Consult for Management, Training and Technologies

Draft Report on

Assessment of Training Needs

in

Health Care Technical Services

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Report prepared by
Ralf Lange, FAKT gGmbH

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Acknowledgement

We sincerely thank all people who helped to make this survey happen. Our special thanks goes to all the contributors who took the effort of filling lengthy questionnaires without which we would have nothing to report on.

Thanks to all of you.

Summary

Background

Since 1996 FAKT was co-ordinating the ""Hospital Technology Dissemination Programme" which found a succession by the "Health Care Technology Management Programme" since 2001

One intention of the programme is to support human resource development of health care technical services by assisting in development and implementation of appropriate training measures.

In order to assess real training needs of personnel working in service units or hospital maintenance units FAKT carried out a questionnaire survey.

Three areas were under focus:

- Existing training measures, current practice
- Training needs
- Supply of training

A total of 55 persons and organisations were contacted, responses were received by 37 organisations ranging from regional/ district health co-ordinators to hospital maintenance departments and health care technical service organisations. Further we received feed back from several "training providers" such as universities and technical colleges.

Below we have presented a summary of results and conclusions for way forward

Position and responsibility of respondents:

- Hospital Engineer 7
- Hospital Technician 22 (+2 incomplete)
- General Artisan 6

Position of Hospital Engineers:

- Heads of HCTS 4
- Supervisors, 2
- Working in Technical Services 1

Position of Technicians:

- Regional or District Technical Officers of MoH 5
- Supervisors (e.g. workshop manager or foreman) 10
- Working in Technical Services 7

Summary Results of Training Needs Assessment for Health Care Technical Services

Training needs of Hospital Engineers		
Present Situation	**Training Needs**	**Conclusion for way forward**
Only one engineer was employed out of 3 HCTS units and one out of 9 hospitals responding. Difficulty to recruit qualified engineers High costs of employing an engineer Post graduate studies and upgrading were the most effective training measures. 43% attended a post graduate course in medical engineering. An additional 29% participated in short term upgrading. Those who attended a post graduate study in medical engineering have benefited significantly.	Management and supervision Specific technical know how Except for South Africa, there are few institutions offering graduate and post graduate courses/studies in the field of clinical/ bio-medical engineering. There is a great need for special courses in hospital technology management. Specific short term courses in the field of medical engineering (particularly in the high-tech field) are virtually not available in most African countries	Engineers have to use existing facilities for post graduate studies abroad (South Africa, Europe, North America). Specific training should, if possible, be conducted by equipment manufacturers/ suppliers Establishing dialogue with Government bodies about possibilities for offering certified courses Any plans for training courses need to be based on thorough market assessment (expected number of students per year, jobs available)

Summary Results of Training Needs Assessment for Health Care Technical Services

Training Needs of Hospital Technicians		
Situation	**Training Needs**	**Conclusion for way forward**
The ratio of engineers/ technicians employed in HCTS in most African countries is estimated by 1:11 Most technicians working in HCTS have received formal training in a related field Very few technicians have received special training in maintenance of hospital equipment In Sub Saharan Africa, there are very few training providers offering short term special courses in hospital technology (except South Africa) Most technicians working in the field lack the entry requirements for formal post graduate courses in hospital equipment maintenance as offered by overseas institutions	Insufficient skills in all areas of hospital equipment maintenance Lack of basic knowledge of electricity and electronics Management and supervision There is a significant need for short to medium term specialised courses in hospital technology In most countries/ geographical sub regions there is need for formal/ certified courses for hospital technicians (except Kenya where there is oversupply!)	Existing training providers to think seriously about diversifying their training programmes by offering short specific upgrading courses in hospital technology HCTS units to explore ways for venturing into the training market, e.g. by offering short courses for hospital technicians Establishing dialogue with Government bodies about possibilities for offering certified courses Any plans for training courses need to be based on thorough market assessment (expected number of students per year, jobs available)

Summary Results of Training Needs Assessment for Health Care Technical Services

Training Needs of Artisans working in Hospitals		
Situation	**Training Needs**	**Conclusion for way forward**
The majority of artisans does not work in the field of medical equipment maintenance. Their areas of work are rather general, covering all kind of infrastructure maintenance and repair Artisans appear to have been working in a similar or related type of work before and this is where they mostly acquired their skills some have been trained in vocational training institutions On the job training is another important method of skill acquisition, particularly when exposed to new tasks more related to specific hospital equipment maintenance that supervisors and foreman need to be trained in instruction skills	Insufficient skills in all areas of hospital equipment maintenance Lack of basic knowledge of electricity and electronics Lack of multiple skills According to the questionnaire analysis, of all training measures analysed, short term upgrading courses are in greatest demand Respondents suggested that upgrading courses should to a greater extent combine theoretical and practical components	HCTS and Hospitals should start a dialogue with vocational training providers in order to adjust curricula and to provide appropriate short term training programs HCTS increasingly should play a role as training providers or could do the co-ordination by contracting another agency to conduct the course such as Vocational Training Centres or private firms. Appropriate training programs be developed on the basis of economical principles.

Summary Results of Training Needs Assessment for Health Care Technical Services

Supervisors/ HCTS Managers		
Situation	**Training Needs**	**Conclusion for way forward**
Very few managers/ supervisors working in HCTS acquired any experiences in management before entering their current positions	There is need for management training at different levels: - General management , supervision of work, work organisation - Financial management - Hospital facility management	Utilising the offers of existing management schools if appropriate Initiating the design of special courses on hospital facility management
On- the job training is the most common form of skill acquisition for technicians in HCTS	Supervisors require instruction skills	Improving on-the-job training by initiating staff training in instruction skills Enhancing on the job training through internships and or attachments
Technicians/ Artisans for general maintenance		
Although most staff in maintenance have a vocational training certificate practical skills are often not sufficient not sufficient	Insufficient repair and maintenance skills in all areas of hospital equipment maintenance	HCTS to offer attachments and to organise/ co-ordinate skill upgrading To organise internships at hospital maintenance units (HCTS or other providers to make trainers available)

New approaches of training in HCTS

Key Questions

- how can the present methods and quality of training be upgraded in order to better satisfy the needs?

- what other, cost efficient and effective methods of skill development could be found?

- How can existing resources be mobilised?

- Who/ which organisation has the mandate, capacity and competence to offer quality training?

Possible approaches

Improving on-the-job training

Improving instructions

Appraising staff (quality control)

Using HCTS facilities for attachment of people from outside (e.g. staff of hospital maintenance units

HCTS offering short term upgrading courses

HCTS to conduct training courses in-house with own staff in fields where they have an comparative advantage/ specific expertise

HCTS to use its facilities for training courses with external trainers

HCTS to co-ordinate courses which are conducted by other providers

Way forward

As a way forward after the TNA survey the following measures are suggested:

1. Results be shared with the questionnaire respondents and stakeholders of the “Health Care Technology Management Programme”.

2. Potential for training measures and training needs be surveyed and analysed by individual HCTS units and appropriate training programs be developed on the basis of economical principles.

3. TNA Information be shared and discussed with training providers (colleges offering medical engineering courses and upgrading measures), dialogue with training providers be established with the aim to qualify the training offers.

4. The issue of training needs be discussed during international conference of HCTS

1 Introduction

1.1 Background of the survey

From 1996 until 2000 FAKT was co-ordinating the “Hospital Technology Dissemination Programme”, since 2001 that programme has found a succession by the “Health Care Technology Management Programme”. The latter includes measures to strengthen the management of health care technology and physical infrastructure in the health sector. Its objectives are to build capacities in technology management, to disseminate knowledge gathered in the field of hospital technology and to promote co-operation between the Church and public institutions.

One intention of the programme is to support human resource development of health care technical services by assisting in development and implementation of appropriate training measures. For that purpose, FAKT carried out a questionnaire survey with the purpose to assess training needs of personnel working in service units or hospital maintenance units. Three areas were under focus:

- Existing training measures, current practice
- Training needs
- Supply of training

A total of 55 organisations were contacted, responses were received by 37 organisations ranging from regional/ district health co-ordinators to hospital maintenance departments and health care technical service organisations. Further we received feed back from several “training providers” such as universities and technical colleges.

