Functioning Advanced Scientific Equipment (FAST)

Operational plan

Guideline

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Document information		
Document name: FAST Support Services, Guidelines		
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File name: FAST Support Services, Guidelines		
Revision history	Version No.	Date
	1.0	Dec 2015
This version	1.01	Jan 2016

Introduction

The Operational plan has been developed to support scientific institutions with the procurement and use of advanced scientific equipment. The intention is that an operation plan shall be developed prior to procuring a new piece of advanced equipment. Thus each piece of equipment shall benefit from its own operational plan. It is the responsibility of the Institution to ensure that all aspects of the operational plan are addressed in actual practice.

The plan shall be filled in jointly by the institutional management, the researchers and the technologists (Nigeria) / technicians (other countries) together. A separate document is generated for each piece of equipment that addresses all the issues below.

The final version of pre-procurement version the operational plan shall be signed by the Vice Chancellor/Director, one representative from the researchers and one from the technicians and technologists (in countries which operates with technologists) prior to procurement.

The FAST support program represent offers from the FAST Program partners to the PRIMS Target partners. The Target partners choose to buy the services from the Program partner or to manage them by themselves. **In case the institution will be in charge of a Support program activity, then the institution will use that special chapter in this document to complement their Operational and financial plan guidelines.**

The Operational plan addresses

1. Stakeholder committees

1.1. Equipment management committee

The Institution shall develop a committee which includes representatives from all stakeholders that will be affected by the new equipment, such as policy makers, researchers, technologists and technicians. For the FAST project the committee can be named “the FAST committee”. The committee shall:

- Be gender balanced and the names of the committee members be compiled as part of the operational plan.
- Meet continuously, and develop a democratic and efficient working spirit and have the successful output of the project in mind.
- Minimise bureaucratic procedures and simplify communication channels between scientific institution management and laboratory staff
- Highlight the FAST work and its importance within the scientific institution
- Encourage multi-disciplinary research teams to use the facilities
- Share experiences and learn from other projects within the FAST network
- Promote the FAST Concept within other scientific institution authorities networks and groups.
- Secure complementary grants to FAST.
- Encourage the private sector and governmental entities to use lab services in order to maximize revenue.

1.2. Supplier

A committee with representatives from the equipment management committee and from the supplier is developed, which meets face-to-face bi-annually. Such meetings are necessary to address issues related to logistics; such as transportation, custom clearance, delivery, infrastructure preparations, installations, trainings, operations, service and maintenance.

1.3. Research

Also research committees which involve researchers, technologists and technicians can be established which addresses issues related to research

1.4. Education

When appropriate committees are established that addresses educational issues related to the equipment

2. Selection of research topics

The generally agreed overall goal with managing scientific equipment is to generate and implement high quality and relevant research results. Thus the scientific and educational institution is encouraged to select carefully the research projects and/or educational areas, which the equipment will support and be used within. These shall be scientific disciplines

that are core to mission and objectives of the institution, as well as key research areas suitable for strengthening or building educational and research capacity. The projects require motivated leadership and key scientists, technicians and technologists, and shall be selected considering also a balanced gender and age distribution. It is important also to benefit from the resources that are already present in the institution. A compilation of publications related to those scientific projects proposed can be useful.

3. Selection of equipment to be procured

New equipment shall be selected according to a well defined strategy:

- The selection of equipment, equipment accessories and consumables as well as suppliers must be performed in close collaboration between policymakers, researchers, technicians and technologists
- Product information materials must be made easily available

1. **Research topics or educational**
   The institution identifies research topics or educational areas with potential to be strengthened if provided equipment. These shall be scientific disciplines that are core to mission and objectives of the scientific organisation as well as key research areas suitable for strengthening or building research capacity

    a. The departments are specified at the scientific organisation which will be involved in these projects

    b. A list of publications related to the selected scientific projects proposed is compiled, including papers published in international regional or national peer-reviewed journals

2. **Compilation of proposed equipment**
   The Institution compiles a proposal of related items to be procured; including instruments, accessories, consumables, trainings, services, maintenance, physical infrastructure improvements and the expected costs.

