THE FRONTLINE HOSPITAL

Philip Mein*

CONTENTS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>Page 194</td>
</tr>
<tr>
<td>2. The setting.</td>
<td>Page 194</td>
</tr>
<tr>
<td>3. Project briefing</td>
<td>Page 196</td>
</tr>
<tr>
<td>4. Project feasibility</td>
<td>Page 198</td>
</tr>
<tr>
<td>5. Site selection</td>
<td>Page 200</td>
</tr>
<tr>
<td>6. Site planning</td>
<td>Page 201</td>
</tr>
<tr>
<td>7. Schematic plans</td>
<td>Page 204</td>
</tr>
<tr>
<td>8. Summary</td>
<td>Page 208</td>
</tr>
<tr>
<td>9. References</td>
<td>Page 208</td>
</tr>
</tbody>
</table>

*Director-General, International Hospital Federation, London, England.
1. INTRODUCTION

The perceived role of the frontline hospital has changed in recent years in concert with developing theories on the efficacy of health delivery systems. Indeed the name itself has changed, at least in planning circles, so that traditional facilities, whether they be district hospitals, cottage hospitals, or mission hospitals, can be grouped uncontroversially together under their common characteristic of being in the forefront of health care delivery.

The traditional role of the rural hospital has been that of the farthest outpost for organized health care to which the sick were expected to come. The modern concept of the frontline hospital is that of a facility where some activities take place that could not be conveniently performed at another level or in different settings. The most immediate are those that require apparatus or special environments not available elsewhere, or specialized staff who are not available in such quantity that their time can be lost in travelling; thus the services provided in the frontline hospital most often include radiology, surgery, surgical obstetrics, ear-nose-and-throat, and the like.

The use of the frontline hospital as a centre for outreach and primary health care serving community health needs within its catchment area is open to debate. It is to be feared that the scarce funds and drugs available may be used by the hospital to the detriment of more peripheral health care and also that the patients, impressed by the hospital setting, will clutter it up hopelessly while the primary health care facilities will be left underused, both these factors reinforcing each other. It is thus better to keep primary health care services and hospital services under different heads, although it is imperative that they collaborate to the utmost. However, owing to long-established administrative patterns or to lack of the necessary supervisory staff, this dual system may not be possible everywhere. It will then be a very important duty of the higher echelons to ensure that these two main inconveniences of a hospital-centred system are kept to a tolerable level. Surprisingly perhaps, this change in health system roles has not generally had much effect on the physical requirements and characteristics of the small hospital, and indeed it may well be that the well-designed traditional hospital can, where physical facilities are concerned, take in its stride the functional changes it is required to make. One should be very cautious when devising radical new designs specifically to satisfy the new criteria demanded by health systems based on the primary health care concept, as they could themselves prove inappropriate or might be incapable of adapting to future requirements of the health system, as yet unknown.

Since this paper deals more with the physical realities of health care facilities than with the social and organizational realities of health delivery systems, it may not be over-indulgent to base it on a maxim derived from architectural theory, namely "long life, low energy, loose fit", which embodies the essence of appropriateness in building, whether in the highly developed or developing world. Thus the theme running through this paper will be that health facilities should, as far as possible, be designed to last a long time, rely mainly (if not completely) on energies readily available locally, and be generic enough in their layout to avoid the need for remodelling as functional requirements change in the future.

2. THE SETTING

The frontline hospital has for many years epitomized "health care" to rural populations throughout the world. As the primary health care concept strengthens, it is expected that preconceptions associating the quality of health care with the size of facilities will be modified and that the role of the hospital will consequently change to that of a lively supportive facility complementing a range of community-based health care programmes. Nevertheless, the frontline hospital will retain an important position in the health care system by continuing to act as a link in the referral chain as patients move inwards towards the centres of expertise.
This being so, the type of location in which new frontline hospitals will be required should not be very different from that in which such hospitals have been found in the past. Indeed it is probable that the attention of the architect and health planner will be directed towards an existing building rather than towards a completely new facility. As a rule, such hospitals are in a rural setting, probably near a village of some local importance. The economy of the area will be based primarily upon subsistence farming with an insignificant cash flow, which means that there will be virtually no locally available capital. Material resources such as timber and burnt bricks can sometimes be counted upon, but otherwise most building items will have to be transported from the nearest regional centre. Road communications usually exist, but they are often poor and not necessarily available all the year round. No generalization can be made about the geographical situation; as regards climate, however, heat is more often a problem than cold and it will rarely be possible to count on a constant year-round supply of water. This, then, realistically considered, is the situation facing anyone hoping to develop a viable frontline hospital.

The above-mentioned difficulties associated with building projects in developing areas have been treated in detail elsewhere. The important question here is what effect they should have on the physical planning process. It should by now be generally accepted that hospitals do not make a health system and, more particularly, that hospital buildings do not make people healthier. Thus without going over the well-documented arguments for community-based primary health care, it is clear that the construction of buildings should be proposed only after all other avenues have been explored, especially since the problems of finance, manpower, and logistics so frequent in building would be perpetuated and multiplied over the years of operation.

The argument that primary health activities offer so much more value for money, manpower, and materials has indeed become so persuasive that it is growing increasingly difficult to support building projects in the health sector, particularly projects for any type of hospital. However, it would be wrong to imagine that primary health care can exist in a medical vacuum. There is no doubt that very strong measures should be taken to keep out of the hospital all patients for whom hospitalization is not crucial, and to keep out of the outpatient department all patients whose condition does not warrant the use of the facilities and skills available in a hospital. For the system to function well, it is necessary to be very strict about referring, except in obvious emergencies, any patients not referred from the lower level. As it would be inhuman to send patients home without an examination when they have come a long way, a primary health care facility, similar to that they would find at home, should be available to them near the hospital. From there, they may of course be referred to the hospital if their condition warrants it.

It is thus clear that, should all the minor cases that usually clutter up the hospital (to receive attention which, because of the gross overwork this influx creates, may well be of a quality inferior to that they would have received at primary health care level) be treated at the proper level, the tasks of the hospital would change dramatically. It would provide medical care of a high quality, but restricted to those for whom it was crucial. It could also provide such care, depending, of course, on geographical factors and the state of communications, to an area greater than was previously the case, thus reducing the number of hospitals needed.

On the other hand, it is imperative for primary health care to be supported by the frontline hospital. If the primary health worker does not have the possibility of referring cases that are beyond his competence, he will either lose prestige by doing nothing or overstep the limits of his capacities, with tragic results. In both cases, the whole primary health care system may well lose its credibility in the eyes of the community concerned.

For the purposes of this paper, then, it will be assumed that frontline hospitals will continue to be built and extended and that, although this process should be carried out with a maximum of local involvement, they will usually be developed within a formal framework involving the professional skills of both health planners and architects. For the sake of clarity, the planning and construction of a completely new hospital will be used as a basis, although it is of course realized that additions to existing facilities are often more practical and relevant.
3. PROJECT BRIEFING

With the publication in 1976 of the first volume in the present series (1), a step forward was taken in providing relevant guidelines for the provision of health care facilities in developing areas. Experienced practitioners and theorists have, in the ensuing volumes, addressed themselves to questions which had previously not been documented. Consequently, there now exists a sound basis from which suitable project planning systems can be developed. The aim here will be to see how these systems can be made to function in relation to the frontline hospital.

Before settling down to write a brief, it should first be decided whether the construction of new buildings is the appropriate response to the medical needs that have been established. It is often tempting to see the solution to a medical problem in the tangible form of bricks and mortar rather than in the reorganization of existing facilities, methods, or manpower. The latter may, however, offer an equally good solution for much less expenditure in time and money. The consequences of an overeager attitude to building can be seen in many places where buildings that are old but sound are made redundant by new ones, and where even new buildings go unused owing to a lack of staff, money, or even patients.

An inventory of the existing space and its use should be made to see whether, for example, a new facility can be accommodated by simply reorganizing and consolidating existing ones. Sometimes a combination of renovation, conversion, and new construction is the correct approach, particularly when extending an old facility. For example, if, say, an X-ray unit is to be added to a hospital, it may be sensible to convert an inadequate, poorly lit, operating theatre for X-ray use and build a new theatre to a higher standard elsewhere.

Another question that ought to be answered before proceeding with the expansion of existing facilities is whether the additional buildings might be better located away from the existing ones in a place where they can serve another part of the catchment area more effectively. There is a natural tendency for established services to grow, even after their optimum size has been reached, whereas mobile units or outlying dispensaries may provide a more suitable alternative.

If it is decided that building a new facility is indeed the appropriate course to follow, a detailed brief should be made. This should define the overall goals of the facility as well as the detailed requirements. The whole briefing exercise may be pre-empted by the existence of a "standard design", of which more will be said later. On the other hand, a standard brief or programme may be used effectively as a basis for detailed programming.

In view of the inevitable shortage of professional manpower, it is unrealistic and indeed undesirable to define the requirements for each individual health building project from scratch. Each design should nevertheless respond as much as possible to local variations in needs, climate, and building methods. Probably the ideal compromise is to develop a standard performance brief or programme. Such a brief can be prepared for each functional unit within the health delivery system, using the best possible data and personnel chosen on a multisectoral basis from both central and regional pools.

The standard performance brief should describe in detail the range of services that the facility will be expected to provide, no matter whether it is located in a densely or sparsely populated area. It should show diagrammatically how those services relate to one another for patients/clients and staff. The amount of service required should be worked out on the basis of data on the catchment area, including epidemiological factors, size, and population density, taking into account the extent to which the available financial and manpower resources will allow needs to be met. This will give the number of patients/clients to be catered for and consequently the number of staff required, thus permitting the size of waiting areas, service areas, and inpatient facilities to be determined. A good standard performance brief might even include diagrammatic layouts of the relevant spaces with dimensions for planning purposes.
Such a standard brief should be placed in the hands of a project planning team composed of all those with a legitimate interest in the scheme; the members of this team should have clearly defined responsibilities. The team should be retained for the duration of the project and be responsible for its implementation; it should be small but, if possible, include the following:

- the medical officer of health
- the senior nursing officer
- a hospital administrator
- a member of the local administration
- a representative of the local population.

In addition, building professionals will be involved, preferably from the regional level.