The results of the survey are broad. They show the carrier pattern of the personnel working in the maintenance sector, show were skills and competence for performing the daily tasks are commonly acquired, where deficits and training needs arise.

It is our sincere hope that the results will eventually contribute to the improvement of human resource development in the hospital maintenance sector and thus to help improving health care services as a whole.

1.2 Definitions and Abbreviations

HCTS - Health Care Technical Services are organisations which assist health care providers and owners of health facilities in components of healthcare technology management. They provide consultancy, maintenance and training services at different levels of health care technology. HCTS are operating on an economical basis, i.e. with a fee-for-service approach.

Hospital maintenance units are administrative units, departments in hospitals, responsible for maintenance of the hospital’s equipment. In areas of need, hospital maintenance units may contract HCTS to carry out specific maintenance assignments.

E: stands for engineer

T: stands for hospital technician

A: stands for hospital artisan

Regions: in this report we understand regions as sub-continental regions (e.g. the region of East africa..) with the exception of positions (a regional co-ordinator is someone who works in an administrative region).

2 Findings and conclusions

2.1 Human resource development in HCTS

2.1.1 Overview over the different types of training in HCTS

This chapter shall provide a brief overview over the different training measures applied in health care technology sector. It does not aim at analysing the effectiveness of the different measures applied as this would have gone well beyond the means of the survey.

Formal technical training and education

These are long term courses or studies (2 to 4 years) leading to a formal qualification (engineering degree or technician diploma). As said before, only a small minority of people working in HCTS have acquired a formal qualification in medical engineering/ hospital technology. The vast majority studies a related field and then acquires additional skills either through training at workplace (on-the-job), up-grading, or, in less cases, through post graduate studies.

Post graduate/diploma courses

Post graduate courses usually last from 12 – 24 months and lead to a formal qualification. They are offered for engineers and, to some extent, to technicians. There are very few facilities in Africa, except for South Africa. These courses are in most cases quite unaffordable for an average person and therefore require sponsorship.

Short term upgrading courses

Upgrading courses are usually short term (from a few days up to six months). They usually address a specific topic or a limited range of topics and build on basic skills / knowledge and work experience of participants . There are skill upgrading courses as well as theoretical ones (and combinations). Upgrading courses are non- formal, i.e. they do not lead to a higher formal qualification (and thus attendance does not qualify for a pay-rise). Certificates are usually not offered. Such courses can also be product specific (e.g. covering maintenance of a specific apparatus or piece of equipment.

In-service training

In service training is another type of short term upgrading which is carried out in-house, either by own staff or trainers from outside. It is not on-the-job training (see below) as it takes place in a structured manner and not as part of a work process. In the health sector, user training (training users to operate a certain type of apparatus/ device) is often carried out as in-service training.

On-the-job-training

According to survey results, on-the-job-training is the most common method of skill and knowledge acquisition for artisans and technicians (as most newcomers in HCTS have never before been exposed to hospital equipment). This type of training takes place on a daily basis by performing work under the guidance of a superior/supervisor. It is a very cost efficient form of training. It does have disadvantages too:

- Training imparted can only be as good as the competence of the "instructing" colleague or superior and of his/her willingness to share knowledge, they often lack instructing skills,

- There is no formal testing/ quality control of training imparted.

On the job training sometimes is also provided by external personnel (external trainers/ specialists who provide training at the workplace).

Internship/ attachment

Internship or attachment is, in general terms, another means of on-the-job training. While the latter takes place at one's own workplace, internship takes place at another company, in our context at another HCTS. Its main purpose is to practise a practical skill but also to learn about different work practices, work context and procedures. Trainees on attachment/ internship usually work under supervision of a supervisor (remark: not to confuse with exchange programs which takes place at equal categories of staff)

2.1.2 Formal qualification of personnel in HCTS

Personnel in managerial and supervisory positions

Among the 37 respondents to questionnaire one (personnel of HCTS) were 9 heads of maintenance units, 7 were workshop supervisors, and 5 were regional and district technical officers, this is a total of 21 respondents in supervisory positions[1].

[1] For further information refer to questionnaire analysis Part B, 1st par.

4 heads of HCTSes hold an engineering degree, 5 are technicians (55%). Out of the 4 heads of HCTS units who hold the engineering degree 3 have either a first or post graduate degree in medical engineering. Out of the 5 technicians who are in a HCTS managerial position only 1 holds a technician's diploma in medical engineering.

15 of the 22 responding technicians (68%) are in a supervisory role, either as heads of maintenance units, workshop supervisors or regional technical officers. Only 23% of the technicians received a special or further training in the field of medical engineering/ hospital equipment maintenance/ management.

The majority of engineers (71%) and technicians (72%) covered by this study possess a formal qualification (degree or diploma) in a field more of less related to their current work. E.g. for personnel working in maintenance of medical equipment, electrical or electronic engineering is considered a related field. The initial study/ training can bee seen as a foundation where a specific training for hospital equipment maintenance in whatever form has to built on.

It was difficult to determine the exact number of "certified" technicians, as the meaning of "technician" is widely differing from country to country. It may well be the case that only a minority of responding technicians possesses a proper technician's diploma. It rather appears that a majority obtained one of the vocational training certificates (ranging from Trade Tests to Craft Diplomas) and gained the "title" of a hospital technician through work experience and reputation.

formal qualification and type of initial training	**E**	**T**	**A**
Engineering degree	4	0	N/a
Technician certificate (diploma)	1	15	1
Vocational Training certificate (e.g. trade test)		8	3
Trained on the job		8	1
No information	2	2	2

Table 1:survey results: Initial training and formal qualification of personnel in HCTS

The survey revealed that technicians have far less access to specialised further training (i.e. post diploma course) as compared to engineers. For them on-the job training and (non-formal) upgrading courses are the most important sources of skill acquisition (see under acquisition of skills).

The far majority of personnel working in managerial and supervisory positions holds a secondary or high school certificate (see table 2).

Highest educational level	**E**	**T**	**A**
Primary school	0	2	6
Form 4 (secondary school)	3	13	0
Form 6 (high school)	2	7	0
No information	2	2	0
Total	*7*	*24*	*6*

Table 2: Survey results: educational level of personnel in HCTS

Only one out of 3 HCTS units or zonal maintenance departments employ an engineer. The overall ratio of engineers and technicians employed, according to this survey, is about 1:6.

Out of 9 responding hospital maintenance departments covered by this assessment only one was employing an engineer. The ratio of engineers/technicians employed at hospitals is about 1:11, some estimations suggest that the ratio may well be up to 1:20. The reason for the mismatch appears to be rooted:

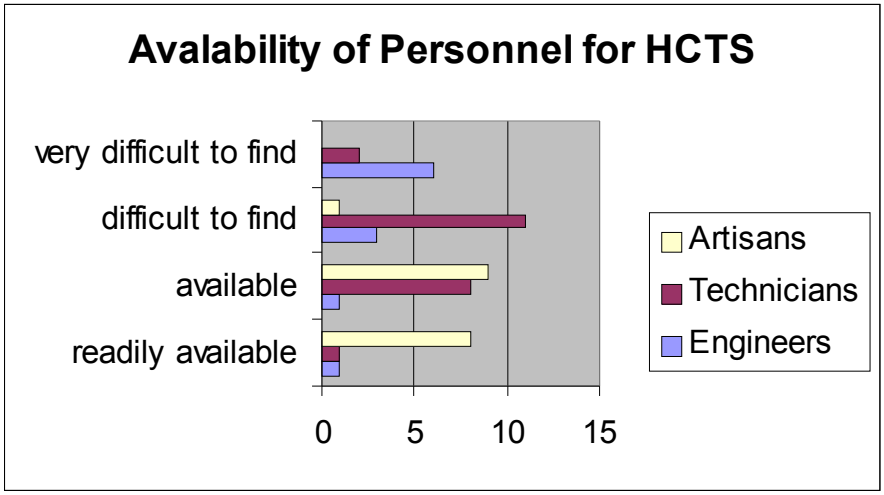
a) in the difficulty to recruit qualified engineers (the majority of respondents stated that engineers are difficult to find in the market, see graph, availability of qualified personnel for HCTS) and
b) in the high costs of hiring an engineer.

