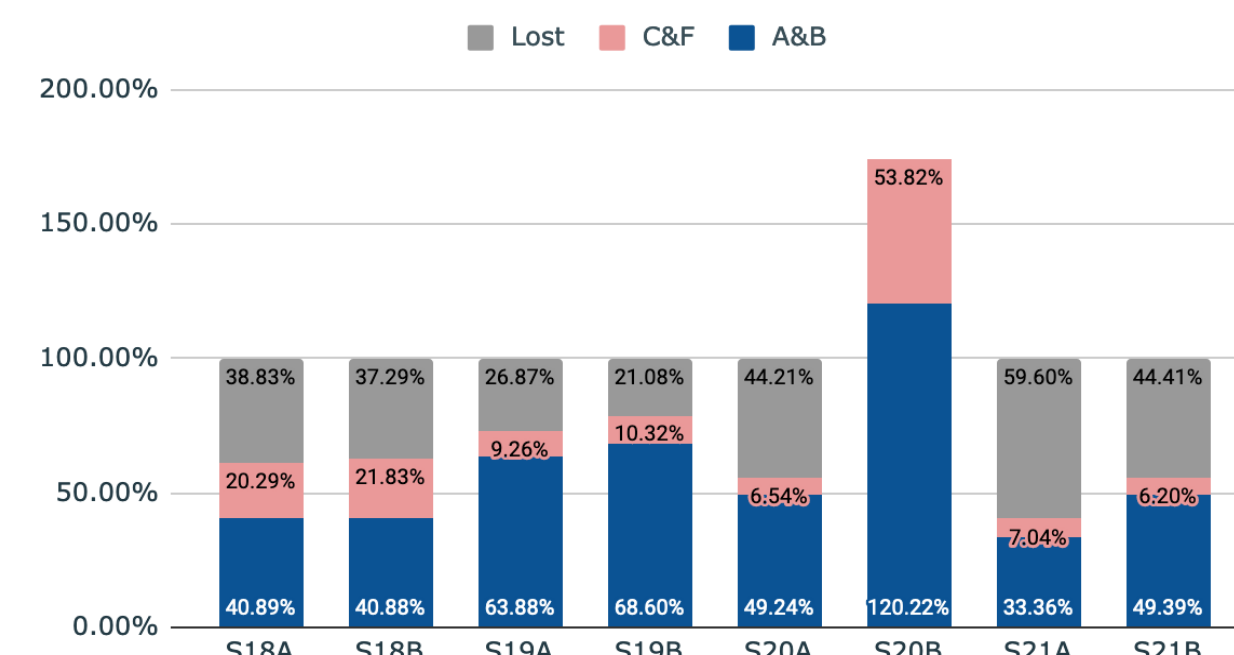


Fig 3b Percentage of the execution and lost hours



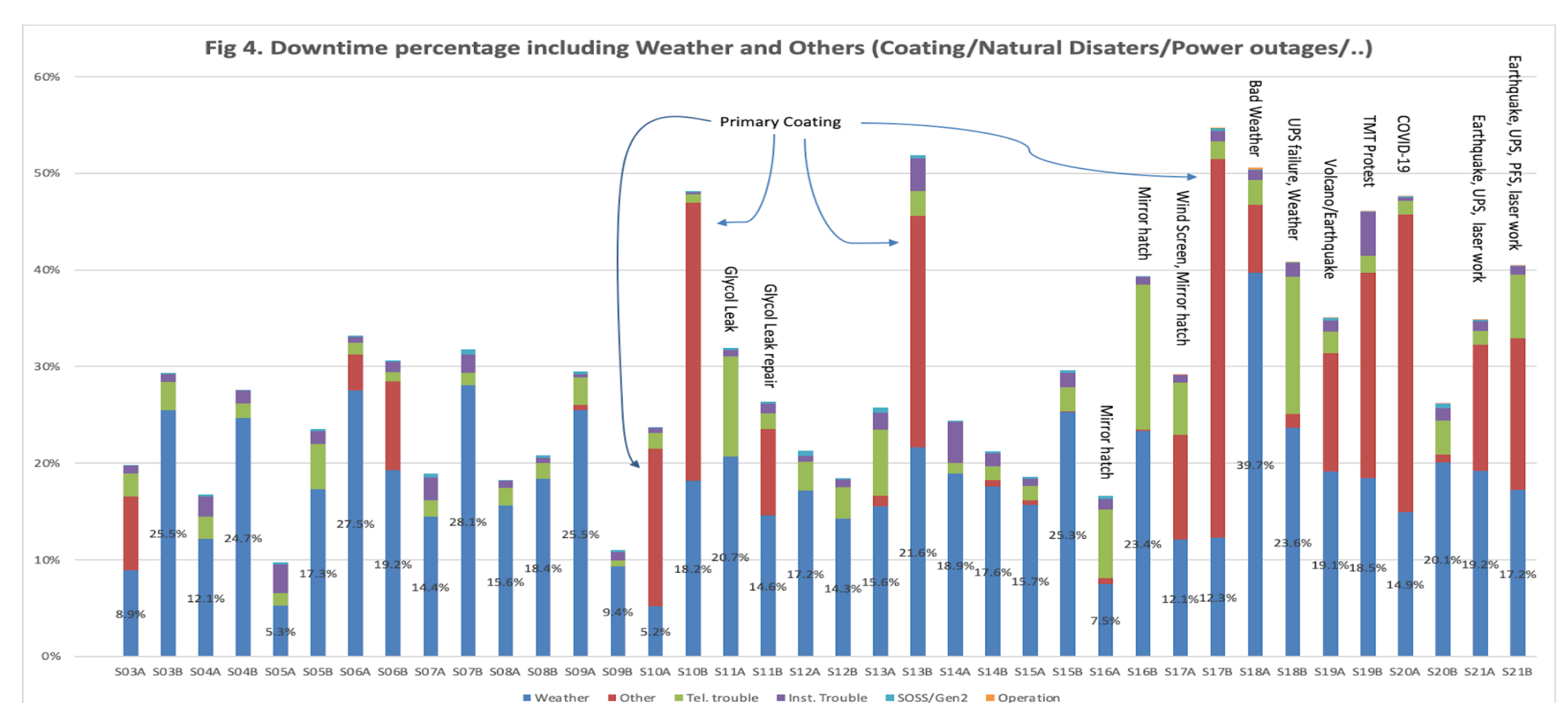
$$\text{Completion rate} = (\text{Completion hours}) / (\text{Total allocated hours})$$

$$\text{Execution rate} = (\text{Execution (observed) hours}) / (\text{Total allocated hours})$$

$$\text{Success rate} = (\text{Completion hour}) / (\text{Execution hour})$$

## 4. Downtimes including weather

For reference, Fig. 4 shows the transition of Subaru's downtime over the past 18 years. In the S18A&B period, there was a lot of downtime due to bad weather, and UPS troubles also affected HSC Queue observations. The S19A&B period was affected by volcanic activity and TMT protest activity, but the HSC observations corresponded to the observation plan and weakened the influence on some extent. The main causes for the S20A period were the cancellation of nighttime observations due to COVID-19, the cancellation of the HSC run in March due to TUE troubles in the S21A period, and the annihilation of the January run due to bad weather in the S21B period. Looking at the transition in Fig 4, the downtime has continued to exceed 35% since the S18A period when the HSC Queue mode started in earnest (however, only S20B is 26%). One of the main reasons for the low completion rate is the short observation time due to bad weather, equipment/telescope troubles, and natural disasters.



## 5. Relation with the Seeing Conditions

Fig. 6 shows the correlation between the completion rate and the seeing observation conditions. Many programs that require seeing better than 0.8" have achieved less than 50%. Two programs show the completion rates of more than 70% under the condition of seeing of 0.8" or less. The two programs have execution rate of more than 100% and a success rate of more than 70%. Right side figure shows cumulative statistics of seeing derived from HSC Queue mode science data so far. Seeing better than 0.85" shows 47% and seeing better than 1.05" shows less than 70%. For the completion rate, it is necessary to consider the temporal instability and fluctuation of seeing. From this statistical value, it is difficult to exceed 70% completion rate for the program requiring a seeing < 1.0" in general. Approximately 40% is unobservable lost time (Fig 3b). Furthermore, considering the effects of seeing and atmospheric transparency, the predicted observational success rate for situations of seeing below 1.6" is 54% (=60%×90%). If we consider the average success rate of 75%, the success rate is expected ~ 40%, which is in line with the current average completion rate of 42.5%.

Fig 6. Completion rate and Seeing Constraints