It is hardly original to propose that a project planning team should have a strong local bias in view of the value of local knowledge. Here, the recommendation stems from the fact that the project team will have to make some fundamental decisions concerning the location, size, and constructional standard of the facility. Poor decisions on these factors have contributed more than anything else to the vast number of inappropriate projects that have been constructed in recent years.

Sophisticated systems analysis and the long-range planning of health services will be of little avail if:

(a) facilities are put in the wrong place, owing to pressures which cannot be countered for lack of solid health expertise locally;

(b) facilities are oversized because of the notion that a hospital is a hospital regardless of population density and health needs;

(c) facilities are built to urban or even international standards of construction and accordingly prove both difficult to build and impossible to maintain.

For the project planning team to function effectively, it must include, or be able to draw upon, architectural expertise. Care should be exercised, however, in selecting an architect. Preferably the choice should fall on one who has previous experience of designing medical buildings for rural areas and who sympathizes with the need to achieve an acceptable solution at a minimum cost. Even architects with experience in medical buildings generally may be used to designing within budgets more generous than those affordable in rural areas and thus may find it difficult to design cheaply. Furthermore, the method of calculating architects' fees, based upon a percentage of the total contract cost, is hardly an incentive to stringent economy. The need for caution in these respects might be underlined whenever the services of international consultant architects and engineers are being considered.

Probably the best solution is to have architects and engineers working either as a special health group in the Ministry of Works (or its equivalent) or as an implementation group within the Ministry of Health. Such a group furnished with good basic data (e.g., a health atlas) and a range of facility performance briefs can produce appropriate designs in an efficient manner. It would be preferable to have such groups at the regional level, although initially it may only be feasible at the national level.
4. PROJECT FEASIBILITY

The first and most critical exercise in facility development is the establishment of the economic feasibility of the project. For this, a provisional estimate should be made which can be compared with the funds available. Here, three pieces of information are needed. One is the amount of building required to meet the functional needs of users and staff, the second is the constructional standards that will be used, and the third is an estimate of the running costs of the facility. The first step, then, is to assess the total floor area needed.

Although there are many factors that determine the size of a hospital, the most telling is the number of inpatients and outpatients who will use the facility. Here, it is assumed that this will have been established from demographic and epidemiological statistics for the area.

In the case of additions to existing facilities, a preliminary design can be worked out, using either standard designs or rough sketch designs, and an approximate floor area arrived at. Where a new hospital is proposed, it is impractical to work out the whole design at the feasibility stage merely in order to arrive at an approximate building area. Fortunately, it is possible to use a rule of thumb, based upon the number of beds required, to obtain a sufficiently accurate estimate of floor area for the purpose of provisional costing.

Although the area taken up by each bed is somewhat less than 2 m\(^2\), the total area required in a ward, where space must be allowed around each bed for nursing and general circulation, amounts to about 6 m\(^2\). For each nursing unit of 20-30 beds, other facilities such as toilets and showers, duty room, examination room, and storage must be included, bringing the total floor area per bed required in the inpatient department to 8 m\(^2\). When other essential items, both medical (laboratory, theatre, X-ray, etc.) and nonmedical (kitchen, laundry, central stores, etc.), relating to inpatients are added, the area per bed doubles to around 17 m\(^2\). Finally, the outpatient department will require 50-70 m\(^2\) per 100 patients per day which, as the size of the outpatient department is more or less proportional to the number of beds in the hospital, brings the total floor area required per bed to approximately 20 m\(^2\).

The figure of 20 m\(^2\) is an average based on surveys of a number of hospitals, taking into account the adequacy of their facilities. It assumes a hospital of around 120 beds with an outpatient department dealing with up to 400 patients/clients a day. For a smaller hospital of, say, 60 beds, the area per bed will increase to some 23 m\(^2\), because the size of common facilities cannot be scaled down in direct proportion to the number of beds. The converse is also true in that a larger hospital of, say, 240 beds should require nearer 18 m\(^2\) per bed.

The above figures will vary according to the situation and the particular facilities provided, but in practice they should be accurate within a tolerance of ±10%. The total area arrived at should be used only for estimation purposes. When detailed design is undertaken, it ought to be possible to reduce the area by careful planning. Staff housing is not considered in the above estimates, but it should be borne in mind that this essential item can account for up to 30% of the total building budget.

The next question is that of the kind of construction that should be used. In Medical Care in Developing Countries (2) Maurice King puts the case for minimizing the capital expenditure on buildings most forcefully, saying: "Patients should be treated ... in the smallest, cheapest, most humbly staffed and most simply equipped unit that is capable of looking after them adequately." He also points out that, generally, "there is little relationship between the cost and size of a medical unit and its therapeutic efficiency". An added consideration is that lower-cost buildings using local materials will be more familiar and acceptable to the users. The principle, then, is to build as simply and economically as is consistent with medical standards and cultural acceptability. The best guide to an appropriate type of construction is provided by other buildings in the area - for example, their shape, whether they have flat or pitched roofs, and the materials from which they are made. It is generally true that the further one deviates from the local style of architecture, the more money and time will be used in building.
There is, then, a cardinal principle to be applied in the selection of building materials, namely that local materials should always be preferred to imported ones. The reasons for this should be obvious, but nevertheless are often not appreciated:

- A saving is nearly always to be obtained by using materials and equipment that do not include transport charges or import duty in their price.

- It is sensible to encourage the local economy and employment situation by using goods manufactured locally.

- Local materials have the advantage that they can always be easily maintained or replaced if necessary.

- The use of local materials can lead to a type of architecture that is in harmony with neighbouring buildings.

However, many items needed in even the most simple building, such as cement or roofing timbers, may not be locally produced. In addition, there is the commonly held attitude that certain materials (ceramic tiles, PVC floors, etc.) are "suitable" for medical buildings, whereas others (fair-faced blockwork, concrete floors, etc.) are not. Where resources are extremely limited, this attitude must change.

To begin with, it is neither necessary nor desirable for all medical buildings to be built to the same standard; in fact, some - including relatives' shelters, self-care wards, and waiting areas - need satisfy only the basic requirements of soundness, durability, and shelter from the elements. From this basic level of building, a range of construction types of a higher standard can be worked out to suit the function of each hospital building. If this is done, following the rule that any higher standard can only be justified if it leads to the possibility of a higher level of medical care, then each building will be only of the standard that it needs to be and the best use will be made of the money and materials available.

Once the range of construction types has been agreed on, a unit cost in square metres must be determined. This will vary from place to place, but an approximate figure can usually be obtained by studying the figures for other local buildings, or statistics kept by the Ministry of Works. By multiplying the approximate area (obtained from the number of beds and outpatients) by the unit cost, a total construction cost can be arrived at. To this, the following items must be added, in order to arrive at a total project cost.

- 15-20% for site development;
- 15-20% for furniture and fittings;
- 10% for contingencies;
- an amount for professional fees;
- the cost of the site.

In some cases, materials, labour, or land may be donated; if so, their value should be assessed and deducted from the total. The above figures do not cover medical equipment and supplies. This item now represents the total capital cost and can be compared with the available budget to establish the economic feasibility of the project.

One way of cutting initial capital costs is to phase development over a number of years; this may in any case be rendered necessary, by a shortage of materials or labour. The disadvantage is that, with inflation even at the low rate of 10% over, say, a 10-year period, the cost per m² for the last buildings to be erected will be more than twice that for the first.
A further argument against phasing, particularly for projects located in remote areas, is that much of the cost of building is related to the logistics of getting materials and labour into the field (the contractor's overhead). It is therefore sensible to build whatever is required for the foreseeable future, even if it means some initial redundancy, if this will avoid having to go out again in, say, five years' time to make additions. In any event, if phased development is decided upon, a plan for the final building is essential at the outset, otherwise confusion is likely to ensue.

5. SITE SELECTION

No limitation in building is so severe as shortage of space; it is therefore essential that any site should be easily capable of providing for all present and future needs. Bearing this in mind - as well as the fact that, for reasons of economy, flexibility, and amenity, the different departments will be fairly well spread out - the site area for, say, a 120-bed hospital and housing should be at least 4 ha (10 acres). It would be quite possible to build in less space, if need be, but, in cases where no cost is involved, such as the allocation of government land for a government hospital, considerably larger areas could be set aside.

The location of medical facilities is vital to their successful operation. They should be sited close to the centre of the population served, preferably near the largest village, and be well connected to the regional communications network. This will not only be convenient for the largest number of patients, but will aid in bridging the commonly experienced gulf between hospital and community. Having stressed the importance of proximity to the community, it should be said that areas emitting noise and pollution, or harbouring disease-carrying insects - for example, factories, main roads, rubbish tips, and stagnant water - must be avoided or, at any rate, kept downwind.

The determination of the size and preferable location of the site will cut down the choices considerably; even so, all possible sites should be further checked against the following considerations.

A hilly site, though invariably more expensive and difficult to develop than others, may provide an opportunity for a more pleasant design, with possibilities of views and good ventilation. Slopes greater than 1:12 are too steep for easy walking, and sites on top of hills should be avoided. Good ground-cover is a great asset, for, apart from enhancing the visual and thermal environment, it is a good indication of the prospects for a future hospital garden.

In hot areas, slopes facing north or south attract less solar radiation and are therefore desirable; more important, they facilitate the orientation of buildings to face north and south. In hot, humid areas, however, it will be more important to catch the breeze. In highland areas, a slope that catches the early morning sun is welcome. Where the nights are cold, the bottoms of valleys or depressions should be avoided, if possible, as they are the coldest areas of all. In arid areas, exposed sites are to be avoided because of the nuisance of dust storms.

A site with good natural drainage will be relatively easy to build upon, will not flood or cause mud-holes, and will be unlikely to harbour insect-breeding grounds. The bearing capacity and stability of the ground will affect the cost of foundations.

