Policies

Science Team Policies

Document No.: MST-POL-PSC-20103-9213-0001

Issue No.: 4.00

DocuShare Document URL: https://ds-web.aip.de/docushare/dsweb/Services/Document-3648

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Released by	Sofia Feltzing, PS Digitally signed by Roelof S. de Jong Date: 2020.05.19 16:54:23 +02'00' Roelof de Jong, PI	2020-05-16

Change Record

Issue	Date	Page, Section, Paragraph Affected	Reason, Remarks
0.01	2014-03-20	All	New document
0.02	2014-09-09	All	Comments from RdJ
0.03	2016-02-27	All	New template
1.00	2016-04-08	None	Version issued for PDR
1.01	2017-02-14	All	Extensive revision
1.02	2017-02-24	Sections 1 and 5	Clarified the temporal scope
1.03	2017-06-20	Several	Updates, comments by J. Walcher
1.04	2017-10-13	Several	Updates
1.05	2017-11-30	Several	Comments by ESO and others
1.06	2017-12-04	Sections 5.5 and 12	More comments from SCB
1.07	2018-02-01	Several	Comments by R. Ivison
2.00	2018-02-09	None	Second release
2.01	2019-11-01	Several	Various updates
2.02	2019-11-16	Section 9	Comments by ESO
3.00	2019-11-21	None	Third release
3.01	2020-04-19	Sections 5.5 and 15	Protection of target catalogues
3.02	2020-05-05	Section 15	Comments by ESO
3.03	2020-05-11	None	Renewed distribution to SCB
4.00	2020-05-16	None	Fourth release

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Table of contents

1 Scope

This document defines the policies that govern the scientific collaboration of 4MOST, including all Consortium and participating Community Surveys. Additional policies may apply to Consortium Surveys. Non-participating Community Surveys are not covered by this document. Throughout this document, the term "Community Surveys" should thus be understood to mean "participating Community Surveys".

This document covers all phases of the 4MOST project, from the preparatory phase involving only the 4MOST Consortium, to the joining of the Community Surveys and the joint preparations phase, and finally the operations phase.

2 Applicable Documents (AD)

The following applicable documents (AD) of the exact issue shown form a part of this document to the extent described herein. In the event of conflict between the documents referenced herein and the contents of this document, the contents of this document are the superseding requirement.

AD ID	Document Title	Document Number	Issue	Date
None				

3 Reference Documents (RD)

The following reference documents (RD) contain useful information relevant to the subject of the present document.

RD ID	Document Title	Document Number	Issue	Date
[RD1]	Operations Plan	MST-PLA-PMO-70100-9710-0001	2.00	2017-02-27
[RD2]	Operations Requirements	VIS-SPE-4MOST-47110-9710-0001	1.00	2017-01-30
[RD3]	Science Coordination Board Rules of Procedure	MST-POL-PSC-20101-9211-0001	1a	2015-04-14
[RD4]	4MOST Consortium Agreement	MST-CON-PIN-10100-9110-0001	1.00	2018-05-18

4 Introduction

The 4MOST instrument will be used by the 4MOST Consortium, in collaboration with ESO and the community, to carry out a comprehensive, multi-year public survey programme consisting of a number of individual surveys, initiated and implemented both by the 4MOST Consortium and the community, covering a large fraction of the southern sky and addressing an extremely wide range of scientific questions. For reasons of efficiency, this survey programme will normally be carried out in an integrated manner, with all individual surveys being carried out in parallel and sharing the focal plane. This requires an integrated approach to the planning, development and operational implementation of the survey programme as a whole. However, going beyond the efficiency argument, it is the view of both ESO and the 4MOST Consortium that the scientific value of the 4MOST survey programme as a whole will be larger than the sum of its constituent parts. Therefore, the integrated approach should be extended beyond planning and operations to the dataset itself as well as its scientific exploitation. This is the reason why the 4MOST scientific community has decided not to view itself as a collection of individual, disparate and disjoint survey teams, but rather to come together in a single 4MOST Science Team that will collectively plan, execute and exploit the 4MOST survey programme in a collaborative manner.

It is thus the declared intent of the Science Team to work together in a cooperative and respectful atmosphere, with scientific best practices at heart, and in the interest of the overall 4MOST science programme. While the Science Team acknowledges that each constituent survey of this programme has its legitimate individual interests, and that the effort invested towards attaining a survey's main science goals should be respected, the Science Team also recognizes the value of cooperation across survey boundaries to the extent that it strives to minimize these boundaries as far as possible. It is this spirit of partnership that guides all interactions among the Science Team.

5 Definitions

This section does not contain any policies but instead defines a number of terms and entities that are governed by the policies set forth in the rest of this document.

5.1 Science Team

5.1.1 Composition

The 4MOST Science Team (ST) is comprised of the 4MOST PI, the 4MOST PSs, and all scientific members of all Consortium and Community Surveys. The ST thus encompasses the entire 4MOST user community (in the usual sense of a "user" being a co-author of a 4MOST proposal), apart from the non-participating Community Surveys.

The ST sets the science requirements, defines the survey programme, and delivers the scientific data products back to ESO and the public. The ST is also a privileged end user of these data products through both early access (see Section 14) and intimate knowledge of their genesis. As such, the ST is the primary scientific exploiter of the 4MOST data.

5.1.2 Structure

5.1.2.1 4MOST Principal Investigator

The 4MOST Principal Investigator (PI) is responsible for the overall management of the 4MOST Project and of the Consortium. The PI also represents the ST towards ESO. As such, the PI is responsible for negotiating the contents and schedule of the ST's deliverables to ESO, and ultimately for the delivery of the 4MOST survey programme, i.e. the L1 and deliverable L2 data products (see Section 5.5).