Thirdly, most hospitals prefer to "outsource" maintenance of bio-medical equipment to external HCTS units, this is where greater capacities (and needs) exist to employ qualified engineers for managerial position.

Workers (technicians and artisans) in maintenance of hospital equipment

According to table 1, 50% of the artisans and most of the technicians working in maintenance possess a vocational training certificate (trade test and other vocational training certificates) in a field related to their work. The far majority of them has not had formal technical training in medical/hospital equipment maintenance.

Heads of maintenance units would prefer to employ artisans with multiple skills (e.g. a welder who has been trained in plumbing as well). As such "tailor made" training courses do not exist in most African countries (e.g. a course in building maintenance, combining different trade areas) on-the job training/ upgrading is the most common practice to qualify artisans for their duty in HCTS (see under human resource development).



2.1.3 Work experience before entering HCTS

80% of the engineers and technicians (the majority of them works in managerial and supervisory positions) have not been working in the field of hospital equipment maintenance

before entering into their present employment. For 33% of the engineers and 17% of the technicians, the present job is their first employment after graduation.

3 of the 5 engineers with work experience were previously teaching in technical colleges, only one (that is 14%) was working as a service technician/engineer in the field of hospital equipment maintenance. Only 21% of the technicians worked in another HCTS before entering the present job.

Considering the fact that only a minority of the technicians received formal training in hospital equipment maintenance and that only a minority has got previous work experience in the field, acquisition of skills at the workplace and further training for staff in HCTS is tremendously important.

	E	T	A
This is my first place of work after graduation:	2	4	1
I worked elsewhere in a different field	2	7	5
I worked elsewhere in a distantly related field (e.g. hospital technicians previously working in electronics or electrical installation)	2	7	0
I worked in another hospital or HCTS unit	1	5	0
No information		1	0

Table 3: Work experience before joining a hospital maintenance unit

Non of the managers and supervisors in HCTS, according to the questionnaire analysis, were trained in business management. None of the engineers and only one of the technicians in supervisory position have worked in a managerial or supervisory position before getting employed with the present HCTS.

The majority of artisans worked in a related field before entering HCTS.

2.1.4 Acquisition of skills, knowledge and competence for work in HCTS according to staff categories

Engineers

For the responding engineers, post graduate studies and upgrading were the most effective training measures. 43% of the engineers attended a post graduate course in medical engineering. An additional 29% participated in short term upgrading or seminars.

Those who attended a post graduate study in medical engineering (that also applies for technicians) appear to have benefited significantly. As one respondent was saying:

There are far less problems with those who have had a further study in our field

The present place of work received the second highest rating for acquisition of skills and competence.

The initial study ranks in the middle and appears to form the basis for specialisation. In contrast to the technicians, the majority of responding engineers did have access to further education and training.

Engineers	1	2	3	4	5	Sum	Average score	Ranking[2]
during formal training/ technical education			2	2		14	3.5	3
while working in another firm/institution		1		2		10	3.3	5
during further training/ up grading courses				1	5	29	4.8	1
at my present place of work			4	1	1	21	3.5	2
in internship/ attachment			1	1		7	3.5	4

Table 4.1: acquisition of skills and knowledge for the present job

Technicians

Technicians	1	2	3	4	5	sum	average score	Ranking
during formal training/ technical education	3	1	9	3	5	69	3.8	2
while working in another firm/institution	1	3	4	5	3	56	3.5	4
during further training/ up grading courses		2	4	3	5	53	3.8	3
at my present place of work	3			5	9	68	4	1
in internship/ attachment	2	1	2	3	2	32	3.2	5

Table 4.2

For technicians, in contrast to engineers, “on-the-job training” at the present place of work is the most important measure for acquisition of skills and knowledge. Causes for the difference appear to be that :

- Technicians have limited access to post graduate studies/ specialised further training (only 14% of the technicians attended a diploma course in medical engineering after graduating from their initial field of training),
- only another 27% did have access to short term upgrading in a specific field related to their job,
- there is maybe less investment into or sponsorship for upgrading of technicians, and/or
- there are less training providers offering upgrading to technicians, (see supply of training)

Despite the fact that technicians have been the major group who benefited from upgrading courses (in numbers) in relative terms (percentage) they rank behind engineers. That underlines what has been said in the previous paragraph.

For technicians, initial technical education and training ranks second. It shows that initial training forms an important base for later specialisation. It again shows, however, that there is too little upgrading/further training taking place.

As only few technicians worked in another HCTS unit before, skill acquisition at a different place of work did not receive a high score.

[2] ranking was done by using a combination of average score and the sum of the scores by each respondent

According to table 4.2. internship/ attachment to other HCTS units, as with engineers, ranks at bottom end. It shows a) that very few staff participated in this type of activity so far, and b) internship may not have been as effective as anticipated. This is in contrast to the result of question 5 asked at questionnaire part 2 (most and least effective measures of training) where internship received a highest score (before on the job upgrading). As the diverting results do not allow the final formulation of a finding, we suggest that each person who participated in exchange or internship programmes is encouraged to evaluate the effectiveness of the activity.

Artisans

The majority of artisans does not work in the field of medical equipment maintenance. Their areas of work are rather general, covering all kind of infrastructural maintenance and repair, ranging from mechanical work (automotive repair) to building maintenance including air condition. Most of the artisans appear to have been working in a similar or related type of work before and this is where they mostly acquired their skills. On the job training is another important method of skill acquisition for artisans, particularly when exposed to new tasks more related to specific hospital equipment maintenance.

The latter underlines the necessity that supervisors and foreman need to be trained in instruction skills (the same of course applies for on-the-job training of technicians).

2.2 Summary of training needs in HCTS

Training needs according to questionnaire responses are listed in the Annex II, Questionnaire Analysis:

- *part 1, section 8: Greatest needs to advance knowledge and skills, and*
- *part 2, section 2, key competencies, section 6, weaknesses and shortcomings.*

The needs identified can basically be categorised into 3 broad areas:

1. Management and supervision

2. Specific technical know how

3. Practical skills

While the first two areas apply for engineers and technicians, the 3rd area applies for artisans and to some extent to technicians.

Short term upgrading courses are considered as the most adequate method for the first two areas. On-the-job training and internship appears most suitable for the third area.

As the survey covered a vast spectrum of different categories of HCTS and geographic regions, the results are rather general. For the planning or review of new training measures TNA surveys would need to be done at regional[3] and or national level. At the following is a summary of the training needs according to staff categories:

[3] in the sense of sub-continental regions

Engineers and technicians in managerial and supervisory position

This section deals with non-technical issues, related to management of HCTS units and supervision of work:

Weaknesses/ need for training were identified in the following areas:

For HCTS managers/administrators

- financial management/ basic accounting,
- overall management, personnel management (including staff appraisals)
- Facility management (hospital equipment and infrastructure) (for HCTS managers and decision makers in hospitals), including:
  - procurement,
  - disposal, replacement,
  - maintenance strategies
- Waste management

For workshop supervisors and team leaders,

- Supervisory skills including aspects like:
  - communication skills,
  - group leadership,
  - quality control,
  - instruction skills (for better delivery of on-the-job training)
- workshop organisation:
  - planning, organisation, co-ordination of work
- Computer skills (e.g. data base programming, etc.)

Engineers and technicians working in maintenance of medical equipment

This section deals with technical issues regarding R & M of medical equipment:

- Insufficiency of knowledge in medical/ hospital equipment technology and maintenance in general including:
  - trouble shooting/ fault finding techniques
  - basic and advanced medical electronics
- Lack of knowledge about specific technologies/ products, e.g.:
  - maintenance of diagnostic and imaging equipment
  - maintenance of laboratory equipment
  - advanced cold chain technology

It was suggested that equipment/ product specific training should, if possible, be conducted by equipment manufacturers/ suppliers. This will only be possible in countries with a sufficient presence of equipment suppliers. If they are not available or accessible, other avenues of training need to be explored.

Technicians and Artisans in maintenance of general hospital equipment

- Insufficient repair and maintenance skills in all areas of hospital equipment maintenance,
- Lack of basic knowledge of electrical engineering and electronics (for technicians),
- Lack of multiple skills for general application

2.3 Supply and demand of training in HCTS

This chapter looks at both the supply of training and the demand as analysed from the questionnaire response. It also contains some conclusions on what type of training should be offered and by whom.