Parts of the site with poor subsoil should be avoided. For foundations, the best soil is sand or gravel. Heavy clays are liable to swell dangerously when wet, whereas soft clays may give under load, causing cracking. In very wet areas, fine sand can become "quick" and move under the foundations. Organic soil (peat) is unacceptable for building, and filled land, unless of well-compacted sand or gravel, should be avoided. Rock is good for foundations, but is difficult to remove if the site has to be levelled. Test holes should be dug to a sufficient depth to establish the subsoil conditions and, if any doubts arise as to their suitability, samples should be taken for analysis.
Often utilities are not available. Electricity can be generated and sewage can be treated in septic tanks, but a plentiful supply of good water is imperative. This must be established beyond doubt. A rule of thumb for water supply is that 200 l/hospital bed/day is adequate.

Finally, the legal ownership of the proposed site should be ascertained and a search carried out to ensure that there are no restrictive covenants or other limitations to its development.

6. SITE PLANNING

No two building problems are identical; variables such as needs, topography, and climate, as well as the personalities involved, combine to make any standard solution seem grossly oversimplified. Nevertheless, there are common factors that make it possible to create a system for development.

Hospital planning can be conceived in terms of buildings belonging to a nucleus of medical departments whose relationship to one another is critical, with a periphery of supporting buildings serving the medical functions, the precise location of which is less critical. Even so, the design of the nucleus should not be carried too far without a clear idea of the distribution of the peripheral elements on the site.

The nucleus is composed of five basic elements (Fig. 1):

- The Outpatient/Maternal and Child Health Department, providing general outpatient care, clinic care for mothers and children, and family-planning services.

- Medical services, consisting of diagnostic facilities (generally X-ray, laboratory, and pharmaceutical services).

- The Inpatient Department, consisting of general nursing units, a maternity unit, and several self-care units.

- The Surgical Department, consisting of an operating theatre and possibly a minor theatre and delivery suite (the two latter may be located elsewhere).

Fig. 2 shows the nucleus in greater detail, with diagrammatic connecting lines, which, if translated into physical terms, would be the routes used for the movement of patients, staff, or supplies.

The peripheral facilities are composed primarily of service elements (see Fig. 3).

- Kitchen/laundry to serve the inpatient department.

- A central store for hospital and district supplies, possibly with a garage to accommodate and service a mobile unit.

- Staff housing for both senior and junior hospital staff.

- Shelters for the relatives who accompany inpatients and frequently provide care and food for them. (It may also be the case that self-care facilities are best located in the periphery.)
FIG. 1. NUCLEUS OF HOSPITAL PLAN SHOWING BASIC ELEMENTS

FIG. 2. DETAILS OF BASIC ELEMENTS IN HOSPITAL PLAN
Although the locational requirements of the peripheral buildings are not so stringent, there are some factors to be taken into account in positioning them around the nucleus:

- All buildings have an obvious connexion with at least some part of the nucleus.

- Any function likely to cause air pollution (smoke or smell) should be to the leeward side of the nucleus.

- Most buildings, particularly the garage and main stores, will require vehicular access.

- Staff housing will probably be situated on the most attractive part of the site, but, to provide some off-duty peace and quiet, it should not be too close to the nucleus. Conversely, the noise from staff quarters may be disturbing to patients in the wards.

- Most important of all, peripheral buildings should never be placed in such a way as to restrict the future expansion of the nucleus.

For a successful and workable building, the functional relationships described above must be satisfied. There are, however, other factors, both objective and subjective, that have a considerable impact on the eventual shape of the hospital.

The climatic characteristics of the site must be established, and, if possible, climatic data should be studied and local knowledge tapped. Generally, however, in tropical countries the sun should be excluded, by facing buildings north and south, and any available breeze should be caught, except in highland areas, where some sun penetration might be welcome and where high winds may have an excessive cooling effect. Open arrangements of buildings allow for greater ventilation, but at the same time provide less protection against high winds and dust storms. The converse is true for enclosed arrangements such as courtyards and squares. A sufficiency of natural light is not normally a problem in tropical areas, but generally the faces of buildings requiring light should not be spaced closer together than twice their height.

The problem of sound is usually that of the reduction of noise. Buildings should be spaced 10 m apart for conversational privacy when windows are open. Courtyards are noisy, especially if they have a hard ground surface such as concrete, and parking areas should never be surrounded on three sides by buildings. Soft ground surfaces such as grass absorb sound. External noise sources are best controlled by solid walls, the nearer the source the better. Trees and foliage are fairly poor sound barriers, tending to diminish only high-frequency noises.
The contours of the site will affect the choice of building type. Diffuse arrangements of smaller units are the most adaptable for undulating sites. Longer buildings should run with the contours. Flat sites present fewer building problems, but may need special provisions for drainage.

The layout of buildings should be flexible enough to allow for growth, but extra money should not be spent in anticipation of future expansion (which may not take place and which in any case may not be desirable). It is ideal to allow for the extension of individual buildings by leaving space beyond the gable end of each block and for the addition of further units by setting aside zones for expansion within the master plan. The future growth of the circulation and services networks should also be considered.

The size of buildings should, as far as possible, be standardized in order to reduce costs and allow for future changes in use. This applies particularly to the cross-dimension which, if kept constant, permits standardization of roof construction, whereas the length of the building can be varied incrementally. Simple rectilinear blocks are the easiest, and therefore the cheapest, to construct, although there are other planning and aesthetic criteria that may work against this. As external walls are expensive, small buildings and those with highly articulated facades are more costly per unit area.

The connexion of services such as sewerage and water supply is always expensive. Buildings should therefore be arranged in such a way that these connexions are as short and direct as possible. This applies particularly to those parts of a building, such as toilet blocks and laundries, that consume most water and discharge most waste material. In view of the frequent maintenance required by most services, the main runs should be easily accessible, running, for example, at the side of footpaths or roads and never having to run beneath buildings. Supply services such as water and electricity can sometimes be accommodated in the roof structures of the buildings and covered ways, where they can be very easily maintained.

There are also subjective considerations that are no less important for being a matter of personal choice. A plan consisting of rows of identical blocks may be efficient, but, if it looks like a prison to the occupants, then much of the advantage is lost. The character of the medical unit and its acceptability to both patients and staff are determined by the shape of the buildings and the spaces between them. Outside spaces are important and often have a function and character as clear as those of inside spaces. They should therefore be designed in a deliberate way as "outside rooms", which people will use for working or relaxing in, or even for the temporary storage of furniture while adjacent rooms are being cleaned. Well-defined spaces are more useful and pleasant to be in than spaces that are merely the left-over areas between buildings.

Both the preservation of existing foliage and new planting are of the utmost functional and psychological benefit. Not only is the shade afforded by trees almost always welcome, but more general planting can have an overall cooling effect through the absorption of solar radiation and by evaporative cooling. Trees are also useful for defining outside spaces and providing windbreaks, though care should be taken not to build too close (2-3 m) to existing large trees because of the risk of damage to foundation walls by roots. Good ground-cover reduces unpleasant reflected glare and the nuisance of wind-blown dust. Finally, a vegetable garden, besides providing a reliable source of food, can serve as an outdoor classroom for nutrition education.

7. SCHEMATIC PLANS

The elements composing the nucleus of a typical frontline hospital may be arranged in an infinite number of ways; it is, however, possible to trace most arrangements back to a small group of generic type plans. Three of the most common of these types - dispersed, linear, and rectilinear - are examined here in terms of the following criteria:
- climate and orientation,
- topographical adaptability,
- circulation and planning,
- flexibility and extendibility,
- construction and economics,
- architectural quality.

The dispersed plan, commonly called the "pavilion" type, is found in many existing rural hospitals where generally there has been no shortage of space, and buildings have been added gradually over a number of years. The buildings are typically scattered over the site although Fig. 4 shows a fairly tight arrangement.

FIG. 4. PAVILION-TYPE (DISPERSED) PLAN

This plan is both pleasant and suitable in warm to hot climates. In cold or wet areas, movement between units is difficult unless an extensive network of covered ways and footpaths is installed. The dispersed arrangement is, however, extremely adaptable, allowing buildings to be placed so as to fit in with the terrain and vegetation, and in the correct functional relationship to one another. The dispersed plan is probably the most simple, since it permits different methods of construction to be used according to needs and resources. It is also flexible, in that additions can easily be made. From an architectural standpoint, the environmental quality of this type of plan hinges primarily on the quality of the individual buildings and the natural landscape, since there is little opportunity for creating well-defined outdoor spaces.
The linear plan usually takes the form of a number of blocks, each housing a distinct function, arranged along a circulation spine as shown in Fig. 5. It combines many of the advantages of the pavilion type with a more efficient circulation system. Climatically, the disadvantages are that cross-ventilation can be inhibited if the blocks are too close to one another; also, if the wind blows in the opposite direction, a wind-tunnel effect can be created, causing dust problems. The adaptability of the linear plan to undulating sites is limited, owing to the interconnection of the elements, and it is particularly unsuitable for sites sloping lengthwise along the buildings. On a suitable site, it can accommodate growth easily, through the extension of blocks or the addition of new ones, and it is generally economical from a construction point of view. The spaces between buildings can, by landscaping or the addition of fences or secondary smaller buildings, be turned into attractive outdoor courtyards.

FIG. 5. LINEAR PLAN

One variation on the linear system of planning is to substitute a building for the circulation spine. Such a building would house the shared medical services (X-ray, laboratory, pharmacy, etc.) and possibly the outpatient/maternal and child health services. Other elements, such as the nursing and maternity units and the theatre, would then be connected to the spine building. This can lead to an extremely compact and economical plan. However, there can be problems of overcrowding in the spine. It is unsuitable in hot climates, where all buildings should face north/south.
The most common form of rectilinear planning is the "gridiron", which, in hospital design, is usually composed of separate rectangular blocks positioned in such a way as to form a chequerboard of buildings and open space, with circulation along the coordinates of the grid, as shown in Fig. 6. Environmentally it is one of the most attractive layouts, suitable in various climatic conditions as long as the courtyard spaces are large enough to allow good air circulation. The major disadvantage is that it is a "closed" system, inflexible to growth and change except by the addition of further blocks. The circulation routes then tend to become fairly extensive; however, they can generally be incorporated into the buildings themselves in the form of verandahs. The shape of the buildings is not so much rectangular as square, which can be helpful from the standpoint of interior planning but might give rise to some constructional difficulties if a single span were required across the width of the buildings.