5.1.2.2 4MOST Project Scientists

The two 4MOST Project Scientists (PSs), one for Galactic, one for Extragalactic science, are the internal leaders of the ST and are responsible for the management of the ST. They oversee the development of 4MOST science cases, guide the development of the resulting requirements, develop a vision for the overall legacy of the 4MOST survey programme, foster the integration of the different science cases, represent the "One 4MOST Survey" perspective in any discussion, and define the deliverables and the schedule for the Surveys (except for the L2 data products). Metaphorically speaking, the PSs are the oil in the 4MOST science machinery.

5.1.2.3 Surveys

A Survey is a specific sub-set of the 4MOST science programme that is pursued and supported by a specific sub-group of the ST. In other words, a Survey is an observing programme on 4MOST of a specified set of targets that is pursued by some members of the ST. Normally, a Survey is centred around a specific science theme, and is thus driven by a set of closely connected scientific goals. However, some Surveys may instead be centred around a common methodological approach, resulting in more disparate scientific goals (e.g. TiDES).

A Survey is defined by its: PI(s), Survey team, Survey Science Plan (science case and derived requirements), Survey Management Plan (WBS, resource planning, team structure, schedule), target list with associated spectral success criteria, overall survey figure of merit, and L2 data products to be delivered to ESO.

Surveys are free to define their internal structures as they see fit.

By definition, every ST member except the 4MOST PI is a member of at least one Survey. Since ST members may be members of more than one Survey, there will in general be overlap between Survey teams.

Surveys have the responsibility to prepare and exploit their "own" programmes, as well as to contribute to all aspects of the planning, implementation and analysis that concern multiple Surveys, as carried out by the Infrastructure Working Groups (IWGs). Specifically, the main responsibilities of Surveys include staffing the IWGs and creating their own target lists and L2 data products.

A given Survey may include sub-surveys. These are defined as sub-groups of the Survey's target list that are critical to the Survey's success. The successful completion of each sub-survey is thus a condition of the successful completion of the Survey itself.

Some Surveys were initiated by the 4MOST Consortium and will be carried out using GTO time (Consortium Surveys), while others will be initiated by members of the ESO community and will be carried out using public time (Community Surveys). In this document, the term

"Community Surveys" only refers to *participating* Community Surveys. In all aspects of the 4MOST project, including this document, every attempt is made to distinguish between these two types of Surveys as little as possible.

5.1.2.4 Science Coordination Board

The Science Coordination Board (SCB) represents the 4MOST Surveys and consists of all Consortium and Community Survey PIs, the 4MOST PI (no voting rights), the 4MOST PSs (no voting rights) and the ESO 4MOST PS (no voting rights). It is the central body in charge of the planning of the 4MOST science programme, including both Consortium and Community Surveys. Its decisions are binding on the Surveys (but see Section 8 of [RD3]). Its four main roles are:

- The SCB coordinates the scientific programmes of the Surveys and mediates between potentially conflicting interests of different Surveys. In this capacity, it is also responsible for defining a sample of "supplementary" targets, to be observed only when fibres cannot be filled with survey programme targets (see Section 5.3).
- The SCB is conceptually the owner of the Science, User and Operations Requirements. As such, it is the customer of the 4MOST project and represents the interests of the science programme to the Consortium. It is mandatory for the Project Office to consult the SCB on all matters concerning the requirements. The SCB is responsible for negotiating a solution in case of conflicting requirements. The SCB verifies whether the requirements are met by the facility and operations. In particular, the SCB approves the final survey strategy (Section 7).
- The SCB assists the 4MOST Project in coordinating all matters affecting more than one survey, in particular the joint planning and execution of all Consortium and Community Surveys.
- The SCB defines, manages, implements and enforces the Science Team Policies, and is the owner of the present document. The day-to-day implementation of the Science Team Policies is delegated to the Science Policy Board.

The rules governing the transactions of the SCB are described in [RD3]. The minutes of its meetings are available on Docushare.

5.1.2.4.1 Science Policy Board

The Science Policy Board (SPB) is a sub-committee of the SCB. It consists of one representative from each Survey. Its task is to deal with all matters arising from the implementation of the Science Team Policies in relation to ST membership (Section 6), scientific exploitation (Section 15), data sharing (Section 16) and accelerated publication (Section 17.1). All requests for approval in these matters, as required by the Science Team Policies, will first be handled by the SPB. Issues on which the SPB is unable to reach unanimous consensus are referred up to the SCB for resolution. In other words, the SPB will act as a kind of filter which only lets controversial issues through to the SCB, but deals with uncontroversial ones itself.

All transactions of the SPB will be as transparent as possible to the rest of the ST.

5.2 Survey programme

The set of all Consortium and Community Surveys is collectively referred to as the 4MOST survey programme.

5.3 Survey programme and supplementary targets

Any object for which any of the Surveys request any observations is referred to as a "survey programme target".

It is a priori clear that it is not possible to guarantee that every single 4MOST fibre in every single observation can be allocated to an uncompleted survey programme target. In order not to leave any fibres empty, thereby wasting observing time, it is therefore necessary to supplement the survey programme target sample with an additional sample of targets referred to as "supplementary targets". A supplementary target will thus only be observed if the fibre allocated to it cannot be allocated to an uncompleted survey programme target instead.

An object may be both a survey programme and a supplementary target. In other words, a survey programme target may be proposed for additional observations beyond what is required by the survey programme. Conceptually, such an object should be thought of as two targets, with the supplementary target "replacing" the survey programme target once its survey programme observations have been completed.

The policies governing supplementary targets are described in Section 9.

5.4 Survey strategy

The term "survey strategy" refers to all aspects of the execution of the observations for the 4MOST survey programme. This includes, e.g., the procedures to decide where to point the telescope at any given point in time, which targets to observe in this field, and how to allocate the fibres to these targets. This also includes the procedures to determine the values of any "free parameters", such as, e.g., the use of any fixed tiling pattern, the number of exposures at a given position, and the exposure times.

The policies governing the survey strategy are described in Section 7.