2.3.1 Formal technical education and training (graduate and post graduate courses)

a. Engineers

Except for South Africa, there are few institutions offering graduate and post graduate courses/studies in the field of clinical/ bio-medical engineering. Short falls have been noted for most of the Eastern, Southern and Central African countries, where in most countries not a single training facility exists.

With meagre budgets to finance technical education in general, most Governments in Sub-Saharan Africa have shown a very low capacity of sustaining such institutions by their own means. Factors are the high costs involved (e.g. the need to update, maintain and replace expensive lab-equipment, etc.) and the lack of qualified manpower.

It was beyond the means of this survey to get insights into the effectiveness/ relevance of the courses offered. However we have received hints that the standard of training providers and the practicability of the training offered is differing. One provider in East Africa who once enjoyed a good reputation in the region appears to have dropped in standard, particularly in the delivery of practical training.

For further information see Annex III List of training providers

Investment and re-investment into health care technical facilities by African Governments takes generally place at a very low level in most of the sub-Saharan countries. It has been noted that donors started to invest more readily into the health sector. Fast technology advancement in the North is having its effect in the South, although on a slower rate. However, as long as Governments do not increase significantly the financing of health

care facilities, the human resource needs for advanced positions in the maintenance sector (i.e. bio-medical engineers) are relatively limited in scale.

Conclusion:

Despite the obvious lack of technical education and training in this field in sub-Saharan Africa it may, at the current stage, not prove to be viable for Governments as well as for non-Governmental agencies to establish new training facilities for the engineering level (Higher Diploma, Degree Courses, post graduate courses). Reasons are:

- There is a greater need for trained technicians (see below)
- To establish top end training facilities for engineers is a very costly undertaking.

Engineers should continue to use existing facilities for post graduate studies abroad (South Africa, Europe, North America).

b. Technicians

As said for engineers, there is a significant lack of further training for hospital/ bio-medical technicians in Africa (except South Africa and Swaziland)[4]. Facilities, according to our knowledge, exist only in Tanzania, Kenya, Senegal and Ghana. We do not have knowledge about the quality and relevance of training provided by these institutions.

The human resource needs for bio-medical/hospital technicians are by far higher than for engineers (see above).

The problem with financing of initial training is nearly the same as for engineers. It is very expensive to run good quality long term training courses for technicians in that field. Under the present economic conditions (training providers are urged to operate on a financially sustainable basis!), a training provider would have to operate at least on national, but better on a regional level[5]. That would require to have appropriate marketing mechanisms in place.

Conclusion:

Considering the need, ways should be explored to expand existing or establish new training facilities for initial and further training of hospital technicians. As a long term perspective, each country/ sub-continental region should have one training facility in place. Any planning should be based on thorough market assessment and feasibility analysis answering questions such as:

- what are the needs of employers in terms of quantity (jobs available) and quality of training (requirements of employers in terms of competence as well as formal qualification of graduates), e.g. it needs to be considered that the health care maintenance sector is limited in size. As a rule of thumb: approximately one technician is needed per district hospital.

[4] please note: even in Europe medical engineering is usually offered as further and not as initial technical education

[5] in terms of sub-continental regions

- how much will the training cost (considering that appropriate quality standards have to be maintained) and how shall it be financed?

c. Artisans

For artisans, initial training is mainly provided by the numerous vocational training institutions, by industry (large and small scale alike) and the public sector (on-the-job training).

The quality standards of (formal) vocational training are widely differing. National certification, in most African countries, does not ensure quality standards (in particular the standards of practical training). As a result many employers regard vocational training graduates merely as apprentices who have got a theoretical base but who still have to acquire the practical skills and competence of their trade.

Vocational Training Courses usually cover one specific trade area and do not produce "multi-skilled" graduates. In order to acquire multiple skills as required for hospital equipment maintenance graduates would need to be exposed to additional short term training and, more common, on-the job training at workplace.

HCTS should start a dialogue with vocational training providers in order to adjust curricula to their and other stakeholder needs (e.g. the local service industry) . Multi-skill courses in the field of building maintenance have been successfully implemented in other regions (Asia, the Middle East), combining elements of electrical installation, building/construction and plumbing. Graduates would probably not only be attractive for HCTSes but also for the hotel industry, maintenance firms for high rise buildings and so forth.

2.3.2 Short term training/ upgrading courses

General issues

According to the questionnaire analysis, of all training measures analysed, short term upgrading courses are in greatest demand. These courses are more affordable than long term, post graduate courses, they are flexible and do have the advantage that staff will not have to be replaced while being on training. Most respondents felt that upgrading can best address the weaknesses of personnel in HCTS and thus can contribute to raise quality standards of service delivery. Up-grading courses can, to some extent, compensate for the lack of formal training in the area of medical engineering.

The first obstacle is the fact that there are very few institutions/ organisations offering sufficiently specific and high quality training courses as required by HCTSes.

The second one, as stated by respondents, are the limited means of hospitals and HCTS units for financing such training measures without external support.

Respondents suggested that upgrading courses should to a greater extent combine theoretical and practical components, i.e. there is a component where the knowledge acquired is practically applied in the context of HCTS. That applies to management courses as well as technical courses, and it means that upgrading courses, to a large extent, need to be tailor made to the specific requirements of HCTS. At this stage, we have too little know-

ledge about the capacity of the existing training providers to respond to such demands. This issue would need to be further explored, preferably at national/regional[6] levels.

Considering the large need, the existing training providers should seriously think about diversification of their training programs i.e. to introduce short, specific courses on demand (see summary of training needs). As there are only few existing providers, others, capable of providing the services should explore the feasibility of venturing into the training market. HCTS Units, as the example of HTU in Ghana shows, can well become a training provider. As said for the long term courses, any plans need to be based on market surveys and feasibility studies (see next chapter).

Below is a analysis of courses of different categories:

Training courses in overall management/ workshop management

In most African countries institutions are available which provide a range of training courses in general management including finance management and personnel management. However, these courses, in most cases, will not be "tailored" for the needs of HCTS.

Some of the management training institutions offer courses for supervisors as well. Such courses may not be part of a standard package but could be offered upon request. It is important that the training provider is familiar with the commercial sector and with workshop organisation in particular.

As mentioned above, there is a great need for special courses in hospital technology management. On the African continent, such courses, to our knowledge, are at present only offered in South Africa (see Annex III, list of training providers). Courses in this field would need to be specifically designed and suitable training providers be identified.

Short term upgrading courses in medical engineering/ hospital equipment maintenance

As with the facilities for long term training, specific short term courses in the field of medical engineering (particularly in the high-tech field) are virtually not available in most African countries. The few centres in existence do have a regional role to play. Any change of their programs/ performance do have vast implications.

Taking into consideration the higher number of technicians working in the field (as compared to engineers) there is a vast need for short term upgrading courses (see summary of training needs).

Several respondents suggested that private industry (equipment suppliers) should play their role in provision of training, particularly when it comes to equipment/ product specific training. In some countries (Ivory Coast) this is already common practice (equipment suppliers, mainly from overseas, offer "product based" training as part of the sales package). However, this service is usually not available in case of equipment donations (second hand equipment), in some countries suppliers do not have residential offices. There are vast regional differences. Approaches have to be further explored.

[6] in the sense of sub-continental regions

It was also suggested that short term training shall be accompanied by in-service training or “extension”, either through:

- experts following up trainees at their workplace, giving practical advice
- upgrading course be accompanied by internship programs offering on the job training

Also these areas need to be further explored.

Short term skill upgrading

Short term skill upgrading courses are increasingly offered by Vocational Training Institutions/ Centres (VTCs). For the VTCs skill upgrading courses are an opportunity to earn additional income, for HCTS there is the opportunity to “outsource” some of the training usually provided “in-house”. With all types of short term training, it is crucial to evaluate the quality and relevance of the training imparted. Short term skill upgrading courses are a new field for most VTCs. As most of these centres are mainly experienced in “initial” training (where the target group are young and inexperienced youths), they still have to adapt their training methods (dealing with adults who are already experienced and who want to acquire advanced skills). The client of such courses (the HCTS) should be encouraged to participate in the design of such courses. This is not a very time consuming task, as most people would be afraid of. It requires to determine objectives for the course (what should a person be enabled to perform afterwards...) and thus to contribute to the design of a simple curriculum.