    a. Resource persons linked to the proposed equipment are identified. It can be expected that the proper management of possible new equipment may require the attention of a few truly dedicated persons from the scientific institution, who have the energy and capacity to properly manage these new pieces of equipment. Such resource persons must have the authority by the scientific institution management to take on the necessary responsibilities. The key persons are the researchers, the technologists and the technicians

3. **Meeting with equipment experts**

    a. The management, researchers, technologists and technicians meets with equipment experts, to review the research projects and the related items

proposed for procurement. At this meetings, the researchers present the research projects (and teachers presents educational areas for which the equipment is required).

b. Thereafter the experts recommend appropriate equipment, accessories and consumables. The experts may propose relevant manufacturers.

4. **Revision and fine-tuning of equipment procurement compilation**

   The final compilation of equipment to be procured is developed.

4. Selection of equipment to be repaired

While planning for procurement of new equipment, equipment repair shall be considered as a less expensive option or may be complementary to the new equipment planned to be procured. Repaired equipment may fulfill the need instead of procuring new pieces. The cost for such repair would thus be expected to be covered by the funds set aside for the new equipment. Another alternative may be to complementing existing equipment with new accessories.

5. Selection of supplier

The suppliers selected must have an excellent track-record of high quality equipment manufacturers, installation and after sales-services

6. Timely release of funds

It is important that funds can be timely released in case of unexpected repair requirement or other costs that cannot be for-seen. Key stake holders close to the project, such as the Director of a central laboratory hosting the equipment, shall have the authority to withdraw funds from an account. It shall be arranged through a process where an appropriate size of funds is always available when required.

To facilitate the procedures for the FAST project the university shall open a separate bank account to be linked to the equipment procured.

7. Buildings and laboratories

- Buildings with laboratories to host the equipment must be available prior to placing orders of new equipment
- Certain installation must be in place to protect the equipment from being damaged by external conditions (next chapter)
- Other installations must be in place to provide certain supplies required by the equipment (second next chapter)
- Yet other installations are required to protect human health and the environment (third next chapter)

- The supplier or external equipment experts must visit the laboratories where the new equipment shall be located to inspect if the appropriate physical infrastructure is in place, and when required, make the necessary arrangements. Only when the supplier has approved the laboratory environment shall orders be placed for new equipment

8. Protection of equipment

Certain installation must be in place to protect the equipment against unstable electricity provision, effects from lightening dust, high temperatures, high humidity, flooding and vibrations and exploding gas tubes.

- **Electricity**
  - The electricity if often unstable and the equipment need to be protected from spikes. UPS units together with search protectors are recommended.
  - Depending on the situation also chargeable batteries shall be considered.
- **Lightening**
  - The equipment is protected from lightening through connecting to earth at the time for installation. The connection to earth is to be kept at all times.
  - The laboratory shall be protected by a lightening collector at the roof and each sensitive equipment with a CVC stabiliser.
- **Dust**
  - Protection from dust is often required. Such protection is achieved through double sliding windows, covering of the equipment when not used, avoiding swirling fan in the ceilings and procedures of having doors and windows closed.
- **Temperature:**
  - The equipment can often not perform well at temperature above 30 °C. Thus, in environments with high temperatures, AC is required
- **Humidity**
  - Humidity rise at certain regions, at certain times of the year, to a level that damage the equipment. Thus, AC is required in laboratories situate in those regions.
- **Flooding**
  - The risk of flooding must be considered, and adequate protection be taken in regions with such risks.
- **Vibration**
  - Marble benches can sometimes be required.
- **Explosion protection for gas tubes**
  - Special housing for protection of the environment in case of gas tube explosion must be provided.
- **Rats and mice**

9. Protection of occupational health, safety and natural environment

It is required to ensure that all work is carried out in a safe and environmentally friendly manner so as to minimize the risk of injury or death to persons on or off the work site and of damage to the work and other facilities and equipment. Also any related risk of long term health hazards or damage to the environment shall be guarded against. . To uphold this policy the operations shall be carried out in accordance with stated objectives.