5.5 Data and data products

Section 4.3.1 of [RD1] defines 3 levels for data and data products, from L0 (raw data) to L2 (data products derived from 1D spectra).

L0 and L1 data are produced by the observing and data management systems, and are made available to the ST with a frequency defined in Section 6.4 of [RD1]. L2 data products are produced by the ST. Among the L2 data products this document further distinguishes between those that are deliverables to ESO and those that are not. Since all 4MOST Surveys are ESO Public Surveys the ST will be required to deliver, for each Survey, a certain set of pre-defined L2 products to ESO. These are termed deliverable L2 (DL2) products. However, the ST is in no way precluded from generating, exploiting and publishing additional L2 (AL2) products.

Again, since all 4MOST Surveys are ESO Public Surveys the L0, L1 and DL2 data and data products will eventually become public through ESO's Science Archive Facility (SAF), as well as the 4MOST public database. L0 data will be public immediately, whereas L1 and DL2 data will become public on a pre-determined schedule to be negotiated with ESO. AL2 data products

will normally be published in the 4MOST public database. The policies in Sections 12 – 16 thus only apply to L1 and L2 data and data products that have not yet been published by the SAF or the 4MOST public database, and the unqualified term "data" is used accordingly in these sections. Nevertheless, in keeping with the spirit of Section 4, all ST members are encouraged to observe the policies of Sections 12 – 16 even for data and data products that have already been published.

6 Science Team membership policies

Every ST member shall be registered in the 4MOST User Management System.

All ST members should participate in the activities of the Surveys they are a member of. "Passive" membership is discouraged.

As a guideline, ST members should be members of at most 2 Surveys. This guideline is meant to promote and encourage active participation.

6.1 Membership types

Two types of ST members are defined in the following. This differentiation is needed for the regulation of the scientific exploitation rights.

An ST member who is a member of a 4MOST Consortium institute (as defined in [RD4]) or who is an individual Consortium member is termed a Consortium ST member. All other ST members are termed Community ST members. (Note that ST membership type is defined by membership of the 4MOST Consortium, not by membership in a particular type of Survey. In particular, Community ST members may be members of Consortium Surveys and vice versa.)

Permanent ST members (see Section 6.4) shall retain the ST membership type they had when their permanent ST membership was awarded, irrespective of their membership of a 4MOST Consortium institute (as defined in [RD4]) or their individual Consortium membership.

6.2 Admission

This section describes the policies governing the admission of members to Surveys. Since Survey membership is a necessary and sufficient condition for ST membership (except for the PI), these policies also govern ST admission.

6.2.1 Consortium Surveys

Existing Consortium ST members, all members of 4MOST Consortium institutes (as defined in [RD4]) and all individual Consortium members shall be admitted upon request.

Existing Community ST members may be admitted upon application at the discretion of the Survey, without requiring approval from the SPB.

Every Survey shall admit all PhD students of its members upon request. PhD students from outside of both the existing ST and the 4MOST Consortium shall be admitted as Community ST members.

6.2.2 Community Surveys

The initial members of a Community Survey are the co-authors of the Survey's proposal.

Existing ST members, members of 4MOST Consortium institutes (as defined in [RD4]) and individual Consortium members may be admitted upon application at the discretion of the Survey, without requiring approval from the SPB.

6.2.3 Common policies

A given Survey may admit a new member from outside of both the existing ST and the 4MOST Consortium under the following conditions:

- The proposed new member shall bring a capability or expertise to the Survey that is essential for the preparation of the Survey, allows the Survey to produce a new type of data product or significantly enhances the Survey's ability to scientifically exploit its data.
- Said capability or expertise shall not be available among existing ST members or, if it is, the relevant ST members have declined a collaboration with the Survey (e.g. for lack of time).
- The 4MOST PI can give a temporary Survey membership to those scientists who are in the process of raising funds to become Consortium members. Memberships on this basis will be reviewed once 4MOST is fully funded. If insufficient funding has been contributed to become Consortium member, membership under the previous clause may still be applied for.

The SPB shall verify whether these conditions have been met based on an application submitted by the Survey PI(s) on behalf of the proposed new member. The application (~1 page) should address the above points as well as any other relevant issues.

Upon SPB approval the new member shall be admitted to the ST as a Community ST member, irrespective of the Survey they are joining.

The number of members any Survey may admit under this policy shall be limited to 15. Members admitted under this policy who have since been awarded permanent ST membership (see Section 6.4) or whose ST membership has ended shall not be counted towards this limit.

6.3 End of membership

As a guideline, every Survey should review their membership every 2 years. Members who have not participated in any of the Survey's activities over the previous 2 years may be asked to resign their Survey membership at the discretion of the Survey PI(s).

A PhD student's ST membership, and thus all Survey memberships, shall expire upon completion of their PhD project unless permanent ST membership has been granted (see Section 6.4). Individual Surveys may also be re-joined by the former student through the process described in Section 6.2.3.

A PhD student's Survey membership shall normally, but not necessarily, be terminated when their supervisor's Survey membership ends unless permanent ST membership has been granted (see Section 6.4). An exception may be made by the SPB upon application from the student and their supervisor if this is in the interest of a successful completion of the PhD.

Consortium ST membership is contingent on membership of a Consortium institute (as defined in [RD4]) or on individual Consortium membership. Expiration of Consortium institute membership (e.g. due to relocation to a non-Consortium institute) or of individual Consortium membership shall thus automatically entail the termination of ST membership, and thus the

termination of all Survey memberships, unless permanent ST membership has been granted (see Section 6.4). Individual Surveys may also be re-joined by the former Consortium ST through the process described in Section 6.2.3.

An ST member who has severely violated the policies set forth in this document may be expelled from the ST (and hence from all Surveys) jointly by the 4MOST PI and ESO upon recommendation by the SCB. The ST member shall be given the opportunity to comment on the issue to the SCB in writing and/or in person before the SCB issues its recommendation on the matter.