2.3.3 In-service/ on-the-job training

See under section: improving on-the-job training

3 Thinking about new approaches of training in HCTS

As we learned above, very few suitable training providers exist in sub-Saharan Africa to satisfy the need for high quality initial and further training in the area hospital technology maintenance and management. We also learned that it is expensive to run formal and non formal training courses of high quality in this field. We can not expect miracles such as Governments will see the need swiftly act, i.e. will readily invest into new or upgraded facilities and to provide the finances required to run such institutions up to a standard as required.

The key questions arising are:

- how can the present methods and quality of training be upgraded in order to better satisfy the needs?

- what other, cost efficient and effective methods of skill development could be found?

- How can existing resources be mobilised?

- Who/ which organisation has the mandate, capacity and competence to offer quality training?

3.1.1 Improving on-the-job training

In-service or "on-the-job" training takes place informally and, as we outlined above, is the most important form of skill acquisition for technicians and artisans. "in-built" limitations of that type of training is:

- the competence level of supervisors/ instructors,
- their ability and willingness to instruct, to share their knowledge.

We assume that most people who work in supervisory functions have not been trained in "instruction skills". This is a weakness per se and affects the "transfer" of knowledge and skills.

On the basis of the needs analysis we do have the following thesis:

1. Due to the lack of adequate training facilities for hospital technicians and artisans on-the-job training will remain a very important method of skill acquisition.

2. In order to upgrade the existing skill levels and in order to keep up with technology changes, those who are responsible for instructions (the supervisors) should have priority access to technical and skill upgrading.

3. Supervisors need to be upgraded in instruction skills

4. Particularly when employing new, inexperienced staff, there should be some sort of quality control of the "on-the-job training imparted on them,

5. On the job training can not replace other important forms of skill and knowledge acquisition. There have to be complementary up-grading courses, with the objective to fill the gaps.

3.1.2 HCTS offering short term upgrading courses

There have been suggestions that HCTS increasingly should play a role as training providers. Before venturing into this field a HCTS unit should answer questions such as:

- who will be our clients/trainees, what are their specific demands/ needs?
- will we be able to enrol a sufficient number of trainees in order to justify to start a new course? How do we market the course?
- do we have the know how and capacity of becoming a training provider in HCTS? I.e. do we have the technical know how, the pedagogical know how, the ability to plan and to coordinate the activities?
- How does it fit into out strategy?
- will it be profitable for us, will the clients be able to cover the costs of training? If not, who then will bear the costs?

HTU in Ghana (see list equipment providers) has become a training provider. For them, offering training is also a financially profitable undertaking. HTU uses three different modes of implementation:

a) HTU staff conducts the course

b) HTU uses external trainers for conducting a course

c) HTC contracts another agency to conduct the course such as Vocational Training Centres or private firms. Co-ordination (planning, advertisement, enrolment etc. is done by HTU)

As an outlook, HCTS could play a role in the following areas:

- Offering a range of special short term upgrading courses on demand to different target groups (HMU staff, others)
- Offering user training for different target groups (e.g. nurses) using upgrading as well as attachment/internship (see below)
- Being co-ordinators for training measures (see HTU example)

3.1.3 Exchange

There have been several exchange programs between HCTS in different parts of Africa (e.g. South-South exchange program) including internship at supervisory level. Although the extent of activities of other actors (WHO...) is not known survey results suggest that exchange so far took place on a rather small scale. Programs of this kind need to have

clearly defined objectives and activities and a co-ordinated approach where the information is shared between the parties involved and where planning of these measures is made transparent.

3.1.4 Internship/ attachment

There have been internship programs on regional level, e.g. where artisans/technicians of hospital maintenance units (HMUs) were attached to a HCTS unit for on-the-job training. Similar activities can be offered to equipment operators in combination with upgrading courses. The potential of such activities would need to be further explored.

4 Way forward

As a way forward after the TNA survey the following measures are suggested:

1. Results be shared with the questionnaire respondents and stakeholders of the “Health Care Technology Management Programme”.

2. Potential for training measures and training needs be surveyed and analysed by individual HCTS units and appropriate training programs be developed on the basis of economical principles.

3. TNA Information be shared and discussed with training providers (colleges offering medical engineering courses and upgrading measures), dialogue with training providers be established with the aim to qualify the training offers.

4. The issue of training needs be discussed during international conference of HCTSes in Nairobi 2002

Annex I

Questionnaire: Assessment of Professional Training Needs in Health Care Technical Services

Part 1

Only for personnel of Health Care Technical Services

Name of the institution: .....

Date: .....

Your position: .....

1. Please describe your present occupation:

are you a:
hospital engineer □
hospital technician □
general artisan □

What are your specific responsibilities?

.....

.....

2. Please indicate your educational and professional background:

Education:		Technical Training and Education	
primary school	□	Engineering degree	□
form 4 (secondary school)	□	Technician certificate (diploma)	□
form 6 (high school)	□	Vocational Training certificate (e.g. trade test)	□
other (please specify):	□	Trained on the job	□
		other (please specify):	

In what specific field did you graduate?

.....

3. What were you doing before working in a hospital maintenance unit?

That is my first place of work after graduation: □ .....

I worked in a different field □ .....

If yes in which field?.....

.....

I worked in another hospital maintenance unit □

If yes, what were your responsibilities:.....

.....

.....

Others (please specify):

.....

.....

4. Where did you acquire most and least of the skills and knowledge for doing your present job: (please tick ✓ a grade from 1 lowest to 5 highest)

	1	2	3	4	5	not at all
during formal training/ technical education						
while working in another firm/institution						
during further training/ up grading courses						
at my present place of work						
in internship/ attachment						

5. Did you attend any further training, upgrading or practica (internship) in the field of hospital technology or related fields?

yes □ no □

if yes
where: .....

when and for how long: .....

in what particular field: .....

.....

6. For those who attended further training/internship: to what extent did the training help you to do a better job

yes, my work performance has improved significantly	yes, there is some improvement	no, the improvement is not significant	no, the training had no impact at all
□	□	□	□

If yes, please describe in detail in which area you can now perform a better job?

.....

.....

.....

.....

If no, why? (please specify)

.....

.....

.....

.....

7. In what particular areas do you personally see the greatest need to advance your knowledge and skills in order to perform a better job?

.....

.....

.....

8. Where and how do you think you could best acquire these skills and knowledge (please tick ✓ a grade from 1 lowest to 5 highest)

	1	2	3	4	5
by internship/ attachment to other maintenance units					
by inviting specialists who train us on the job					
by attending short term training courses (upgrading)					
others (please specify):					

In case of upgrading/further training, please make suggestions for the content of the training:

.....

.....

.....

.....

.....

.....

9. Any other comments

.....

.....

.....

.....

We thank you for your effort and co-operation to fill this questionnaire

Questionnaire: Assessment of Professional Training Needs in Health Care Technical Services

Part 2

For health secretaries/ co-ordinators, hospital managers and heads of maintenance units

Name of the institution: .....

Date: .....

Please describe your position, are you a:

health secretary/ co-ordinator □ hospital manager □
head of maintenance unit □
(for heads of maintenance units: please fill also questionnaire part 1)

Type of maintenance unit::
Regional/ Zonal Health Care Technical Service □
Technical department of a hospital/clinic □

1. How many staff are employed in the maintenance unit:

engineers	technicians	artisans[1]

2. What key competence[2] should staff possess to fulfil tasks up to the required standards:

	technical competence and know -how	non- technical competence
Engineers	.....	.....
	.....	.....
	.....	.....
	.....	.....
	.....	.....
	.....	.....
	.....	.....

[1] general maintenance personnel
[2] key competence describes the most important qualities/skills/experience of personnel to fulfil their role within an organisation/ firm. It covers technical aspects (i.e. know-how for performing a specific technical task, e.g. maintenance skills of a specific apparatus, knowing how to read a balance sheet for financial managers e.g.) as well as non-technical aspects/ social competence (being able to motivate people, being accurate, having good co-ordination skills)

	technical competence and know -how	non- technical competence
technicians	....	....