FIG. 6. GRIDIRON PLAN
8. SUMMARY

This brief description of the planning process for a frontline hospital is intended as a guide only: there will be a variety of approaches depending on local conditions. However, certain of the principles raised have universal relevance for the construction of health facilities where resources are limited. In brief, these are:

- The changing role of the frontline hospital should not be allowed to obscure the fact that the small hospital still has a significant role to play and that future, as yet undefined, functional changes will take place necessitating generalized designs that can accommodate those changes.

- The erection of new buildings is not always the appropriate solution to apparent problems with facilities. Often a more relevant course is to adapt existing buildings or to provide community-level primary health care services not based on facilities.

- The development of standardized, though flexible, briefs for hospitals of different sizes is essential, since there will, for some years to come, be a shortage of the professional manpower needed to enable completely individual designs to be produced for each facility. Standardized briefs are infinitely preferable to standard or type plans, which tend to be inflexible and lead to overbuilding.

- Local involvement in the planning process is essential, not only because it provides useful knowledge but primarily because local commitment is the only way of avoiding the construction of inappropriate facilities.

- Architectural expertise must be available within the health system, since very often outside consultants are unable or unwilling, because of the system of payment, to design suitable hospital buildings.

- The type of construction used should be the simplest and most economical that will provide an effective environment for the health tasks to be carried out so that the limited resources available can be stretched to serve as many people as possible.

- Local building materials should always be preferred to imported ones in view of the lower initial cost, greater ease of maintenance, and cultural acceptability.

9. REFERENCES


2. KING, M., Medical care in developing countries. A primer on the medicine of poverty and a symposium from Makerere, Nairobi, Oxford University Press, 1966
EDUCATION FOR PLANNING AND DESIGN OF HEALTH CARE FACILITIES

Raymond Moss

Over the last twenty years or so, a considerable number of short courses have been held on the planning and design of healthcare facilities. But, in spite of an accumulation of experience over the years, in both the theoretical and practical aspects, there is some evidence to suggest that the commonly held "short courses" may have hindered rather than helped the cause of multiprofessional collaboration and identification of common problems. In fact, it could be held that the early short courses actually strengthened professional separation instead of blurring the edges of traditional professional boundaries, which was their purpose. Only comparatively recently, with the recognition that training for planning has two levels, have the longer, more carefully structured courses begun to show signs of success in improving both collaboration and the quality of decision-making.

At the time of the early multiprofessional short courses back in the 1950s and 1960s, it was not appreciated fully that it was not sufficient merely to bring the disciplines together in order to achieve collaboration. What is submitted here is that it is necessary to weave together the various skills represented into a new discipline which might be called the "interskill" of planning. To provide a basis for further discussion, this paper attempts to identify some of the characteristics desirable in planners and tentatively to suggest a basis for the development of an education and training programme.

For the most part the people serving on a planning and design project team (i.e., responsible for a particular project) ¹ have learned their trade by practising it, carrying forward with them, so to speak, a vivid impression of the last job in terms of the particular sort of professional education and experience they happen to have received. Now it may be true that the most effective way of educating the members of the planning team is for them to teach each other in a real-life situation, but this implies some basis from which a sympathetic approach to, and an understanding of, the problems of the others involved can be developed, a willingness to attempt to evaluate jointly previous work, and a continuity of association over a number of years. Unfortunately, such conditions rarely exist. All too often, planning and design project team members come together with the prime purpose of putting forward their own "professional" viewpoints, e.g., doctors act as mouthpieces for their specialist colleagues apropos of the particular subject under discussion; architects are concerned either with the aesthetic quality of the environment they are creating, or with perpetuating their traditional "leadership" role; engineers frequently separate engineering from building as a result of their concern to maintain their separate but equal status vis-à-vis architects; quantity surveyors, where they are present at all, concern themselves with controlling costs, frequently in a way that, while valid to them, appears to others to be contrary to the principle of "true value for money"; administrators, lacking the skills for design evaluation that would enable them to control the quality of the project, concern themselves primarily with keeping to the book, where one exists, and attempting to deliver the goods on time; and, in places where they are allowed to have their say at all, nurses - who perhaps more than any other members of the team represent the views of the widest range of user needs - in certain circumstances appear to be too concerned with what they see as the low status of nurses and their lack of qualifications even to understand what planning is all about.

On the other hand, all these professions have legitimate and constructive contributions to make to the planning and design processes. However, in the production of a design, the bridging of the gaps between the areas of professional responsibility is more important than narrow professional knowledge itself, if the final result is to represent a successful synthesis of the many, often conflicting requirements. Bridging these gaps appears to be a question largely of establishing a common technical language as a vehicle for understanding and finally defining common objectives. Without this common language, it is not possible to understand fully, and thus approach sympathetically, the problems of one's collaborators.

¹ See: MOSS, R. The planning team and planning organization machinery.
In a general way, understanding of the problems arising in health care facility design has grown considerably in the last decade and particularly since multiprofessional research into the management and design of health care facilities has been taken seriously by governments, and the results of such research have been published on a regular and orderly basis. For instance, there is now a greater understanding of the hospital as a whole and what makes it work efficiently. We know more about the design of departments and spaces, not only from the point of view of the hospital as a whole, but also from that of the user, and there are the beginnings of an ordered body of knowledge about the subject. But, if some progress has been made and there are considerably more data to draw on, it may well be asked why the task of planning and designing health care facilities has not become easier nor the results significantly better.

The answer is not easy to find, and indeed there are many possible answers. The problem of the use and meaning of words can be easily identified, but perhaps a more fundamental cause of the widening gap between professions is increasing specialization. Indeed, planning and design teams are quite often pulled apart by increasing specialization and the use of jargon as a form of shorthand that goes with it. In fact, one editorial group preparing a glossary of hospital planning terms found that some words were not capable of an agreed interdisciplinary interpretation. Indeed, with the increasing sophistication of planning and design concepts, the problem of language has become worse rather than better over the last few years.

On the other hand, despite our growing knowledge of the whole hospital, a further result of specialization is concentration of the design effort on the "department" rather than on the whole hospital at far too early a stage in the process. This "subordination of the whole to the part" has been supported and even encouraged by the types of short course and officially produced guidance material on hospital design problems that have taken some particular department as the central theme.

But perhaps even more serious is the destruction of any frame of reference or design method that might have emerged if the members of the planning and design teams had been orientated in the same direction by means of a common identification of goals and tasks. Because the team cannot define common problems and procedures, the frame of reference disintegrates and subsequently complicates the moving back and forth, proposing and testing, that "planning" or "designing" involves. The result is that people who are supposed to be collaborators arrive at positions where they are actually opposing rather than supporting one another.

Team fragmentation and the current philosophy of "learning by doing" have denied planning-team members the opportunity to discover as much as they should about each other, the real needs of users, or the interactions between the closely woven patterns of activities that occur in a health care facility. Learning by doing has become merely doing. There appears to be little hope of this situation being halted, let alone reversed, until a fully structured educational programme exists, through which all members of planning and design project teams can pass.

The potential element of conflict is not, however, the same for all the professions involved. Doctors and nurses on planning teams are responsible for the quality of both patient care and the therapeutic environment. Hence, the users of health buildings identify architects and engineers as being the people who provide the plant that they use every day and consequently hold them responsible for failure in any particular. As a result of their continuing responsibility, architects and engineers, and to a lesser extent doctors and nurses, involved in planning have developed certain common fields of interest such as user satisfaction, ease and cost of maintenance, and environmental quality. Professional pride also plays an important part. Doctors, nurses, architects, and engineers conceive the design, and the architects, engineers, and constructors bring it into being. They tend to show the finished product to their friends and relatives from a number of different viewpoints according to their audience. Consequently they may feel pride, shame, or both, but their responsibility for the whole thing remains.
On the other hand, the quantity surveyor or building economist sees his role as being to secure what he calls "value for money" and no one would disagree with this aim. The questions that arise immediately are: what does he consider to be "value" and by what means does he set about achieving it in a way that he considers "economical"? The methods employed are a natural end-product of a combination of his professional education, the disintegration of a recognizable multiprofessional operational framework (referred to earlier), and the excessive expectations on the part of administrators who have been seduced by an inadequate and oversimplified concept of cost control.

All too often, the task of the quantity surveyor or building economist has become cost "control" in the shallowest sense of the word. The field he is expected to cover, i.e., building economics, cost planning, performance specifications, and the making of balanced economies in terms of space, performance, and maintenance require a width and depth of knowledge that can only be achieved fully in a very sympathetic team situation, with full discussion of every aspect. This is not intended as a criticism of quantity surveyors but as an analysis of a situation that develops all too frequently. One of the most serious outcomes of the resultant conflict is that operational function and the design that is intended to serve it are being pulled progressively apart, and hospital design and operational efficiency suffer accordingly.

The administrator is frequently cast in the role of manager for the whole, or part, of the overall design and building process, and his lack of knowledge of the design component often results in misunderstanding and the risk of friction. In many ways, the administrator in planning and design demonstrates the same characteristics as the quantity surveyor, and it is interesting to note that the administrator's training, like the quantity surveyor's, has not traditionally concerned itself with either user-requirement investigation or "the design process" as understood by the design disciplines. Happily, however, a number of centres responsible for the training of health service administrators are now correcting this deficiency.

The administrator "holds the ring" but, at the same time, does not necessarily understand the tasks of his collaborators and, although this may happen in other professions too, it can be seen that the quantity surveyor and the administrator are involved in the project in ways that have no direct, easily apparent consequences for the user of the building which has resulted from their efforts. This makes it less likely that they will identify with the project, either in the same way, or for as long, as their colleagues. Hence a psychological factor operates that encourages the fragmentation of the team.

In brief, some of the problems may be identified as follows:

(a) because planning is a multiprofessional exercise, in the process of planning the gaps between different kinds of professional knowledge become more important than that knowledge itself;

(b) because planning teams lack a common language, they are incapable of adequately defining their common objectives;

(c) because of (a) and (b), a hierarchy of words and meanings and the frame of reference that goes with them have disintegrated; and

(d) as a result, function and design have become so divorced that function-based planning and meaningful objective evaluation have become increasingly difficult.