6.4 Permanent Science Team membership

Permanent ST membership shall be awarded upon application in reward for important contributions to 4MOST (e.g. fundraising) or significant services rendered to the ST, in particular in the form of work done in any of the IWGs. Scientific exploitation of 4MOST data shall not be considered in this context. As a guideline, permanent ST membership shall be granted for a total, cumulative contribution equivalent to at least 0.8 years of full-time work in the case of staff members (tenured or documented tenure-track), 0.4 years in the case of postdocs and 0.3 years in the case of PhD students. An application for permanent ST membership may be submitted to the SPB by any ST member who stands to lose their ST membership within the next year. The application (~1 page) should describe the applicant's situation and achievements for the ST and should (not shall) be accompanied by a corroborating and supporting statement from the PI(s) of at least one Survey. If such a statement is missing the SPB shall escalate the case to the SCB immediately. In this case the applicant shall be given the opportunity to address any criticisms of their application before the SCB reaches its final decision.

Permanent ST members shall retain the ST membership type (see Section 6.1) they had when their permanent ST membership was awarded, irrespective of their membership of a 4MOST Consortium institute (as defined in [RD4]) or their individual Consortium membership.

7 Survey strategy policies

The survey strategy shall be decided upon by the SCB, subject to (i) the available resources, (ii) the boundary conditions negotiated between ESO and the 4MOST Consortium, and (iii) the final approval by ESO.

The survey strategy shall satisfy all relevant Science, User and Operations Requirements of the Surveys, satisfy the boundary conditions imposed by ESO, and ensure that the time allocations to the different Surveys are (approximately) respected, wherever possible. In case of conflicting requirements, i.e. in case no survey strategy can be identified that satisfies all requirements, a compromise shall be negotiated among the SCB.

The survey strategy shall be documented in the 4MOST Survey Plan.

The survey strategy shall be designed and optimised by the Survey Strategy IWG using the 4MOST Facility Simulator (4FS).

Every Survey shall define a Figure of Merit (FoM), which, at any given point in time during the execution of the survey programme, shall reflect the current state and scientific usefulness of the Survey. Every Survey shall be free to define its FoM as it wishes, subject to the condition that all parameters used in the definition of the FoM (such as, e.g., the fraction of targets

successfully observed) are parameters on which the Survey has placed a Science Requirement. Although it is acknowledged that not all parameters on which a Survey has placed a Science Requirements can be incorporated into the Survey's FoM, it should nevertheless encapsulate as many of the Survey's Science Requirements as possible.

Furthermore, a FoM shall be defined such that a value of 0.5 means that the Science Requirements on the parameters that went into the definition of the FoM have been satisfied, and a value of 1.0 shall mean that the goals for these parameters have been met.

All Survey FoMs, and any changes thereof, shall be subject to the approval of the SCB.

The Survey FoMs shall be the key quantities used in the design and optimisation of the survey strategy. Specifically, the survey strategy shall maximise the value of the overall 4MOST FoM, defined as:

$$FoM_{4MOST} = \begin{cases} min(\{FoM_i\}), & min(\{FoM_i\}) \leq 0.5 \\ \langle FoM_i \rangle, & min(\{FoM_i\}) > 0.5 \end{cases}$$

where $\{FoM_i\}$ is the set of individual Survey FoMs, and <x> denotes some kind of averaging procedure TBD. Furthermore, in the unlikely event that two competing survey strategies, A and B, produce almost the same FoM_{4MOST}, i.e. $|FoM_{4MOST}^{A} - FoM_{4MOST}^{B}| < 1\%$, the strategy with the smaller T shall be preferred, where T is the sum of the total number of fibre-hours spent on survey targets, including overheads.

During operations, the success of the survey strategy shall be evaluated by the SCB at least annually. The primary evaluation criterion shall be the comparison between the predicted evolution of the Survey FoMs and their actual evolution.

Any changes to the survey strategy and any revisions of the Survey target catalogues shall require the approval of the SCB, as well as that of ESO.

8 Operations requirements

All Surveys shall observe the operational requirements on Surveys as described in Section 6.1 of [RD2]. In particular, they shall provide their target catalogues in the format and on the timescale required.

Furthermore, each Survey shall provide 2 FTE/yr to the IWGs and participate at least in the activities of the Survey Strategy and Selection Functions IWGs. Participation in the activities of other IWGs is only required from those Surveys that will make use of their results.

9 Supplementary target policies

By definition, a supplementary target shall only be observed if the fibre allocated to it cannot be allocated to any uncompleted survey programme targets.

Observations of supplementary targets shall not prevent or obstruct any observations of survey programme targets (which could be caused, e.g., by fibre collisions).

For an object that is both a survey programme and a supplementary target the above implies that the survey programme observations of this object must be completed before any supplementary observations (at the same spectral resolution) can begin. Hence such an object should be thought of as a supplementary target "replacing" a survey programme target upon completion.

Supplementary targets shall have no influence whatsoever on the progress of the survey programme. I.e. they shall not be considered at all when deciding on field positions, field priorities, fibre allocations to survey programme targets, exposure times, etc. Supplementary targets shall thus have no influence at all on the 4MOST selection function of survey programme targets.

Conversely, it shall not be possible to place any requirements on the 4MOST selection function of supplementary targets.

The sample of supplementary targets shall be defined jointly by the whole ST (after the Community Surveys have joined) by a process TBD. Survey programme targets may only be proposed as supplementary targets (i.e. for supplementary observations of any spectral resolution) by the PI(s) of the originating Survey(s). The supplementary target sample shall be approved by the SCB and finally by ESO. Any subsequent changes to the supplementary target sample shall also require the approval of the SCB and ESO.

The observing time spent on supplementary targets shall be accounted for in the manner described in Section 11.

The data on supplementary targets shall be considered the joint property of the ST and no restrictions shall apply to their scientific exploitation, except that they shall not be used to address the core science of any of the Surveys, in accordance with Section 15. Any supplementary data on survey programme targets shall be regarded as a separate dataset from the survey programme data, and shall be considered part of the data on supplementary targets.