3. When recruiting new personnel for the maintenance unit, did you experience that people with the required qualification and competence (the latter as specified under 2) were:

	readily available	available	difficult to find	very difficult to find
engineers				
technicians				
artisans				

please tick right answer with ✓

4. What measures did you take to upgrade your staff?
(indicate number of staff who have undergone training in the different categories)

	engineer	technician	artisan
none			
attended short upgrading courses			
internship/practical at other HCTS			
on-the-job upgrading			
other (please specify)			

please tick right answer with ✓

Additions/ remarks:

.....

.....

.....

5. In case your staff underwent some kind of training, what were the most and the least effective measures (please grade from 1 (lowest) to 5 (highest)

question is not valid □

type of further training	engineers	technicians	artisans
internship/ attachment to other institutions			
on the job upgrading			
short term training (upgrading)			
others (please specify)			

additional remarks:

.....

.....

.....

6. Where do you see weaknesses/shortcomings among your staff (compared to the key competence under 2.)

Areas to be considered:

- managerial skills (planning, supervision, personnel management)
- financial management
- specific technical knowledge

Engineers:

.....

.....

.....

.....

.....

.....

.....

.....

Technicians:

.....
.....
.....
.....
.....
.....

- general and specific technical knowledge on medical equipment
- practical repair and maintenance skills

Artisans:

.....
.....
.....
.....
.....
.....

- technical background knowledge in their trade,
- practical skills in general
- multiple skills for general maintenance,

additional remarks:

.....
.....

7. What could/should be done to overcome these weaknesses?

.....
.....
.....
.....

8. Are there suitable training providers or firms/institutions for attachment/internship you could recommend in your region/ your country? Please consider the issues identified under question 6) and 7) and list the firms/institutions below

I recommend the following institutions/firms for provision of:

a) training/ upgrading of engineers:

.....
.....

b) training and upgrading of technicians:

.....

.....

c) training and upgrading of artisans:

.....

.....

d) Internship for engineers, technicians and artisans (please specify for each group):

.....

.....

.....

e) Experts/specialists for on the job training of engineers and technicians

.....

.....

Any other comments:

.....

.....

.....

.....

.....

.....

.....

.....

We thank you for your effort and co-operation to fill this questionnaire

Annex II

Analysis of Questionnaire Response : Assessment of Professional Training Needs in Health Care Technical Services

Part 1: Personnel of Health Care Technical Services

Abbreviations:

A Artisan
E Engineer
T Technician
HCTS Health Care Technical Service

Definition "Related Field": That describes training in an area which is somehow related to medical equipment but not specialised, e.g. someone who graduated as a technician in electronics and now works in maintenance of bio-medical equipment.

General information

Number of questionnaires sent: 55
Total number of responses: 37
2 of the questionnaires received were incomplete

responses according to regions:

East Africa:	16 (Ethiopia, Kenya, Tanzania, Malawi)
Central Africa	11 (Cameroon)
Western Africa	10 (Ghana, Cote d' Ivoire)

1. Position and responsibility of respondents:

Remark:
The distinction between the three categories was strictly done in accordance to respondent's answers at question #1. It was observed, however, that approximately 20 - 30% of the respondents who claimed to be technicians would rather fall under the category artisans.

I am an:

hospital engineer	7
hospital technician	22 (24)[1]
general artisan	6

Engineers:
- 4 (out of 7) are heads of HCTS units,
- 2 are supervisors, and
- 1 is working in technical services.

[1] Including two incomplete questionnaires

Technicians:

- 5 are regional (non-governmental) or district technical officers of MoH
- 10 are in supervisory positions (e.g. workshop managers, foreman),
- 7 are workers in technical services (no supervisory role)

in total, 68% of the responding technicians work in a supervisory position.

2. Educational background of personnel in HCTS:

Highest educational level	**E**	**T**	**A**
Primary school	0	2	6
Form 4 (secondary school)	3	13	0
Form 6 (high school)	2	7	0
No information	2	2	0
Total	*7*	*24*	*6*

3. Professional background of personnel in HCTS

a. Initial Technical Training and Education

	E	**T**	**A**
Engineering degree	4	0	
Technician certificate (diploma)	1	15	1
Vocational Training certificate (e.g. trade test)		8	3
Trained on the job		8	1
No information	2	2	2

Remark:

In some cases there was no clear differentiation possible between a technician certificate/diploma and a vocational training certificate (e.g. a crafts certificate) which widely depends on the (differing and diffuse) definitions used in each country.

b. initial field of training and specialisation

Engineers:

Initial technical education:

- Electrical engineering 2
- Electronics 2
- Biomedical engineering 1
- No information 2

Post graduate study in bio medical engineering (remark: all studied abroad) 4

Technicians

Trade area initially trained in:
Specific field:
- Bio medical engineering 1

Related field
- Electrical installation and electrical fitting 8
- Electronics 5
- Air condition and refrigeration 1

Total related field *14*

Non related field[2]
- Auto Mechanic 2
- General Maintenance 1
- Building construction 1

Total unrelated field *5*
- No information 3

Grand Total *22*

Post graduate specialisation/further training:

Specialisation as cold chain technician 2
Specialisation in medical engineering 5

4. Work experience before joining a hospital maintenance unit

	E	**T**	**A**
This is my first place of work after graduation:	2	4	1
I worked elsewhere in a different field	2	7	5
I worked elsewhere in a distantly related field (e.g. hospital technicians previously working in electronics or electrical installation)	2	7	
I worked in another hospital or HCTS unit	1	5	0
No information		1	0

[2] non related in the context of maintenance of hospital equipment in its narrow meaning. It may well be the case that a technician with background of building/construction is mainly responsible for infrastructure maintenance, in that sense, his qualification is related

5. Where did the respondents acquire their most and least skills and knowledge for doing their present job:

Engineers	1	2	3	4	5	Sum	Average score	ranking[3]
during formal training/ technical education			2	2		14	3.5	3
while working in another firm/institution		1		2		10	3.3	5
during further training/ up grading courses				1	5	29	4.8	1
at my present place of work			4	1	1	21	3.5	2
in internship/ attachment			1	1		7	3.5	4

Technicians	1	2	3	4	5	Not appli-cable	sum	average score	Ranking
during formal training/ technical education	3	1	9	3	5	1	69	3.8	2
while working in another firm/institution	1	3	4	5	3	3	56	3.5	4
during further training/ up grading courses		2	4	3	5	8	53	3.8	3
at my present place of work	3			5	9		68	4	1
in internship/ attachment	2	1	2	3	2	9	32	3.2	5

6. Respondent's attendance in further training, upgrading or practica (internship) in the field of hospital technology or related fields

	E	**T**	**A**
Yes	6	11	2
No		11	2
Only in related field		0	2
No info	1	2	0
Total	*7*	*24*	*6*

Type and fields of further training attended

Specification of training measure	**E**	**T**	**A**
Post graduate course in bio-medical engineer-ing/electronics (12-24 months)	3	0	N/a
Diploma course in related field after basic training	0	1	N/a
Diploma course in maintenance of bio med equipment	0	3	N/a
Upgrading course hospital and med equipment (short to medium term)	2	6	2
Upgrading course health care technology man-	1	0	N/a

[3] ranking was done by using a combination of average score and the sum of the scores by each respondent

agement			
Internship, attachment in field of hospital equipment maintenance	0	1	
Seminars in hospital equipment management		1	
Internship industry (related fields)		2	2

Institutions and companies were respondents attended courses/seminars:

West of Scotland Health Board (1)
UTC France (1)
University of London (St. Bartholomew's Medical College), (2)
Mombasa Polytechnic (1)
Diourbel Senegal (hospital maintenance) (1)

Centre Hospitalier Univ. Yopougon (1)
Siemens (1)
SPARTS (1)

7. The impact of training, a subjective evaluation by the participants
(did the training help to do a better job?)

	E	**T**
yes, my work performance has improved significantly	4	10
yes, there is some improvement	2	1
no, the improvement is not significant		
no, the training had no impact at all		

If yes, please describe in detail in which area you can now perform a better job?