- **Occupational health**
  - Carry out all medical examinations as required by law, and ensure the confidentiality of such examination
  - Identify health hazards at all work places and educate employees adequately
  - Carry out special investigation where there is evidence of occupational ill-health.
- **Safety, fire incidents and fatalities**
  - Prevent unsafe acts, personnel injury, and property damage
  - Prevent accident and protect personnel so as to avoid suffering and hardship
  - Recognize that occupational health and safety are the responsibilities of qualified supervisors and are taken seriously by management
  - Installations and supplies are required for the protection of health and safety, such as hoods, gloves, coats, glasses and gas masks
  - Monitor the effectiveness of health and safety policy.
- **The natural environment**
  - Promote environmental awareness, conservation and protection
  - Promote sustainable resourcing of the environment
  - Procedures, installations and supplies are required for the protection of the natural environment, such as waste management.

10. Supplies

Certain installation must be in place to provide for the required supplies such as electricity, water, purified water, gases, computers and internet.

In addition, the university must develop and maintain procedures, and appoint the responsible persons, for timely provision of supplies. Each supply compiled below, which would benefit from timely provision, must have its own procedure for timely provision presented.

- **Electricity**
  - Laboratories can be expected to be connected to the national electricity supply network. Still, frequent failures in the distribution of electricity can often be expected, why support systems are required for equipment depending on electricity.
  - Common support systems are back-up electricity generators. These must be of sufficient magnitude and have access to fuel.

    - The back-up generators may also fail, but this is expected to happen only seldom. Still, a second level of back-up electricity supply is appropriate for equipment sensitive to electricity failures.
- **Water**
    - Water must be available in enough volumes and at appropriate quality at all laboratories where new equipment are to be installed
    - Suppliers shall help identify needs and donor institutions may consider the importance of water purifications systems
- **Gas**
    - Certain equipment requires gas supply of different type and quality
    - The universities are responsible for the installation of gas lines, for securing gas tubes from falling and for providing the required gas, through-out the life time of the equipment
    - Agreements are preferable entered between the universities and the local gas supplier. The equipment suppliers may help establish such contacts
    - Under certain circumstances it may be preferable to invest in gas generation bench plants. Such units must be maintained and replaced, when appropriate, by the university
- **Consumables and glassware**
    - The universities are responsible for providing all consumables and glassware required for the research projects that shall use the new equipment, through-out the life time of the equipment
- **Computers and printers**
    - The universities are responsible for providing computers, printers and related items that are required for the research projects that shall use the new equipment, but is not part of the equipment itself, through-out the life time of the equipment
- **Internet**
    - Many times internet can be required
- **Spare-parts**
    - Spare parts for one year should preferably be included in the estimated procurement cost of a new piece of equipment. Thereafter the universities are responsible for providing a timely access to all necessary spare-parts, through-out the life time of the equipment
    - Internal stock of the frequently used items shall be considered
    - The procedures developed, shall take into consideration that manufacturers do not keep stock of spare-part longer than five years after the equipment has stopped being manufactured, as well as that there is a lag time of at least three weeks between ordering spare-parts and delivery
- **Servicing tool**
    - One set of servicing tools are delivered per equipment. This set is to be kept at a central unit, for technicians to have access to
    - The universities are responsible for providing one personal set of servicing tools to each technician who is appointed to a certain piece of equipment and, when appropriate, to each technician participating in a training course on repair, service and maintenance
- **Repair and user manual**

- The original manuals, delivered together with the equipment, are to be kept at a central unit, for everyone to have access to
- Manuals are to be copied in appropriate numbers and placed at appropriate sites so that they are always available when needed
- Most modern manual are presented as CDs and repair and user information can often be achieved through internet
- Technical manuals are not provided by suppliers these days, to the same extent they were before

11. Insurances

- The supplier arranges for that the equipment is insured during the transportation
- The scientific institution arranges for that insurance of each piece of equipment is initiated at the exact time of equipment delivery to the laboratory. This insurance must be valid though out the life time of the equipment and include coverage of theft, fire, water and related issues. This may include a visit by the insurance company.