10 Shared target policies

An astronomical object may be targeted by more than one Survey. An object targeted by multiple Surveys at the same spectral resolution shall be considered a shared target among these Surveys. An object that is targeted by two Surveys at different spectral resolutions shall not be considered a shared target.

The number of shared targets between a Community Survey and a Consortium Survey shall not exceed 20% of the number of the Consortium Survey's targets. The number of shared targets between a Community Survey and all Consortium Surveys shall not exceed 20% of the number of the Community Survey's targets. These policies may be waived jointly by the SCB and ESO if the scientific goals of the Community Survey in question differ substantially from those of the Consortium Surveys.

The observing time spent on shared targets shall be accounted for in the manner described in Section 11.

All data (of a given spectral resolution) obtained for a shared target shall be part of the dataset of every Survey that targeted this object. Whenever a given Survey's dataset is referred to in this document it includes the data of shared targets without any restrictions.

11 Observing time accounting policies

Observing time shall be accounted for in order to verify that individual Community Surveys have received the time allocated by ESO, and that the ratio between the time used by the Consortium and by the Community Surveys imposed by ESO has been respected.

Observing time shall be accounted for in units of fibre-hours (fh). One hour of real time thus provides $N_{\rm fib}$ fh of observing time, where $N_{\rm fib}$ is the number of fibres available for scientific observations at that time (i.e. excluding any guide fibres and disabled fibres).

The amount of observing time in fh provided by one hour of real time shall be independent of environmental and observing conditions. I.e. observing time shall not be adjusted for varying seeing, sky brightness, system throughput, readout noise levels, etc.

Observing time shall be accounted for separately for fibres feeding the high and low-resolution spectrographs. Accordingly, all relevant quantities in this section (such as $N_{\rm fib}$) should be understood to represent two values, one for the high-resolution fibres, and another for the low-resolution fibres, as appropriate.

Daytime calibrations as well as twilight and night-time Observing Blocks (OBs) that are primarily required for instrument calibration, quality control or maintenance purposes shall not be accounted for. This shall remain true even if such OBs also contain scientific targets.

Thus, only science OBs shall be accounted for. Of the $N_{\rm OB}$ science OBs observed over the lifetime of the survey programme, consider OB i, in which $N_{{\rm c},i}$ different fibre configurations are observed, where each configuration j is characterised by the numbers of survey programme targets ($N_{{\rm sp},ij}$), supplementary targets ($N_{{\rm sup},ij}$) and blank sky positions ($N_{{\rm sky},ij}$) being targeted, and by the total exposure time for which this configuration is observed ($t_{{\rm exp},ij}$). For the present purpose, the term "survey programme target" includes targets requested for technical or scientific calibration purposes (e.g. flux standards, radial velocity standards, duplications, etc.). The total observing time to be accounted for in this OB is thus given by:

$$T_i = \sum_{j=1}^{N_{{\rm c},i}} \left(N_{{\rm sp},ij} + N_{{\rm sup},ij} + N_{{\rm sky},ij}\right) t_{{\rm exp},ij} + N_{\rm fib} t_{{\rm oh},i}$$

where $t_{{\rm oh},i}$ denotes the total overheads of this OB, including the time required for field acquisition, preset, autoguiding start, active optics starts, fibre reconfigurations, all detector readouts, OB-specific calibrations, etc., and where it is assumed that $N_{{\rm sp},ij} + N_{{\rm sup},ij} + N_{{\rm sky},ij} = N_{\rm fib}$ for all i,j.

Each survey programme target k, observed in the jth configuration of OB i, shall be attributed the gross observing time:

$$T_{ijk} = \left(1 + \frac{N_{{\rm sky},ij}}{N_{{\rm sp},ij}}\right) t_{{\rm exp},ij} + \frac{N_{\rm fib}}{\sum_{l=1}^{N_{{\rm c},i}} N_{{\rm sp},il}} t_{{\rm oh},i}$$

which includes the net observing time spent on target k, its share of the time spent on sky observations in configuration j, as well as its share of the OB's overheads. All sky observations and overheads are hence associated with the observations of survey programme targets (and not with supplementary targets).

T_{ijk} shall be billed to the Survey(s) that requested observing time for target k in configuration j of OB i. Formally, in the case where only a single Survey m requested time, the time charged to Survey n is given by:

$$T_{ijk,n} = \delta_{nm} T_{ijk}$$

If, on the other hand, k is a shared target (Section 10) and other Surveys also requested further observations of this target in configuration j of OB i, then T_{ijk} shall be divided among these Surveys. Assuming a set $\mathbb{S} = \{S1, S2, \ldots, SN\}$ of N Surveys requested further observations of this object, each with a remaining requested exposure time $t_{ijk,Sl}$, where $t_{ijk,S1} < t_{ijk,S2} < \ldots < t_{ijk,SN}$, then Survey $n \in \mathbb{S}$ shall be billed the observing time given by:

$$T_{ijk,n=Sl} = \begin{cases} \dfrac{T_{ijk}}{N}, & t_{\mathrm{exp},ij} < t_{ijk,S1} \\ T_{ijkS(l-1)} + \dfrac{t_{ijk,Sl} - t_{ijk,S(l-1)}}{N-(l-1)}, & t_{ijk,S1} < \cdots < t_{ijk,Sm} < t_{\mathrm{exp},ij} < t_{ijk,S(m+1)} < \cdots < t_{ijk,SN} \text{ and } l \le m \\ T_{ijk,Sm} + \dfrac{T_{ijk} - t_{ijk,Sm}}{N-m}, & t_{ijk,S1} < \cdots < t_{ijk,Sm} < t_{\mathrm{exp},ij} < t_{ijk,S(m+1)} < \cdots < t_{ijk,SN} \text{ and } l > m \\ T_{ijk,S(l-1)} + \dfrac{t^*_{ijk,Sl} - t^*_{ijk,S(l-1)}}{N-(l-1)}, & t_{ijk,SN} < t_{\mathrm{exp},ij} \end{cases}$$

where $t^*_{ijk,Sl} = t_{ijk,Sl}\, T_{ijk} / t_{ijk,SN}$.