Engineers:

- Generally doing a better job, improved repair and maintenance work (4)
- Gained better knowledge for servicing specific medical equipment (2)
- Having an idea of preventive maintenance (1)
- Knowing better to analyse technical problems (1)
- Improvement in the area of equipment management (1)

Technicians

- Gained better knowledge for servicing specific med. equipment (8)
- Can better train local technicians and/ or equipment users (2)
- Improved in fault finding (2)
- Can better plan the work (1)
- Know how to test equipment (1)
- Better knowledge of equipment (1)

- Preventive maintenance has improved (1)
- Better inventory planning (1)
- Improved in controlling of work and communication with people

If not why:
- Course was not sufficiently specialised
- It is really difficult to get training in hospital technology in our country (Tanzania)

8. In what particular areas do you personally see the greatest need to advance your knowledge and skills in order to perform a better job?

Engineers:

- Maintenance and repair of specific equipment (5)
  (particularly mentioned: x ray, ultra-sound, lab equipment)
- Management in general (4)
- Electronics in general (3)
- Preventive maintenance (2)
- Computer (2)

Technicians

- Advanced courses in maintenance of special medical equipment (8)
- Basic course in maintenance of bio medical equipment (6)
- Hospital equipment management (planning, procurement, disposal, maintenance) (2)
- Practice in Trouble shooting (2)
- Computer skills (2)
- Basic accounting (2)
- Electronics in general (2)
- Workshop management (2)

- Formal training in maintenance of medical/hospital equipment (advanced long term courses) (3)

Recommendation by respondent: Training must contain theory as well as practical “on the job” application

9. How could the required skills and knowledge best be acquired (grade from 1 lowest to 5 highest)

Ranking by respondents

Engineers	1	2	3	4	5	sum	ranking
By internship/ attachment to other maintenance units		1	1	1	1	14	3
By inviting specialists who train us on the job	1		3	1	1	19	2
By attending short term training courses (upgrading)				2	4	28	1
Others (please specify): long term training					1	N/a	N/a

Technicians	1	2	3	4	5	sum	ranking
By internship/ attachment to other maintenance units	6	4	4	1	1	36	3
By inviting specialists who train us on the job	1	5	2	3	7	62	2
By attending short term training courses (upgrading)	1	1		8	11	89	1
Others (please specify):long term course					4	N/a	N/a

Suggestions for the content of the training:

Remark:
Suggestions given by respondents are in most cases identical with their current field of work. As the tasks cover the entire area of hospital equipment maintenance and management (e.g. from maintaining sewage systems, to repairing of hospital beds and x-ray apparatus), the training needs are spread over a very broad area.

Engineers:

Technical areas:
- Waste management in hospitals (2)
- Circuit tracing (1)
- Trouble shooting (1)
- Servicing and maintenance techniques (1)
- Basic electronics (1)
- How to read block diagrams (1)
- Focus on practical training/ application of knowledge (1)

Management:
- Personnel management (2)
- Financial management (2)
- management of HCTS (2)
- Resource/ infrastructure management (2)

Technicians

Technology in general:
- Medical equipment technology and maintenance in general (6)
- Trouble shooting techniques (4)
- Maintenance of hospital equipment in general (3)
- Basic electronics (3)
- Medical electronics (2)
- Basics of electrical engineering (1)

Specific technology:
- Medical imagery equipment (4)
- Air conditioning, refrigeration (2)
- Laboratory equipment (2)
- Operation of specific medical equipment (user training) (1)
- Boiler technology (1)
- Cold chain technology (1)
- Upgrading on sewage treatment technology (1)

Management:
- Health care technology/ equipment management (2)
- General Mgt, (1)
- Financial Mgt., (1)
- Computer skills. (1)

10. Final comments, suggestions

- Further training should be offered as all the kind of technology we have in our hospital is very challenging, we need a broader exposure to the equipment.
- Upgrading would enable us to cope with modern technology in the market
- Upgrading should last two weeks up to three months
- Besides upgrading courses we need specialists who could train us on the job
- I prefer training with equipment manufacturing companies
- We need to have post graduate training like at the Health Board of Scotland (12 months course on medical equipment technology, see Annex)

Analysis of Questionnaire Response:
Assessment of Training Needs in Health Care Technical Services

Part 2: Response of health secretaries/ co-ordinators, hospital managers and heads of maintenance units

General information

Position of respondent

health secretary/ co-ordinator	4	hospital manager	7
head of maintenance unit	14		
total returns taken in account[4]:	24		

Type of maintenance unit:

Regional/ Zonal Health Care Technical Service	13
Technical department of a hospital/clinic	9
No information:	5

1. Average number of staff employed per maintenance unit and per qualification

Engineers: 0.3

Technicians: 1.7

Artisans: 2.9

In other words, only one out of 3 HCTS or hospital maintenance units employ an engineer. The overall ratio of engineers and technicians employed in this sector is about 1 : 6.

Out of 9 responding hospital maintenance departments only one was employing an engineer, the ratio engineers/technicians according to this survey is 1 : 11, some estimations suggest that the ratio may well be up to 1 : 20.

The ratio of technicians and artisans employed in hospitals is amounting to 1 : 2.6. As not all respondents were indicating the number of artisans employed the ratio may well be higher on the side of artisans.

According to the analysis of questionnaire part one, not all of the technicians employed possess a formal certification as a technician and could as well be classified as hospital artisans.

[4] one of the returns was incomplete and therefore was not considered in the final analysis.

2. The key competencies engineers and technicians in HCTS should possess to fulfil tasks up to the required standards

Engineers

technical competence and know -how	non- technical competence
• In-depth knowledge of and experiences in servicing/maintaining and repairing of medical equipment (8) • Computer skills/literacy (4) (e.g. for maintaining an equipment data base) • Sound knowledge of electronic and electrical engineering (2), e.g. knowledge to understand and diagnose circuit diagrams	• Financial management skills (4) • Business management skills (for private HCTS) including book keeping (1) • Personnel management skills (identifying needs, recruiting the right people, carrying out of performance appraisals) (2) • Time management skills (1) • Know how to deal with very different people and occupations, communication skills (2) • Workshop organisation (2) • Knowledge of administrative procedures (2) • Reporting skills (1) • Creativity to solve technical problems (1) • Equipment management including procurement (2) • Know-how to train equipment users

Remark:
As most responding HCTS units and hospitals do not employ engineers there were only few respondents addressing this issue.

As the survey reveals, engineers, beside having in-depth knowledge of medical equipment, are expected to have a broad competence in management of HCTS. That ranges from general areas such as finance and personnel management to specific ones such as hospital equipment management.

Technicians

A total of 15 returns of 24 (62.5%) were giving information on the required technical competence of technicians in HCTS. More than one third of the respondents were not in a position to determine any key competencies. To some extent, key competencies were mistaken for personal qualities.

technical competence and know –how	non- technical competence
• Maintenance and repair skills of all kind of hospital equipment (12) • Theoretical background knowledge of electrical installation/engineering and electronics (for bio medical field) (5) • Computer literacy (3) • Knowledge of tools and their uses (2) • Knowledge of safety issues (2) For technicians working in general maintenance: • Basic mechanical skills (2) • Basic skills in welding and plumbing (1)	Supervision and management:: • Organisation and co-ordination of work (5) • General supervision and management skills (1) • Group leadership (1) • Basic accounting/ financial management (if technicians are in managerial positions) (2) Other "soft" skills: • Good communication skills/ being able to associate with colleagues, communicate/relate with clients (5) • Being able to motivate others (1) • Store keeping (1)

<u>Expected qualities of technicians:</u>

Sense of responsibility (3)
Punctuality (1)
Responsive to emergency calls (1)
Willingness to learn/ upgrade skills (3)
Being able to work in teams (1)
Being transparent/ honest (2)
Being time conscious (2)
Being obedient (2)
Being motivated for hard work (3)

Most HCTS and maintenance departments in hospitals are headed by a (Chief-) technician. In these cases the technician needs to have comparable managerial and supervisory competencies like an engineer (see table above).