The gaps between the various design team professions could be filled in part by a common language, in part by a knowledge of the planning and design process, in part by theoretical exercises, and in part by practical experience. But the last should come last, whereas in the majority of cases it has come first. Short courses of the kind that have been run in the past cannot reasonably be expected to bridge these gaps. It takes some time even to gain a nodding acquaintance with the skills involved in problem definition and operations research, and topics such as the methodical collection, sifting, storing, and application of data have hardly been touched on. And yet a major hospital project, for example, generates such an enormous amount of information that the lack of an agreed classification system before the project starts is a sure guarantee of chaos.
The teaching of multiprofessional groups is referred to as "cross-fertile teaching" and, even though it is still in its infancy, some principles are apparently becoming recognized. First, the courses, where they do exist, are wide in scope and can be compared with urban design in relation to architecture, i.e., buildings are involved, but not the design of the buildings. Secondly, they are at postgraduate level and are concerned with producing teams of people who have received their undergraduate training in different disciplines; and, thirdly, they are concerned with evolving a "theory" for a subject, where none had existed previously.

All cross-fertile courses take a problem of great importance, e.g., planning of management, and use it as a focus for teaching and learning, but grave risks appear to be inherent in departing from the more well-worn academic channels. Unlike that of algebra or chemistry, the subject matter itself remains undefined and without validation.

For the exploration of the problems of education and training involved, the following basic structure can be proposed:

1. There should be a central theme or core, and, in the case of planning of health care facilities, it is suggested that this should be some systematic investigatory method that all disciplines can understand and contribute to.

2. Methodologies should be developed by students and teachers working in collaboration.

3. The interrelationship between the parts and the whole should be stressed continually and clearly understood by all parties to the process. And, equally important, an understanding of the interaction between operational objectives on the one hand and design implications on the other is basic to any interpretation of the context within which planners work.

4. Course content should be capable of modification, either immediately or in the long term, and there should be regular "feedback" from past students.

5. Fluidity of working should be maintained without damaging the internal cohesion of the group.

6. To try to balance theory and practice, a close association with research and development in the real world should be maintained.

So far, so good, but what is happening in the world, where are courses for planners being attempted, what is their structure, and what is being achieved? In fact, the current world situation in this area is very difficult to assess as, to the author's knowledge, it has never been the subject of a survey. The centres that are mentioned in this paper are those that the author has contacted personally during his work in the area of health facilities planning, research, and teaching, and sincere apologies are due to any that have been omitted. Perhaps one very useful task that could be undertaken by the World Health Organization is the sponsorship of such a survey so that some order could be introduced into a situation that is both confusing and uncharted. In this very brief review, government research and development centres are not included. In the context of this paper, these centres are seen as being part of the machinery of central government, as distinct from academic institutions with easy and equal access for all students, a structured course of teaching and research, and some recognized qualification at the end of it all.

In the USA for example, a number of centres have been set up over the years, but only two seem to have survived the rigours of time and funding in this highly uncertain area of educational endeavour. Perhaps the best known is at Columbia University, New York, where a joint programme between the schools of Architecture and Public Health concentrates on the problems of hospital planning and design. An M.Sc. is awarded at the end of the one-year course, which concentrates heavily on the physical planning aspects of the building itself. The techniques of construction in such areas as designing for particular environments and the adaptability demands of flexibility are the focus of a course at Texas A & M University. This
course, which has a wide variety of overseas experience and connections to draw on, has, over the years, produced some very ingenious design and construction solutions to particular health care problems.

In Europe, the Institute for Hospital Building at the Technical University of West Berlin carries out research projects in both health care delivery and health facility planning, along with a teaching programme in health facility planning. However, the teaching component is offered as a specialist option for those taking the normal undergraduate architectural course rather than being a self-contained, postgraduate, multiprofessional specialist programme. The same approach has been developed in recent years in Düsseldorf, where a hospital institute also serves as headquarters for the Public Health Group of the International Union of Architects.

Poland has a Department of Hospital Construction Theory, directed by a professor. In this department, research is carried out and, during each year, three or four short courses of one week's duration are held in health facility planning and building.

The Belgian centre in Louvain serves not only Belgium but also many developing countries in the field of facilities planning and design.

A recent development has been the establishment of centres for training in health facilities planning and design for a region or group of countries. Examples are the Manila Centre serving the whole Western Pacific area, and the centre in Caracas, Venezuela, serving a group of Andean countries.

However, the course that is perhaps most convenient for discussion and best known to the author is the one-year postgraduate course in health care facility planning at the Medical Architecture Research Unit, London, which is based on the principles discussed earlier in this paper. This course, which shares accommodation with, and is run alongside, a full-time multiprofessional research group on health facilities, is unique in a number of ways. First, it is the oldest course of its type; second, it gives either a postgraduate diploma or a master's degree, depending on the particular option followed by the student; and third, it is fully multidisciplinary as regards both students and staff. But its most distinctive characteristic is that it concentrates on health care organizations, how they grow and change, the relationships between them and the buildings they occupy both now and over periods of time, and what is the most effective and economical way of accommodating those organizations. In a word, the course is problem-centred and thus not rooted in any particular technology or cultural framework, with the result that, to date, students from some 40 countries (mainly developing ones) have taken it.

Briefly, the aim of the course can be summarized as follows:

(a) to encourage students to think of providing health care facilities as a system rather than as a random collection of facilities;

(b) to encourage students to rethink and, if necessary, restructure the complex multiprofessional activities making up what is known as the planning and design process of health care buildings;

(c) to illuminate the connections between operation and design in terms of professional input, and to demonstrate the importance of team work in briefing and evaluation;

(d) to encourage students to take an overview of both the problems and the possibilities in the design of health facilities such as indeterminacy, flexibility, multiuse, value for money, etc.;

(e) to provide students with the opportunity of demonstrating their theoretical understanding of the subjects, in addition to acquiring practical skills and techniques, and also to provide, through the dissertation element of the course, a foundation for future research involvement.
The central theme of the curriculum for the first two terms is the development and application of a methodology, which is employed throughout the course for assessing user needs and for the development of processes by which these needs can be translated accurately and economically into appropriate physical forms. This method of working, which has been developed over a period of 15 years or so in research and development exercises on a wide range of health buildings, provides a basic classification system which students are encouraged to use.

The taught syllabus is organized and presented under the following main subject headings:

- Health service organization
- The nature of health care planning
- Operational policies and design implications
- Investigation for briefing
- The design and building process

Lectures on various aspects of each subject are grouped together and associated with practical exercises, field visits, and seminars, in such a way as to emphasize, in the case of each topic under study, the theory underlying the practice.

The final section of the course is devoted to the preparation of a dissertation of some 15,000 words, in which the student is expected to apply the theoretical knowledge acquired during the two preceding terms. By the middle of the spring term, the student will have obtained the approval of tutors and external examiners of a chosen dissertation subject, indicating possible lines of development in the form of a preliminary synopsis. During the third and fourth terms, supervision is undertaken by the course tutorial staff who also indicate the availability of specialist advisers, buildings, and references in the appropriate subject areas. The choice of subject is left to the student, but it is expected to relate closely to the general content and philosophy of the course. The completed dissertations are submitted for reading to the external examiners in time for the final oral examinations in the last week of the course at the end of September.

Table 1 shows the detailed relationship and overall time sequences of the two courses. It indicates how the MA course is linked to the Diploma course in the first and second terms (taught components). Thereafter, candidates for the MA degree take written examinations during the early part of the third term and devote the remainder of the third term and the whole of the fourth to the dissertation for examination in September.

Table 2 shows the structure of the course and outlines the content of the taught syllabus.

The following teaching methods are employed: lectures, seminars, visits, practical projects, tutorials, and dissertation supervision. Lectures are given by the course staff, research staff, and visiting lecturers; at the end of each week the lecture content of the week is discussed at a seminar. The seminars have a threefold function. First, they are used to assess the students' understanding of lecture content and to deal with any difficulties. Secondly, on completion of a practical project, the students present their work, either individually or in groups, to a jury; this presentation takes the form of a seminar in which members of the jury discuss the project work with the students and assess their progress. Thirdly, this seminar is used to monitor students' reactions to the course and to discuss with them their impressions of various aspects of the course's content. Visits are programmed during the first and second terms and deal with planning at both "macro" and "micro" levels. At the "macro" level, visits are made for the study of whole towns and whole buildings, and of the effect of total hospital policies on layout and design, while, at the "micro" level, details of individual activities are studied.

Students are involved in a programme of both individual and group projects, and in all cases receive individual tutorials from the various tutorial disciplines. In the case of group projects, tutorials frequently involve more than one discipline. One example of this is the Hospital Development Plan where the tutorial group includes the architect, doctor, and nurse planning tutors, each contributing to the discussion of the problems of the project.
<table>
<thead>
<tr>
<th>Term</th>
<th>Time</th>
<th>Subject</th>
<th>Principal lecture groups</th>
<th>Major practical projects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Health service organization</td>
<td>Health services in the United Kingdom</td>
<td>1. Dissertation on a national health service model (individual project)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Health services in other European countries</td>
<td></td>
</tr>
<tr>
<td>first</td>
<td>3 weeks</td>
<td></td>
<td>The role and organization of planning teams</td>
<td></td>
</tr>
<tr>
<td>6 weeks</td>
<td></td>
<td>2. The nature of health care planning</td>
<td>Changes in demand for medical care</td>
<td>2. Case study of a given community health service model (group project)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Allocation of resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The nature of communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Location of health care facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Components of the health system</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Recognizable subsystems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Approaches to planning complex systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Multistrategy and single-strategy planning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Principles of indeterminate planning</td>
<td></td>
</tr>
<tr>
<td>second</td>
<td>2 weeks</td>
<td>3. Operational policies and design implications</td>
<td>Operational policies at the various levels</td>
<td>3. Graphic essay on an approved theme (individual project)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Design implications at the various levels of the health service system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 weeks</td>
<td></td>
<td>The design brief</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The organization of data</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Handling the data</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>An introduction to mathematical techniques and operations research in planning and design</td>
<td></td>
</tr>
<tr>
<td>third</td>
<td>3 weeks</td>
<td>4. Investigation for briefing</td>
<td>A comparison of various methods</td>
<td>4. Whole hospital development plan and operational policies (group project)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>An investigatory method developed</td>
<td></td>
</tr>
<tr>
<td>4 weeks</td>
<td></td>
<td>5. The design and building process</td>
<td>Research and development projects</td>
<td>5. Studies of activity sequences (individual project)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Providing health care buildings</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Standards and systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Commissioning and evaluation</td>
<td>6. A study in functional analysis (group project)</td>
</tr>
<tr>
<td>fourth</td>
<td>2 weeks</td>
<td></td>
<td>Examinations - Unseen papers in subjects 1-5 inclusive</td>
<td></td>
</tr>
<tr>
<td>9 weeks</td>
<td></td>
<td>6. Final dissertation</td>
<td>Completion of individual research and documentation of final dissertation including three weeks’ examiners’ reading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14 weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject headings</td>
<td>Linked components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health service organization</td>
<td>Lectures, Project 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The nature of health planning</td>
<td>Lectures, Project 2, Project 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational policies and design implications</td>
<td>Lectures, Project 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation for briefing</td>
<td>Lectures, Project 5, Project 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The design and building process</td>
<td>Lectures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissertation and examinations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linked preliminaries:</td>
<td>Subject and synopsis approval</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postgraduate diploma:</td>
<td>Completion of dissertation, Submission and oral examination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master's degree course:</td>
<td>Examination - unseen papers, Completion of dissertation, Submission and oral examination</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
group. In this way, the student group can experience at first hand the individual approach of each discipline to the problem under consideration and appreciate the contribution of each discipline to the final solution. For all project tutorials, therefore, the emphasis throughout is on cross-disciplinary or team teaching.