The net observing time spent on supplementary targets in OB i, $T_{\mathrm{sup},i} = \sum_{j=1}^{N_{\mathrm{c},i}} N_{\mathrm{sup},ij}\, t_{\mathrm{exp},ij}$, represents an inefficiency of the survey programme as a whole, and shall thus be borne by *all* Surveys, in proportion to their size, and not just by those Surveys contributing targets to this OB. Survey n shall therefore be billed the time:

$$T_{\mathrm{sup},i,n} = T_{\mathrm{sup},i} \frac{\sum_{i=1}^{N_{\mathrm{OB}}} \sum_{j=1}^{N_{\mathrm{c},i}} \sum_{k=1}^{N_{\mathrm{sp},ij}} T_{ijk,n}}{\sum_{i=1}^{N_{\mathrm{OB}}} \sum_{j=1}^{N_{\mathrm{c},i}} \sum_{k=1}^{N_{\mathrm{sp},ij}} T_{ijk}}$$

for the net observing time spent on supplementary targets in OB i. The overall inefficiency caused by the inability of the survey programme to fill all fibres is thus globally shared by all Surveys by increasing the total amount of time billed to each Survey by the same factor.

In summary, the total amount of time to be accounted for in the ith OB, T_i, shall be billed to the Surveys in the following manner:

- The net observing time spent on survey programme targets shall be billed to those Surveys that requested time for these targets, taking shared targets into account appropriately;
- The time spent on sky observations and all overheads of the OB are billed to the same Surveys, in proportion to the number of targets contributed to the OB by each Survey;
- The net observing time spent on supplementary targets is billed to *all* Surveys in proportion to their size.

Finally, it follows from the above that the total amount of time billed to Survey n, summed over all OBs, is given by:

$$T_{,n} = \left(\sum_{i=1}^{N_{\mathrm{OB}}} \sum_{j=1}^{N_{\mathrm{c},i}} \sum_{k=1}^{N_{\mathrm{sp},ij}} T_{ijk,n} \right) \left(1 + \frac{\sum_{i=1}^{N_{\mathrm{OB}}} T_{\mathrm{sup},i}}{\sum_{i=1}^{N_{\mathrm{OB}}} \sum_{j=1}^{N_{\mathrm{c},i}} \sum_{k=1}^{N_{\mathrm{sp},ij}} T_{ijk}} \right)$$

12 L2 data provision policies

All DL2 data products shall be provided to the 4MOST ST internal database on a schedule defined in [RD1].

Since AL2 data products are not part of this schedule, they may be provided to the 4MOST ST internal database at any time. Whenever appropriate and possible, they should be provided as soon as their scientific exploitation begins, e.g. when a corresponding scientific project is submitted for registration (Section 15). At the very latest they shall be provided at the time of submission of any refereed publication making use of them.

All data products shall be delivered in the format required and shall include all required meta-data. In particular, a detailed description of the data products shall be included, that enables other ST members to use these data products in a scientific context.

If a Survey repeatedly fails to deliver their DL2 data products on time, the SCB (in consultation with ESO, or at the request of ESO) shall have the right to slow down the observational progress of this Survey.

13 Quality control policies

All L1 and L2 data and data products shall undergo a rigorous quality control process before being uploaded to the ST internal database. The details of this process are TBD.

14 Data access policies

All data shall be accessible to all members of the ST in the internal database. In addition, all target catalogues and all selection functions produced by the Selection Functions IWG shall be accessible to all members of the ST. All of these data may be freely used without restriction by all ST members for all purposes except for scientific exploitation, for which some restrictions apply (see Section 15).

15 Scientific exploitation policies

All scientific work that exploits the 4MOST target catalogues or 4MOST data shall be compartmentalised into individual scientific projects (equivalent to a work package). This includes in particular: (i) all scientific analyses involving the 4MOST target catalogues or data that lead to a publication in the most general sense (i.e. including papers, conference proceedings and presentations); (ii) all scientific work leading to non-4MOST observations of survey programme targets if these targets were selected from 4MOST target catalogues or data (i.e. non-4MOST observations of survey programme targets selected by some 4MOST-independent means, e.g. from publicly available data, are of course *not* included here).

A project shall be defined by: its leader (normally the first author of the resulting publication), a title, a scientific description (~0.5 pages), a list of the data and data products to be used, and an indication of whether the project is part of a PhD. By definition, each project shall lead to at most one publication in a refereed journal, i.e. each planned refereed publication requires its own project.

All scientific projects shall be submitted to the SPB for registration at their outset. Work on projects shall only proceed once their registration has been completed. No scientific work (apart from initial explorations) shall be carried out outside of registered projects, and no scientific

results shall be publicly presented in any shape or form unless they are connected to a registered project.

Any ST member may submit any scientific project using any 4MOST data for registration.

A project shall only be flagged as being part of a PhD project if it is actually led by the PhD student in question. In other words, placeholder projects for future, yet to be recruited students shall not be allowed.

The SPB shall have the right to refuse the registration of the project (but may choose not to exercise this right) if one of the following sets of circumstances are met:

- The proposed project overlaps with an existing project that is flagged as being part of a PhD.
- The data products to be used in the project are the subject of a violation of the policies of Section 12, i.e. they should be available in the ST internal database but are in fact not (i.e. they are only available to the proposer).
- The proposer is a Community ST member, the project requires data from one or more Surveys they are not a member of, and the proposed project overlaps with an existing project or it touches on the core science of the Survey(s) concerned.
- The proposer is a Consortium ST member, the project requires data from one or more Community Surveys they are not a member of, and the proposed project overlaps with an existing project or it touches on the core science of the Survey(s) concerned.
- The proposed project requires data of supplementary targets, and it overlaps with an existing project or touches on the core science of one or more Surveys the proposer is not a member of.
- The project proposes non-4MOST observations of survey programme targets selected from the target catalogue(s) or data of one or more Surveys the proposer is not a member of.
- The proposer already leads 2 or more existing projects. Exceptions may be made if the existing projects exhibit good progress.