3. Availability of qualified and competent staff as per requirement:

	readily available	available	difficult to find	very difficult to find
Engineers (11)	1	1	3	6
Technicians (22)	1	8	11	2
Artisans (18)	8	9	1	

4. Measures for upgrading/ further training of staff carried out

No information: 2
No measures of further training except on-the-job training 10 **(42%)**

Measures offered according to staff categories:

	engineer	**technician**	**artisan**
attended short upgrading courses[5]	1	10 (42%)	3 (12.5%)
internship/practical at other HCTS	1	5 (21%)	4 (17%)
on-the-job upgrading	1	11 (46%)	10 (42%)
further training (full time), post graduate course in medical engineering		2 (8%)	
workshops	1		

Comments by respondents:

- Technicians require further training and internship to other, advanced institutions as the technology is changing and they need to keep in touch with it (2),
- Most of our hospitals only employ artisans, they do not offer them training,
- Our system of upgrading of personnel is not efficient because decision makers do not have a technical background,
- Only formal training will help

5. What were the most and the least effective measures of training, grades from 1 (lowest) to 5 (highest)

question is not valid 9
invalid information 3

type of further training	**Average grading**		
	Engineers	Technicians	Artisans
internship/ attachment to other institutions	3	4.3	2.3
on the job upgrading	1.5	3.7	3.4
short term training (upgrading)	4	3.6	3.6

For engineers short term upgrading was the most effective measure of training. On the job upgrading is not seen as a viable option for engineers.
Technicians have, according to the survey results, mostly benefited from internship as well as short term upgrading.

[5] Contains all kind of upgrading (e.g. computer skills, accounting etc.)

Artisans did not have access to internship/ exchange to other HCTS. They have mostly benefited from on the job training and skill upgrading (the latter is not a representative result as very few artisans did have access to skill upgrading!).

6. Where do respondents see weaknesses/shortcomings among the staff (compared to the key competence under 2.)

Engineers:

Question not applicable: 17 (71%)

Technical areas
- Lack of technical knowledge (particular about medical equipment) (4)
- Computer skills (1)
- Insufficient knowledge of medical electronics (1)

Non technical areas
- Financial management (4)
- Mgt skills in general (3)
- Lack of communication skills (1)
- Poor in public relation (1)
- Lack of reporting skills (1)
- Lack of personnel management skills (1)

Technicians:

Technical areas:
- Lacking technical knowledge (particular on maintenance and repair of medical equipment) **(11)**
- Repair and maintenance skills in general (5)
- Lack of knowledge in basic electronics (2)
- No patience for fault finding (1)
- For those who have been trained in bio-medical engineering, there are not much problems (1)
- Limited exposure to medical equipment (1)

Specific technical areas:
- Maintenance/ repair of cooling systems (1)
- Lack of knowledge in installation of solar energy systems (1)
- Lack of skills in wiring of electrical motors/generators in general (2) (remark: for technicians in general electrical field only[6])

[6] it needs to be asked why such specific jobs or not subcontracted to private sector enterprises

Non technical areas:

- Financial management is weak (2)
- Supervision is weak (1)
- Planning skills not developed (1)
- Computer skills (1)
- Weak in stock keeping (1)

Remark:
Only a few respondents looked at the "soft skills" of technicians, i.e. competence for supervision of work, workshop management etc.

Artisans:

- Practical skills in general not sufficient (4)
- Lack of multiple skills for general application (not just one specific area) (2)
- Have adequate skills considering their level of training (1)

Remark:
Not all HCTS units employ artisans

7. What could/should be done to overcome these weaknesses?

General issues:

- Organising/ carrying out of short upgrading courses in areas of need i.e. medical equipment maintenance **(12)**
- Management training (including equipment management) for heads of maintenance units (3)
- We need regular training of technicians and artisans in order to keep up with technology (3)
- Training in financial mgt (2)
- Organise short seminars to specific topics (1)
- Fund raising for capacity building measures (1)
- Leaders should be well trained in order to pass their knowledge to other staff (1)

Technical areas:

- Sending staff to further training (long term) in medical equipment maintenance (3)
- Attachment to other HCTS units (3)
- Organise more on-the job training (2)
- Combining theory and practical application (1)
- Collaboration with local technical institutions (1)
- Having (equipment) specific courses (1)
- On-the job training through specialists from private sector (1)

8. Respondent's recommendations of suitable training providers

institutions marked with question mark: no specific information available, needs to be further investigated

For further information see Annex "List of training providers in health care technology"

a) Technical and non technical training/ upgrading of engineers/ technicians in managerial/ supervisory positions:

general:
- business management and accountancy colleges offering short term training
- on the job training and exchange at other HCTS units

country specific:

Ivory Coast:
INPHB for personnel management and electronics

Kenya:
Mombasa Polytechnic, Medical Engineering Department
University of Nairobi, Dept. of Medical Engineering
TICH (Tropical institute for Community Health) for financial management in health sector (?)
Eldoret Hospital Technician Maintenance School

Ghana:
Ghana Institute of Management and Administration
Biomedical Engineering Unit HFC Korle-Bu

Senegal:
Djiourbel, (Dept. Medical Engineering)

Ethiopia:
ATTC Harar

b) Special training in maintenance of medical equipment

Training provided by med. equipment suppliers, e.g.:
- Philips Medical
– Siemens, and others

HCTS units

Some of the training providers mentioned above

c) Skill training and upgrading of artisans:

on the job training by technicians

Vocational Training Centres

d) Internship for engineers and technicians

Equipment suppliers (see above)
Large hospitals (e.g. Kenyatta Hospital Nairobi, Biomedical Dept.

Other HCTS units

e) Experts/specialists for on the job training of engineers and technicians

Equipment suppliers
Staff of medical equipment training schools

Remark:
It was noted that there are significant regional differences. While countries like Kenya or Senegal (not to mention South Africa) appear to have a satisfactory coverage of training providers (although we can not say anything about their actual performance) there are very few or no training providers in many other countries, e.g. in Central Africa, many countries of Western Africa (e.g. anglophone Cameroon), all East African Countries accept Kenya. For training of engineers, most respondents suggest institutions in South Africa, Europe and America (see list in Annex).

9. Any other comments:

- For skill upgrading courses: specific subjects should be chosen,
- Skill upgrading should be organised at regional level,
- Skill upgrading courses should be evaluated,
- Management training should include practical components (budgeting, equipment management) and should be tailor made for the requirements of maintenance unit managers/ supervisors,
- Artisans should best be trained on the job by engineers and technicians who have undergone internship or upgrading,
- HCTS should play a greater role in providing training
- As much as there is need for further training we are faced with the problem of funding
- Our maintenance workshop has taken up its tasks as it should do with young people who have just finished their training. We want to train them by ourselves, this is a better way than looking for people from outside.

Annex III

Overview training facilities/ providers in Health Care Technology

Region	Engineers	Technicians	Artisans
East Africa	Mombasa Polytechnic, Mombasa, **Kenya**, Diploma and Higher Diploma in Medical Engineering, various short term courses on specific technical subjects	Mombasa Polytechnic, Mombasa, **Kenya**, various short term courses on specific technical subjects Hospital Technicians Training School, Dodoma, **Tanzania,** basic and advanced hospital technician courses	Hospital Technicians Training School, Dodoma, **Tanzania,** short courses in general maintenance
South Africa	Swaziland College of Technology, **Swaziland**, National Diploma in Medical Engineering, 12 months University of Cape Town, Cape Town, **South Africa**, post graduate diploma in health care technology management Technikon Pretoria, School of Electronic Engineering, Pretoria, **South Africa**, Electronic engineering with option of clinical engineering	Swaziland College of Technology, **Swaziland**, Hospital Technician Certificate, 18 months	n/a
West Africa		Centre National de Formation de Techniciens en Maintenance Hospitaliere, Djourbel, **Senegal** - Hospital Technician Certificate HTU, Presbyterian Church of Ghana, **Ghana**, short courses on management and maintenance of hospital equipment	Health Technical Unit, Presbyterian Church of Ghana, **Ghana**, short courses on maintenance of basic hospital equipment

Europe	St. Bartholomew's Medical College, London, **UK**, post graduate diploma in medical electronics and medical equipment management Glasgow Caledonian University, **UK**, Degree in Medical Physics Technology	West of Scotland Health Boards, Glasgow, **UK**, course in medical equipment maintenance Institute International Superieur de Formation des Cadres de Sante, Lyon, **France**, Medical Technician Certificate Technology Transfer Marburg, **Germany,** internship program for hospital technicians	