Table 3 shows the time in hours allocated to the various curriculum activities in the taught component.

Early in the second term each student is allocated a permanent supervisor from the course tutorial panel who is responsible for coordinating the multidisciplinary tutorial needs of the student throughout the dissertation period.

Enough has been said here to demonstrate that a number of serious efforts are being made to establish an education for planning on some scientific basis. At this moment, the London-based course is being evaluated by researchers to try to establish how useful it really is, and what postgraduate students really think about it. Early results are hopeful, and it would appear that a real and lasting contribution is being made towards the closing of that crucial gap that lies between knowing what needs doing and knowing how to do it.

But what has become clear over the years is that ideally the first stage of an education and training effort should be an induction course in which the basic problems of language and planning theory are faced. This basic course can be unidisciplinary and need not be longer than a week. In fact, nurse planners in the United Kingdom have been running such a course for two years now with great success, and the Medical Architecture Research Unit has planned a number of induction courses for developing countries parallel with, and related to, its own postgraduate course to which many students have acceded. Basic courses such as these allow attitudes to be developed, motivation to be generated, and problems and possibilities perceived, for there is no doubt that people will only plan well when they really want to plan.

ACKNOWLEDGEMENT

The author wishes to express his sincere thanks for all the help received in the preparation of this paper from his colleague Eric Jones, ARIBA, Course Tutor for Postgraduate Studies, Medical Architecture Research Unit, London, who allowed him free access to documents and personal papers relating to the one-year postgraduate course in health facility planning.
<table>
<thead>
<tr>
<th>Activity (h/week)</th>
<th>First term</th>
<th>11 weeks</th>
<th>Second term</th>
<th>11 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Health service organization</td>
<td>Nature of health care planning</td>
<td>Operational policies and design integration</td>
<td>Investigation for briefing</td>
</tr>
<tr>
<td>Orientation</td>
<td>12</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lectures and seminars</td>
<td>3</td>
<td>10</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Project briefing</td>
<td>3</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Project presentation seminars</td>
<td>9</td>
<td></td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Visits</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Project work/study research</td>
<td>7</td>
<td>15</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Individual tutorials</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total (h):</td>
<td>20</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>
# MANAGEMENT OF A BUILDING PROJECT

Nils Nilsson

## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>223</td>
</tr>
<tr>
<td>2. A health care facility project</td>
<td></td>
</tr>
<tr>
<td>Briefing stage</td>
<td>224</td>
</tr>
<tr>
<td>Designing stage</td>
<td>227</td>
</tr>
<tr>
<td>Constructing stage</td>
<td>228</td>
</tr>
<tr>
<td>Commissioning stage</td>
<td>228</td>
</tr>
<tr>
<td>3. Organization of management functions</td>
<td></td>
</tr>
<tr>
<td>Objectives</td>
<td>230</td>
</tr>
<tr>
<td>Work plan</td>
<td>230</td>
</tr>
<tr>
<td>Management team</td>
<td>230</td>
</tr>
<tr>
<td>Use of consultants</td>
<td>232</td>
</tr>
<tr>
<td>Client-project manager relationship</td>
<td>232</td>
</tr>
<tr>
<td>Project committee</td>
<td>232</td>
</tr>
<tr>
<td>Methods</td>
<td>233</td>
</tr>
<tr>
<td>Multi-project management</td>
<td>233</td>
</tr>
<tr>
<td>4. Planning</td>
<td></td>
</tr>
<tr>
<td>Participants</td>
<td>233</td>
</tr>
<tr>
<td>Methods</td>
<td>234</td>
</tr>
<tr>
<td>Activities</td>
<td>234</td>
</tr>
<tr>
<td>5. Procurement</td>
<td></td>
</tr>
<tr>
<td>Objectives</td>
<td>237</td>
</tr>
<tr>
<td>Participants</td>
<td>237</td>
</tr>
<tr>
<td>General procurement principles</td>
<td>238</td>
</tr>
<tr>
<td>Forms of agreement</td>
<td>238</td>
</tr>
<tr>
<td>Forms of payment</td>
<td>239</td>
</tr>
<tr>
<td>Methods</td>
<td>239</td>
</tr>
<tr>
<td>Appointing consultants</td>
<td>241</td>
</tr>
<tr>
<td>Appointing contractors</td>
<td>242</td>
</tr>
<tr>
<td>Appointing subcontractors</td>
<td>244</td>
</tr>
<tr>
<td>Appointing suppliers</td>
<td>245</td>
</tr>
</tbody>
</table>

---

*White Arkitekter AB, Göteborg, Sweden.*
6. Control ................................................................. 246
   Objectives ...................................................... 246
   Participants .................................................. 247
   Progress control ............................................. 247
   Quality control .............................................. 249
   Site control .................................................. 249
   Economic control ............................................ 250

7. Communication and reporting ................................ 256
   Communication .............................................. 256
   Communication media ...................................... 257
   Reports ....................................................... 257
   Formal communications .................................... 257
   Meetings ..................................................... 258
   Decisions ..................................................... 258

8. Select bibliography ............................................. 259

Annex 1. Check-lists .............................................. 260
   Briefing stage .............................................. 260
   Designing stage ............................................ 261
   Constructing stage ....................................... 263
   Commissioning stage ..................................... 264
   Project administration .................................... 265

Annex 2. Job description: project manager .................... 268

Annex 3. Glossary ............................................... 270
1. INTRODUCTION

Good management in the realization of health care facility projects should be seen in the light of the importance of capital projects to the development of a young nation. However, the availability of capital is often not the only problem. It is rather implementational capacity that is the most serious constraint.

The implementation of a health care facility project could be regarded as a sequence of phases - formulation, realization, and operation - which may be briefly described as follows:

Formulation consists in establishing the need for a facility; in making sure that its erection would be in accordance with stated policies and priorities; in ascertaining that the resources in money and manpower necessary for its realization and operation are available, or will be available when needed.

Realization consists in bringing the facility physically through the stages of briefing, designing, construction, and commissioning.

Operation consists in the running and maintenance of the facility. It should be noted that the term covers not only activities at the facility itself, but also any support and supervision from national, regional, and local institutions and agencies that are necessary to ensure adequate functioning.

This paper is intended as a guide to management in the realization of facilities. While conditions surrounding construction projects may differ from one country to another, the principles advocated here are of a general character and based on internationally accepted procedures.

Project management may be described as the process of planning, executing, and controlling a project from inception to completion - in a given time, at a given cost, for a given end-product, and in accordance with available technical and human resources (Fig. 1). However, this definition does not exclude the alterations that become necessary when basic assumptions change, original estimates are no longer valid or new facts, changes, and restrictions occur which could not be anticipated.

FIG. 1. THE PROJECT MANAGEMENT PROCESS
The most important goal is not necessarily the completion of a project exactly as planned. The principal aim should be to achieve the intended objectives of the project in the best possible way and with the best possible result.

The main objectives of the project management process are outlined in Fig. 2. These activities form a dynamic cycle of planning, executing work according to plan(s), controlling its execution, detecting changes requiring modifications to the plan(s), and taking appropriate remedial measures. Not only does this cyclic process apply to a complete project, or the parts of a project, it is a continuous activity involving revisions, modifications, and alternative solutions to new problems as they arise.

**FIG. 2. OBJECTIVES OF THE PROJECT MANAGEMENT PROCESS**

2. A HEALTH CARE FACILITY PROJECT

A construction project covers the entire working process from the inception of the idea to the successful use of the completed structure. It consists of many individual and interdependent activities, and involves many individuals and organizations. For the purpose of this guide, the working process has been divided into a series of stages. This procedure also allows the client to make his necessary commitments step by step, as the costs and benefits of the project are classified. The series of stages used in this guide is shown on page 226. The scope of these four stages may differ from one project to another, but their content should be clearly defined in the terms of reference drawn up for each project.

The main parties involved in the working process are shown in Fig. 3. Some persons participate throughout the project, although their degree of involvement may vary from stage to stage.

The term "client", or sometimes "owner", is used for the organization, or the individuals within that organization, having the authority to order and approve the project and to allocate the funds for its execution. For health care facility projects, these client powers normally rest within the Ministry of Health or other health care authorities or organizations. The appropriate responsibility may be delegated, wholly or partly, to suitably qualified persons in the client's own organization, such as project managers, designers, or other specialists.
The composition of the four project teams illustrated in Fig. 3 and named according to the different project stages depends upon the type of project and its content. In general, each team includes all the persons or parties involved in the work at the relevant stage, such as managerial staff, designers and specialists, user representatives, contractors, and suppliers.