The SPB shall have the right to defer (but not ultimately to refuse) the registration of the project by up to 2 months if the following set of circumstances is met:

- The proposer is a Consortium ST member, the project requires data from one or more Consortium Surveys they are not a member of, and the proposed project overlaps with an existing project or it touches on the core science of the Survey(s) concerned.

The purpose of the deferral is to facilitate a discussion between the proposer on the one hand, and the PI(s) of the Survey(s) concerned and/or the leader(s) of the existing project(s) with which the proposed project overlaps on the other hand. This discussion may lead to, e.g., detailed exchange of information regarding the plans for, and/or the status of both the proposed and the existing project(s); adjustments to the scopes of the proposed and/or existing projects; a clearer delineation between the proposed and existing projects; the integration of the proposed project into an existing project; a collaboration between the proposer and others on comparing competing methods; the alleviation of any concerns regarding the quality of data products; etc. The ultimate goal of this discussion is to strike a balance between fostering healthy scientific competition on the one hand, and respecting the legitimate interests of Survey teams or individuals in reaping the rewards of previously invested efforts on the other hand, thus finding a solution that is satisfactory to all parties involved.

The result of this discussion shall be reported back to the SPB.

Once a project has been successfully registered, it shall be announced to the ST. A list of all registered projects shall be maintained by the SPB and shall be available to the ST. It shall therefore be possible for every ST member to be aware of all past and present scientific work being undertaken with 4MOST data within the ST.

Any interested ST member may join an existing, registered project by offering and subsequently negotiating their contribution to the project with its leader, who is responsible for managing the project and allocating the work. A proposal to join an existing project may only be rejected by the project's leader if the proposer's involvement in the project would require access to third-party data which the project leader is not at liberty to share with the proposer due to a formal, written agreement with the originator of said data.

Once a project has commenced, its leader shall provide evidence of its progress at least every 6 months by uploading a report or an updated draft of the intended publication to the ST internal publications database, where it is accessible to all ST members. Failure to do so may result in the project being cancelled by the SPB, unless legitimate reasons (details are TBD) prevent the project from progressing as planned.

A project shall be considered completed upon acceptance of the corresponding publication.

Projects may also be ended by cancellation or completion without publication.

16 Data sharing policies

4MOST data shall not be shared with anyone who is not a member of the ST. This policy has only three exceptions, as detailed below.

16.1 Collaborations with individual scientists on individual scientific projects

Surveys may share 4MOST data with an individual scientist who is not a member of the ST or of any 4MOST Consortium institute (as defined in [RD4]) by entering an informal collaboration with them for the purpose of carrying out a specific scientific project, under the following conditions:

- The 4MOST data to be shared with the collaborator shall only comprise of data of the Survey's own targets.
- The collaborator shall use these data solely for the purpose of carrying out the specified collaboration project. In particular, the collaborator shall not share the data with any third party.
- The specified project shall not overlap with an existing scientific project.
- The collaboration project shall be treated like any other scientific project, i.e. the policies of Sections 15 and 17 shall be applicable.
- The Survey shall nominate one of its members as being responsible for the collaboration.

Where applicable, the SPB shall verify whether these conditions have been met at the same time the project is submitted to the SPB by the Survey on behalf of the collaborator.

Following the approval of the collaboration and the registration of the project by the SPB, it shall be the responsibility of the Survey to provide the collaborator with the data required for the project. The collaborator shall not be granted access to the internal 4MOST database.

16.2 Data sharing agreements with external groups

Surveys may enter formal, written agreements (MoUs) with other scientific collaborations outside of the ST and the 4MOST Consortium for the purpose of exchanging proprietary data under the following conditions:

- The 4MOST data to be shared with the external group shall only comprise of data of the Survey's own targets.
- In return, the Survey (not necessarily the ST as a whole) shall receive a proprietary dataset for which no publicly available equivalent exists, and which is either required for the construction of the Survey's target catalogue or which significantly enhances the scientific value of the 4MOST data.
- The MoU shall specify the scientific exploitation rights of both partners with respect to the other partner's data. These shall be limited appropriately. At the least they shall be limited to scientific projects that involve the joint dataset.
- The MoU shall respect the right of any ST member to join any project registered within 4MOST as far as possible. It is acknowledged that a compromise may be necessary in some cases.
- In case the external data are required for the construction of the Survey's target catalogue, the MoU shall state that these data shall become available to the ST as soon as the target catalogue is submitted, and shall become public as soon as the corresponding 4MOST L1 data become public.

Prior to the MoU's signature, the SPB shall verify whether these conditions have been met based on an application submitted by the Survey PI(s). The application should provide the scientific background of the proposed MoU, address the above points as well as any other relevant issues (~1 page), and shall include the final version of the proposed MoU. The MoU may only be signed by the Survey once it has been approved by the SPB.

Following the signature of the MoU, it shall be the responsibility of the Survey to facilitate the mechanics of the data exchange. The external group shall not be granted access to the internal 4MOST database.

16.3 Data sharing for special types of targets

Surveys may request the data of specific types of rare targets (e.g. certain types of transients) to be exempted from all data sharing restrictions, under the following conditions:

- The 4MOST data to be shared shall only comprise of data of the Survey's own targets.
- The types of targets included in the exemption shall be restricted to very specific types and shall be clearly defined.
- The need for the exemption shall be scientifically well justified in the sense that the scientific goals cannot be met by adhering to the regular data release schedule or by exercising the policies in Sections 16.1 or 16.2.