12. Ensuring that the laboratories are prepared

The transportation of the items not be initiated until the laboratories have been prepared. This is to ensure proper storage upon arrival, the best circumstances for the person in charge of installation and avoiding delays that may damage the equipment, standards, consumables etc. It also avoids calling the person in charge of installation unnecessarily and the related cost of that visit.

- The supplier provides a check list to support the laboratory with the assessment whether the installation can be done. When everything is in place the laboratory can call on the person in charge of installation
- The supplier is asked to visit the laboratory prior to the installation visit to ensure that everything is in place; the laboratory is prepared and all items are available.

13. Transportation

- The supplier and the scientific institution collaborate to arrange for transportation of the equipment from the manufacturer to the scientific institution. The transportation shall be arranged so that no delays occur.
- In case of delays the storage environment and time must be addressed so that the items are not destroyed during the transportation.
- Custom procedures can be handled by the Institution, by an agent or by the supplier. In case the Institution does not have full control, it is advised that the supplier handles the transportation.

13.1. Custom procedures by institution

- In order to benefit from duty - free importation, three documents are required for each piece of equipment: a letter of donation (prepared by the donor if any), a copy

of the invoice (prepared by the supplier) and a letter of aerial transportation (prepared by the supplier).
- Clearance documents are required for hazardous compounds and items, such as EC-detector (prepared by the supplier).
- All other forms and procedures according to the national regulations are prepared by the scientific institution.
- A clearing agency, with good references, can be appointed for the custom formalities when appropriate.

13.2. Transportation by supplier

The supplier is well suited to manage the transportation from the manufacturer all the way to the laboratory. The cost will increase from about 10 % of the procurement cost to about 25 %. But it ensures that costs for storage while waiting for custom clearance is avoided, as well as items being out-dated of store d under un-favorable conditions.

14. On-site item delivery

Thorough procedures must be set in place for how to receive the items at the institution. The supplier will not be around, only the driver of the truck.

- The institution is responsible for having the laboratory prepared before the delivery of items, so that the items can be taken directly from the truck to the laboratory.
    - If, IN WORST CASE, the laboratory is not yet prepared then the institution assures that the items are stores under the same conditions as have been identified to be the case for the laboratory.
- A person or a team must be authorized to receive the items. This person or team is responsible for
    - Checking that everything ordered for has arrived. The person signs a receipt and this receipt is carefully saved together with the packing list from the manufacturer as well as the packing list from the supplier.
    - Arranging so that each item is stored exactly according to the requirements for that item.
- If the delivery is made outside office hours special procedures must handle this situation
- The equipment remains unpacked until the qualified installation technicians arrive.

15. Storage

- The items are stored according to the specifications. Nothing is un-packed.

16. Installation

- The technicians from the supplier arrive and make the installations, calibrations and the related quality checks
- Technicians, technologists and researchers appointed for the equipment are made available to be able to attend during the installation
- Skilled electrician are appointed to support during the installation

16.1. In case the laboratories are not finalised in time

In case the persons in charge of installation arrives when the laboratories have not been finalised, or all items required for installation is not available or non-functional, then the installation personnel has to return. This time for the second visit will depend on the program of the person installing and will be at the cost of the scientific institution.

17. Quality assurance

- Successful installations, calibrations and quality assurances are signed off by the authortized laboratory staff.
- Any deficiency from a successful and professional installation is discussed and actions to be taken agreed on, including person in charge and due dates. The agreement is signed by the laboratory and the supplier and all stakeholders concerned are informed, including the manufacturer.