FIG. 3. PARTICIPANTS IN PROJECT FOR BUILDING A HEALTH CARE FACILITY

The management team is headed by a project manager who has the responsibility and authority to direct the execution of the project. The team may comprise other specialists such as planners, medical experts and advisors, administrators, and supervisors, depending upon the size and complexity of the project. To perform his duties effectively, a project manager must be well versed in the systematic practice of management and have a thorough understanding of the project he is guiding. This understanding should not only cover the physical features of the project, but should also extend to its objectives and the motivation behind it.

Small and simple construction projects may be undertaken without sophisticated management procedures, but for complex projects some degree of organized project management is essential. This guide explains the fundamentals of overall project management, but the internal management of each party involved in the project is outside its scope.

The principles of project management apply to all kinds of construction projects - buildings as well as engineering works - whether carried out by a client's own organization or by outside resources employed specially for the purpose.
The major stages of a project, together with the various aspects that must be considered during each stage, form the framework of the construction process. For organizational convenience these aspects\(^1\) can be divided into four main groups:

- functional aspects,
- location and site aspects,
- construction aspects,
- operational aspects.

The completion of each stage should be linked to a commitment or decision by the client, or his authorized representative. By the clear definition of the purpose of each stage, the tasks to be undertaken, and the decisions to be reached, the entire planning process can often be shortened, a measure that can mean considerable savings.

In considering the functional, site, construction, and operational aspects, the degree of detail required at each stage should be carefully weighed. Each factor should be examined and its content developed, but only to the degree of detail required to fulfil the needs at that particular stage. For example, there is no point in wasting resources on producing a complete room-data programme during the briefing stage, since the work during the following stages will have a significant influence on such matters as finishes and installations and may make much of the early work irrelevant.

The work done in the early stages of a project is very important. The relation between the funds expended and the extent to which the design can be influenced at various project stages is particularly worth noting. Once the project has reached the construction stage, when funds are being expended at a very high rate, it is almost impossible to influence the size and shape of the building. The possibility of influencing the design during the various stages is illustrated in Fig. 4. Clearly the crucial period is when the project brief is being reviewed by the client for final approval. This is when substantial savings can be made.

FIG. 4. POSSIBILITY OF INFLUENCING BUILDING DESIGN AT DIFFERENT STAGES

Fig. 5 shows the sequence of work throughout the different project stages, and the various participants involved.

**FIG. 5. PARTICIPANTS AT DIFFERENT STAGES OF THE PROJECT**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Briefing</td>
<td>Project Manager, supported by planners, designers, etc.</td>
</tr>
<tr>
<td>Designing</td>
<td>Users: representatives of operational staff</td>
</tr>
<tr>
<td>Constructing</td>
<td>Designers &amp; Specialists (architects, engineers, planners, etc.)</td>
</tr>
<tr>
<td>Commissioning</td>
<td>Contractors &amp; Suppliers (surveyors, health administrators)</td>
</tr>
<tr>
<td></td>
<td>Public Authorities Agencies</td>
</tr>
</tbody>
</table>

**Briefing stage**

The purpose of the briefing stage is:

- to prepare a general outline of requirements, and provide the client with an appraisal and recommendation(s), so that he can ensure that the project is functionally, technically, and financially feasible.

The client's first task is to establish a suitable management organization which can develop the project brief by considering and analysing all important factors.

Alternative courses of action and project location should be given extra emphasis during this stage.

In some projects, the initial user requirements may be unclear, the location uncertain, and the cost limit not decided. In such cases, it may be helpful to prepare the project brief in steps, first clarifying the major aspects of the project and outlining alternative courses of action and their consequences. Those alternatives that appear most feasible may then be studied further. Such a study should clarify the functional, technical, and financial aspects of the project in enough detail to enable the management team to prepare its recommendations on how the project should proceed.

Finally, it should be stressed that only during the briefing stage, through a careful appraisal of user requirements, is it possible to make any substantial cost savings in the project.

The main participants at this stage are the management team and the briefing team. The briefing team should include the following persons:

- architect,
- quantity surveyor,
- specialists such as health planners, organizational planners, etc.,
- user representatives.
For more complex projects, structural, mechanical, and electrical engineers, and others, will have to be involved.

See also briefing-stage check-list in Annex 1 for a detailed schedule of activities.

**Designing stage**

The purpose of the designing stage is:

- to complete the project brief and determine the layout, design, and method of construction in order to obtain the necessary approvals from the public authorities involved;

- to prepare the necessary production information, including working drawings and specifications, and to complete all arrangements for obtaining tenders.

In most projects the designing stage is divided into several substages—outline proposal, scheme design, detail design, and production information. The first two substages are sometimes referred to as "sketch plans", and the last two often go under the term "working drawings".

By proceeding with the project design through a series of stages, it is possible to finalize decisions on user requirements, technical problems, design matters, etc., step by step.

An adequate basis for a realistic cost estimate of the project should be possible from the scheme design stage. The project brief should not be modified after this stage.

Regular contact should be maintained between the management team and the design team, preferably through a series of regular meetings at which progress reports can be considered, and any outstanding issues discussed and decided.

The main participants in the designing stage are the management team and the designing team. The designing team should include the following persons:

- architect,
- quantity surveyor,
- structural, mechanical, and electrical engineers,
- specialists such as health planners, organizational planners, etc.,
- user representatives.

See also designing-stage check-list in Annex 1 for a detailed schedule of activities.

**Constructing stage**

The purpose of the constructing stage is:

- to construct the project design to practical completion within the agreed cost, time, and quality targets.

The constructing stage consists of a number of interrelated activities. The failure of one activity can disrupt the entire production schedule. Careful production planning is therefore very important.

The main participants are the management team and the constructing team. The constructing team should include the following persons and organizations:
- main contractor,
- subcontractors,
- suppliers of materials and equipment,
- designers and specialists.

Normally, the main responsibility within the constructing team rests with the main contractor. It is also usual for subcontractors to be directly responsible to the main contractor, even if they have been nominated by the client.

See also constructing-stage check-list in Annex 1 for a detailed schedule of activities.

**Commissioning stage**

The purpose of the commissioning stage is:

- to ensure that the construction works are completed according to the approved drawings and specifications and that the project, as handed over to the client, is fully operational;
- to provide operating instructions, together with practical staff training, to ensure continued good functioning and maintenance.

The commissioning stage is the transition period from construction to occupation and use of the fully operational facility. For large and complicated projects, it is not uncommon for the commissioning to be carried out in several substages.

Commissioning must be planned well in advance so that deliveries of furniture and equipment, as well as the recruitment and training of any service personnel, can be coordinated with the construction timetable.

The main participants at the commissioning stage are the management team and the commissioning team.

The commissioning team should include:

- the client or his representative(s),
- the users or their representative(s),
- designers and specialists,
- contractor and subcontractors.

See also commissioning-stage check-list in Annex 1 for a detailed schedule of activities.
3. ORGANIZATION OF MANAGEMENT FUNCTIONS

Objectives

The procurement of services to design and construct a new building may involve the client organization in activities that are quite apart from, and additional to, its normal functions. The definition of the type of building required, and the carrying-out of various activities throughout the different project stages, will absorb appreciable client time and effort. This time and effort, and often the costs, are usually underestimated by new or occasional clients. Consequently, these additional activities need careful planning and the setting aside of sufficient managerial resources.

Work plan

Each stage includes several separate activities, each of which demands its own separate organizational structure. This organizational structure depends upon the size and character of the project, the existing institutional framework, and the manpower available. How the various activities should be carried out - in what order, to what extent, in what way, and by whom - should be carefully assessed for each project and presented in the form of a work programme. This programme, often known as the work plan, can be drawn up either by the client's own organization, or by specially appointed experts.

The complex and interdependent tasks of briefing, designing, constructing, and commissioning must often conform with national, regional, or local policies.

This may call for the development of a "capital work plan", the purpose of which would be to provide general guidelines within which the project teams, or team-members, could relate their tasks to those of their colleagues. Indeed, some form of approved work plan is essential when independent resources are employed for various tasks. Clients and consultants must be aware of the procedures to be followed, and at what points consultations, cost checks, and approvals are required. The degree of detail in the work plan will largely depend on the size and complexity of the project, as well as the attitude and policies of the client organization.

Management team

The complexity of many development projects calls for a clearly defined hierarchy of responsibility and decision-making. The client is also responsible for appraisals and major approvals, and for the allocation of funds. The project manager, or the management team then undertakes, on behalf of the client, the tasks of planning, directing, and controlling the project.

Project manager

The management team, which should be kept as small as possible, is headed by a project manager or project director appointed by the client. The project manager is formally in charge of managing the execution of the project following directives given by the client (see Fig. 3). Everybody concerned with the project (including the project manager himself) must be aware of the project manager's responsibilities and the extent of his authority.

Few client organizations understand the importance of ensuring that their construction projects are properly managed right from the start, by people with relevant experience and appropriate functional duties. The project manager needs to know specifically how to manage a construction project, and to have sufficient time and energy to apply to this task in order to achieve effective control. Often the project manager is chosen from among persons knowledgeable in general administration and production management. If they do not, at the same time, have experience in project management, they may run into difficulties. A draft job description for a project manager will be found in Annex 2.
However, in the early stages of a project it is quite common to assign the duties of project management to a functional manager on a part-time basis. He can be appointed either from within the client's own organization or from the outside in the form of a consultant. This arrangement may be acceptable during the early stages of a project, when the time required for project management is not too critical and the future of the project is less certain. However, as the project develops and it becomes impossible for a part-time manager to handle all the necessary aspects, the appointment of a full-time project manager is justified. The point when this changeover should be made depends on the size and complexity of the project. Such an arrangement may cause some inconvenience and loss of efficiency during the transition period, particularly if the incumbent project manager and his organization fail to recognize and acknowledge the limits of their capacity. Any savings from the late appointment of a full-time project manager should therefore be carefully weighed against possible losses, at a critical point in the project programme. For the sake of continuity it is generally recommended to appoint an experienced project manager from the very start.

The project manager must thoroughly understand the project. His knowledge of it should not be limited to its physical features, but should also extend to the client's underlying intentions and policies. The most important characteristics of a project manager are his knowledge and experience of management activities, as well as his ability to make logical, impartial, and fair decisions. In other words, the project manager must know how to get the project to achieve its desired objective(s) through people. Cooperation from all parties involved is essential, and the project manager must make sure that he has gained the confidence of all project workers so that they not only perform their tasks well, but also report to him faithfully and punctually.