The SPB shall verify whether these conditions have been met based on an application submitted by the Survey PI(s). The application should provide the scientific background of the proposed exemption, and address the above points as well as any other relevant issues (~1 page).

Following the approval of the exemption, it shall be the responsibility of the Survey to facilitate the sharing of the relevant data. No access to the internal 4MOST database shall be granted for

this purpose.

17 Publication policies

All ST members shall follow the general rules of good scientific practice when preparing publications. The Statement of Ethics of the American Institute of Physics shall be adopted.

In particular, fabrication of data or results, and plagiarism (including self-plagiarism) shall be unacceptable.

Every publication of any type based on 4MOST data (in the sense of Section 5.5) shall originate from a registered scientific project (Section 15).

17.1 Papers in refereed journals

In accordance with Section 15, all papers shall be based on data and data products that are available in the ST internal database.

All papers shall explicitly name the data products they are using (including version numbers) for the sake of traceability.

All papers shall include the standard 4MOST and ESO acknowledgments (TBD).

As described in Section 15, the leader of a scientific project shall regularly update the draft of the intended publication in the ST internal publication database, where it is accessible to all ST members.

When the draft nears completion, the project leader (who shall normally be the first author of the paper) shall notify the ST of the intention to submit, inviting comments and requests for co-authorship (see Section 17.1.1) at the same time, with a deadline of no less than 3 weeks. This phase shall be considered as an internal refereeing process.

Following comments, the revised draft shall be uploaded to the ST internal publication database, and the ST shall again be notified of the intention to submit in no less than 1 week. During this brief period, ST members may comment on authorship issues, provide details or corrections regarding affiliations, additions of acknowledgements, and provide suggestions for very minor changes. The project leader shall be under no obligation, however, to incorporate major changes to the paper at this stage.

In accordance with Section 12, a paper shall not be submitted for publication unless the actual data and data products used in the paper are available in the ST internal database.

Upon submission, the submitted version of the paper shall be uploaded to the ST internal publication database, and announced to all co-authors.

All referee reports, replies to the reports and revised versions of the paper shall be uploaded to the ST internal publication database, and announced to the co-authors, inviting comments with deadlines of no less than 1 week.

Upon acceptance of the paper, the ST shall be informed.

As a guideline, papers should only be uploaded to arXiv after acceptance.

In order to expedite the publication of particularly important or time-critical results, the project leader may exceptionally request a waiver for any of the above policies, and in particular a

shortening of the deadlines. This request, to be submitted to the SPB, shall include a brief (~0.5 page), compelling justification.

All published papers shall appear on a public 4MOST web page.

17.1.1 Authorship policies

The lead author of a paper shall normally be the leader of the project from which the paper originates.

Co-authorship shall be explicitly requested. Requests for co-authorship shall be based on one or more of the following:

- Significant contributions to the concept, design, execution, or interpretation of the research underlying the paper.
- Significant contributions to the preparation of the paper itself.
- Significant contributions to the generation of the L2 data products used in the paper.

The last point shall be interpreted inclusively for data release papers.

Requests for co-authorship shall be decided on by the project leader.

The order of appearance of the co-authors shall be defined by the project leader.

All co-authors shall confirm that they have read the paper and agree to its publication prior to its submission.

17.2 Presentations, papers in conference proceedings and in unrefereed journals

The intention to publish the work performed within a given scientific project in a presentation at a conference or seminar, or in a paper in a conference proceedings or in an unrefereed journal shall be announced to all members of the project as well as to the originators of any L2 products used in this work at least 2 weeks prior to submission. Co-authorship shall be offered at the same time. The order of appearance of the co-authors shall be defined by the lead author.

17.3 Press releases

Press releases or comparable communications shall be coordinated among (i) the members of the project from which the work originated; (ii) the originators of any L2 data products used in the work; (iii) the 4MOST Project Office; and (iv) the SCB.

18 Communication policies

All communication within the ST shall be conducted in a respectful, courteous and professional manner in order to generate a safe and productive working environment that fosters open dialogue and the exchange of scientific ideas, promotes the fair treatment of all ST members, and is free of harassment and discrimination. All communication shall refrain from threats, intimidation and coercion, from derogatory, derisive and abusive language, and from personal attacks based on gender, sexual orientation, disability, physical appearance, race, religion, national origin or culture.

19 Conflict resolution policies

Any ST member shall have the right to appeal to the SCB in the case of a conflict with another ST member or disagreement with an SPB decision. The appeal shall be filed in writing to any

member of the SCB. When receiving an appeal, the SCB shall be required to obtain statements on the matter from all parties involved.

The SCB's decisions are binding on all parties.

In addition, according to [RD3], every SCB member shall have the right to appeal against an SCB decision by requesting that the SCB Chair escalates the matter to the 4MOST Executive Board and/or ESO, depending on the parties involved.

20 Survey-specific policies

Individual Surveys may enact additional policies for internal use. Examples of issues that could be regulated internally include: (i) exploitation of data for the Survey's core science; (ii) introduction of the concept of "builder" status and associated rights; (iii) access to any third-party data that may be available to Surveys or sub-groups within Surveys; membership of a particular Survey should not be presumed to automatically grant access to such third-party data. Regulating these issues is left to the Surveys.

Any Survey-specific policies shall not contradict anything in the present document.

Appendix A List of Acronyms

List of Acronyms	
4FS	4MOST Facility Simulator
4MOST	4-metre Multi-Object Spectroscopic Telescope
ESO	European Southern Observatory
FoM	Figure of Merit
FTE	Full-Time Equivalent
IWG	Infrastructure Working Groups
MoU	Memorandum of Understanding
OB	Observing Block
OpSys	Operations System
PI	Principal Investigator
PS	Project Scientist
SCB	Science Coordination Board
SPB	Science Policy Board
ST	4MOST Science Team
TiDES	Time Domain Extragalactic Survey
WBS	Work Breakdown Structure