18. Equipment use

- The equipment shall be frequently used and procedures for optimum use shall be developed and maintained. The number of use hours shall be estimated and be used as an indicator for monitoring and evaluation.
    a. Preparations must be made to secure that the equipment is used directly after installation, that is, within one month
    b. Instruments shall be shared among users when appropriate
- The equipment must only be used by authorised personnel, and only according to Standard Operational Practices (SOP) and Good Laboratory Practices (GLP).
    a. Each piece of sophisticated equipment may require that a minimum of 2-3 authorised personnel are appointed
    b. Each instrument shall have a log bock attached, where the application, project and name of user is noted
    c. The use of the equipment shall be linked to safety, health and environment policies

19. Repair and maintenance

19.1. Internal technicians and technologists

- Two technicians or more shall be appointed for each piece of sophisticated equipment.
    a. These technicians shall perform maintenance according to a schedule, and report on their activities to the university management every three months.
    b. Technicians must be literate in English or French to read and understand well service manuals
- When an external technician is called upon for repair, the university technicians shall be invited to be informed about the repair work, in order to learn
    a. Certain items, such as those related to the electricity, have to be replaced by the supplier themselves
- The technician shall have access to financial recourses to use directly when required. The technician shall propose an annual budget and provide an annual report.

19.2. External support

- The warranty period for new advanced equipment is often one year. Service contracts or extended warranty periods must be arranged with the supplier to cover the full life-time of the instruments.
    a. In case the supplier is delaying the installation, the warranty period is to be adjusted accordingly.
- Diagnostics support through internet shall be considered as a complementary option and can be made available for all equipment that uses a computer. Such service requires the access to a internet linked computer close to the equipment to be diagnosed

20. Decommissioning procedures

- Obsolete equipment which is too old to be repaired shall be decommissioned
- Procedures for decommissioning shall be operational so that each piece of obsolete equipment are always and immediately removed from the laboratories and managed according to the correct procedures for such waste, or be reused if appropriate

21. Technologist / technician forum

Networks of trained technicians shall be developed in each country. The networks shall have a coordinating committee and access to a website.

22. Training events

The trainings can be divided into six categories;

1. **Pre-installation training**
   Pre-installation basic training is to be provided by the scientific institution prior to the arrival of a new type of equipment
   a. The supplier can often share training material
2. **Installation training**
   Basic equipment specific training is to be provided at the time of installation by the supplier.
   a. The basic training is hands-on and is separated into operational and maintenance training. Operational training will involve an explanation of each hardware and software component followed by information on how to operate the instrument. Maintenance training will involve how to do preventative maintenance to avoid unnecessary failures of the equipment.
   b. This exercise should be two, four or six days, depending on the level of sophistication of the equipment. A six day training would include for example two day training on installation issues, two day training on service and repair and two day training on operation.
3. **Advanced equipment specific training**
   The scientific institution is thereafter responsible for providing advanced equipment specific training and periodic retraining, through-out the life time of the equipment. The advanced training can be arranged on-site and abroad after maybe three months of use of new piece of equipment.
4. **Application training**
   Advanced training on analytical methods and applications and shall also be continuously offered, starting after about six months of use. This training shall be offered to technicians and researcher together
5. **Quality assurance and certification training**
   Advanced training on quality assurance shall be continuously offered, starting after about six months of equipment use. Laboratory Quality Assurance systems (such as ISO 17025), Good Manufacture Practice (GMP) and Good Laboratory Practice (GLP) shall be addressed. One aim of the training shall be to reach the ISO qualification level when appropriate.

6. **Train trainers program**
   Train trainers program and the development of a pool of trainers.

- The training shall address researchers, technicians and technologists. Institutions with service and maintenance units, shall arrange so that staff from these units participate in the equipment training programs.
- Manuals and training guidelines shall be collected preferably electronically and on a on a web-site to be accessible for all. The web-site also holds published analytical methods (author, title, journal, pages, year published).
- As a complement to hands-on training, internet access should be facilitated for technicians
- Consultations through on-line advisory websites and direct communication shall be available for technologists/technicians.

22.1. Training needs survey

Each technologist / technician shall do a test prior to being assigned for a training event. This test will identify the training need of that person, and thus assure the correct level of training offered, not too simple not too advanced. The questionnaire is developed by the technologist forum with support from the supplier.

22.2. Other capacity strengthening activities

- The scientific institution shall identify and implement other capacity strengthening activities, which were not covered by this document, but that are required for the long-term functioning and frequent use of new equipment

23. Technologist / technician career promotion

A career development and financial incentives scheme linked to laboratory performances shall be established for researchers, technologists and technicians.

- Incentives for technicians shall be addressed, with the purpose of being able to offer technicians the sufficiently good working conditions for them to choose to remain working with the scientific institution.
    a. Career paths, including salary scales, must be defined for technicians
    b. Appropriate and continuous training may be considered as such an incentive
    c. Also safety and health programs are important.
- Ensure that an adequate number of qualified and motivated technicians and technologists is employed
- Offer technicians and technologists to attend equipment fairs and exhibitions and international technologist meetings
- Acknowledge technologist in research publications (possibly as co-authors in complex research)
- Ensure that an adequate number of qualified and motivated researchers is employed
- Offer researchers to attend international scientific conferences and seminars

24. Equipment monitoring and evaluation

- Procedures for monitoring and evaluation shall be developed
    - The performances of the equipment are monitored and evaluated. Leesoons learnt are fed into procedural revisions.
    - Two resource persons per university shall be appointed for the collection of monitoring data, preferably those who are already involved with the equipment on a regular basis
- The university is suggested to develop a database and use this as a tool for compiling monitoring parameters

25. Outcome evaluation planning

The purpose with the training program is to provide the tool for the users of the equipment to operate it well. The Outcome evaluation planning measures if the training program was well designed and the goal was reached.

- **Aspirations**
  Compile information on what each technologist / technician would like to see in line with her/his assignment at the laboratory.
- **Outcome challenges**
  Develop the Outcome challenges. This is a compilation of the reasons for why the technologists / technicians are not doing what they want to do in terms of managing the equipment
- **Progress markers**
  Develop the Progress markers. The Progress markers reflect directly the Outcome challenges. The progress markers address outcomes rather than outputs. Outputs are activities we have control over and are compiled in an activity plan, outcomes are the desired results of outputs and something we do not have control over. The progress markers must be formulated in a way that they are measurable. They are separated into single units which can be easily measured.
- **Scoring**
  Score the Progress markers. The operation builds on a sequence of monitoring and evaluation events, for with dates, participants and results are recorded.
  The monitoring starts at the same time as the design of the program. The first task is to identify the baseline of the program; the presentation of the situation prior to the start of the program. Progress marker scorings together with the related comments are compiled in a monitoring data sheet.
    - Scoring method
        - 5 Excellent 90 – 100%
        - 4 Good 70 – 90%
        - 3 Adequate 30 – 70 %
        - 2 Poor 0 – 30 %
        - 1 Insufficient 0 – 10 %
    - Scoring based on percentage supersedes scoring based on words. Thus, when a progress marker can be assessed with a percentage, then this is what the scoring shall be based on.

- **Lessons learnt**
  Compile lessons learnt and revise the training program accordingly. Lessons learnt from the monitoring and evaluation exercises are fed into the training program revisions.

26. Revenue generation

Encourage revenue generation from the use of the equipment and provide enabling mechanisms to make that happen

- Hold policy and information seminars about the facilities and the services offered by the laboratories
- Promote direct participation in consultancy services to private sector
- Provide on-demand assistance and advice to other universities in the region and their technologist groups.

Please find further information on this topic in the Financial plan Guidelines

Appendix
About the Operational Plan

The purpose with the Operational Plan is to propose a strategy for supporting scientific and educational institutions with the management of scientific equipment. The plan is developed to address the most important aspects, including the selection, transportation, installation, calibration, operation, maintenance, servicing, use and decommissioning of advanced scientific equipment.

The Operational Plan template has been developed by Assoc. Prof. Cecilia ÖMAN at the International Foundation for Science. She is grateful for the support provided by friends, colleagues and partners all over the world, especially Prof. Karniyus Gamaniel, Dr. Sune Eriksson and Dr, Amah Klutsé. The work was financially supported y by the MacArthur Foundation.

The tool was developed with the purpose of supporting the strengthening of scientific research around the world and with the ultimate aim to strengthen development and eradicate poverty. Any stakeholder who can benefit from using the template is welcome to do so.

In case you find the tool useful and would like to support the future development of the same, you are welcome to contribute with a donation through the www.RandS.se