Supporting services

The management team will need certain supporting services (Fig. 6), whose composition and size will depend on the size and nature of the project. Their tasks will include the following:

- planning,
- procuring,
- controlling,
- secretarial work.

These services, which may often be shared by several projects, are described later in this paper.

FIG. 6. ORGANIZATION OF MANAGEMENT TEAM
Certain projects require the active participation of the project manager in the briefing, designing, and construction processes. He coordinates the activities of all the designers and specialists involved, brings in a contractor for early discussions, if required, and makes sure that all work is carried out as planned. To fulfill these tasks he may need the support of specialists or assistant managers to deal with certain briefing, design, and construction activities under his guidance.

Use of consultants

A client organization with a fluctuating workload, or a client who builds only rarely, may have difficulty in setting up an internal management team. In such cases, consultants can be employed to provide certain managerial services. However, one person within the client organization should be appointed for purposes of coordination and to express the client's requirements. A management team composed of consultants must have the same aims and objectives as a team created directly within the client's own organization, because any conflicts of interest could adversely affect the progress and economy of the project.

Consequently, the most suitable consultant may be a project management specialist, rather than someone who participates directly in the briefing, designing, and construction work. However, if a project is fairly simple, and the impartiality aspect is taken into consideration, a professional firm, usually the architect, should be employed for all project stages and given the responsibility of managing the project on the client's behalf. The architect may then be supported, where necessary, by a quantity surveyor to deal with matters such as cost assessments, bills of quantities, etc.

Client-project manager relationship

Another possible problem lies in the relationship between the client and the project manager. The chief executive in the client's organization is, in effect, the chief project manager, as he is ultimately responsible for the success or failure of the project. He may decide to delegate part of his responsibility to a project manager - and in fact should do so - but the extent of this delegation depends very much on the chief executive's own style of management. If he does not delegate because he lacks an understanding of the functions of a project manager, or because he lacks confidence, the operations of either the organization or the project will suffer. In other words, the chief executive will have made himself the real manager without having sufficient time to devote to the job.

Project committee

Within a client organization where different departments/parties are involved, it is usual to set up an ad hoc committee, often called a project committee. The members of this committee should represent, at an executive level, the client's planning, financing, and operational interests, as well as the interests of the potential users.

A project committee of the kind shown in Fig. 7(A) has implied powers to act, which may lead to uncertainties about the limits of responsibility. Since it is essential that the project manager should have total responsibility and authority for a project, it may be better to adopt the type of organization illustrated in Fig. 7(B). Here the committee has a purely advisory and coordinating role.

Whatever kind of committee is eventually decided upon, a direct link should be established between the client and the project manager and all directives should be channelled through the latter.

Representatives of the project's operating personnel and other potential users should be appointed to the project or coordinating committee. Careful attention should be given to any advice that they offer, especially during the early stages. Apart from the fact that consultations at user level may provide some very useful and pertinent practical views, such participation is also likely to foster a feeling that a positive contribution is being made by those who will eventually live or work in the building.
FIG. 7. ALTERNATIVE TYPES OF PROJECT COMMITTEE

Methods

Because of the complexity of most construction projects, the task of ensuring that all management functions are carried out well becomes almost impossible without systematic organization of the work. A systematic process of project management consists essentially of a set of established methods and guidelines to aid the project manager and the management team to plan logically, to identify problems easily and promptly, and to solve problems rationally. These methods and guidelines are described in more detail in the sections that follow.

Multi-project management

The simultaneous management of several construction projects is found mainly within organizations, such as ministries of works, whose main responsibility is to deal with construction projects on a countrywide scale.

In such an organization, one person may be charged with the responsibility of managing a number of projects, each of which is likely to be at a different stage of completion.

This complex situation calls for special methods of planning and controlling projects, usually based on diagrams specifying the major dates in the time-schedule of each project. On the basis of these diagrams, workloads can be assessed, resources allocated, and calculations made of the overall cash flow. In order to be able to compare actual with expected progress, these diagrams have to be updated at regular intervals. These tasks may be assigned to a special secretariat.

4. PLANNING

Planning is the backbone of the whole project and must be based on clearly defined objectives. Proper planning makes it possible to ensure that adequate resources are available at the right moment, that adequate time is allowed for each stage in the process, and that all the various component activities start at the appropriate time (Fig. 8).

Participants

The project manager will be responsible for the planning process during all stages of the project. However, the manager and his team will be assisted by the briefing, designing, constructing, and commissioning teams, depending on which stage the project has reached. Each team should be responsible for the detailed planning of its own activities at each project stage.
FIG. 8. THE PLANNING PROCESS

Methods

To illustrate appropriate methods of project planning, it may first be helpful to outline some of the characteristics of a good plan:

- It should be simple. The aim must be to outline complex situations in a simple way.

- It should be flexible. It must be possible to alter certain features without disrupting the entire plan, and a reasonable degree of "slack" must be built in.

- It should provide proper standards of expectation by providing identified and quantified markers along the way so that control may be exercised.

Several methods have been developed over the years to aid the planning process. They range from simple check-lists and bar charts to more complicated charts, schedules, and network plans, showing the interrelationships of different activities. For most projects, a bar chart is normally adequate. It can be prepared as follows:

- make a check-list of the appropriate activities to be undertaken;

- analyse each item in the check-list, considering when, in respect to other activities, it needs to be carried out, and what length of time it requires;

- indicate all activities in chronological order on a time-schedule in bar-chart style.

Activities

The planning of project activities should cover the following major aspects:

- time,
- briefing and design capacity,
- constructing and commissioning capacity,
- supply of machinery and materials,
- allocation of funds,
- staffing.

Time-plan

The most important task in the planning process is the preparation of a realistic time-schedule. A basic time-schedule should be worked out at a very early stage and should serve as a framework within which all key activities can be indicated (Fig. 9).
A whole series of time-schedules will be prepared during the different stages of the project. During the initial stages, the time-schedules will be less detailed, but, as the project proceeds, more and more information will be available and details in the time-schedules can be successively refined and complemented. Some of the activities such as financing, approvals by the client, and the procurement of furniture, plant, and equipment are not always covered in the above schedules. In such cases it is the responsibility of the project management to make sure that these activities are given the proper attention. The management team should maintain a time-schedule clearly showing the activities that the team is involved in and responsible for.

The time-lapse between the decision to build and the actual taking-over of a completed project is seldom less than 2-3 years even for small projects. Therefore, during the briefing stage it should be possible to prepare a time-schedule that, apart from indicating the major project stages, will also provide for such activities as the planning and procurement of furniture, plant, and equipment, financing, obtaining planning permission, etc. The time-schedule should also allow adequate time between each project stage for the appraisals and approvals required by the management team, the client, and the sponsors, etc. Provisions of this kind are unfortunately rare, and this invariably causes delays and shortages of funds.

During the first part of the designing stage, the designing team should prepare, in collaboration with the management team, a time-schedule covering in detail the activities up to and including the proposed tender action. This time-schedule should also indicate the activities to be undertaken by the different designers and specialists in the designing team, and the activities required of the management team, clearly showing where activities are dependent upon each other. Working drawings and tender documents are prepared during the second part of the designing stage. The time-planning during this stage should also cover the tendering activities and the constructing stage. The time-schedule should include such activities as calling for tenders, opening them and awarding the contracts. It should also include the major phases of construction and commissioning.

During the constructing stage, the contractor should prepare a detailed time-schedule based on the time limits stated in the contract. This time-schedule should indicate how construction will proceed, including such activities as installation of plant and equipment and the advance procurement of any materials.

The project manager must ensure that any materials or equipment that have not been included in the construction contract are procured in time.

In the commissioning stage, the project manager will be responsible for planning activities that take place after the building has been completed and handed over. These activities include the running-in of plant and equipment, the installation of furniture, and staffing.
Briefing and designing capacity

One of the first things the project manager should consider is the available briefing and designing resources. The client must consider the available resources and competence within his own organization before employing any external resources. The selection and employment of designers and specialists are discussed further in section 5.

Constructing capacity

The size and organization of the construction industry vary from one country to another. Smaller projects are often constructed on a self-help basis or through direct labour schemes. Larger projects normally use more permanent agencies such as construction units or contractors. Whichever method is selected, it is the responsibility of the project manager to consider the capacity of the selected agency, and to take these considerations into account when the basic time-schedule is prepared. It should be noted that the choice of construction method may have a significant effect on the way the production documents are eventually prepared.

Supply of materials

Many projects are not completed on time because certain vital materials have not been delivered or their delivery was delayed. In many cases delay could have been avoided if the procurement of material supplies had been properly planned. During the designing stage, the project manager should go through the list of major materials and items needed for the project and check whether these will be available. If there is any likelihood that any vital material or item of equipment may be difficult to obtain, it is the responsibility of the project manager to take the necessary steps to avoid possible delays.

Funds

Whether funds for the project are being provided from private capital, a bank, or the government, it is necessary to draw up a total budget showing what funds are needed and when. Funds must be made available not only for actual construction, but also for the payment of the managers, designers, and specialists, and for plant, equipment, water, electricity, etc. (Fig. 10). The time-schedule will provide the first indication of when funds should be made available, and the designing team will be able to assist with an assessment of how much money should be made available at the different project stages. The question of project funds is discussed further in section 5.

FIG. 10. ITEMS REQUIRING FUNDS
Staffing

Proper consideration must be given at an early stage to the staffing of the completed project, and the planning of this should start during the briefing stage. A list of those expected to utilize the building should be prepared during this stage, and this list should form part of the briefing documents. Using this list, the management team should make plans to ensure that adequate staff will be available. If it is found that it will not be possible to obtain adequate staff by the time the project is completed, alternative measures may have to be considered. The completion date for the whole project could, for example, be put back, or it might be found suitable to complete the project in phases.

5. PROCUREMENT

Objectives

A construction project requires basic resources such as manpower, materials, machinery, and technical and managerial "know-how". If the client's own organization cannot provide these resources, they have to be procured (bought or leased) from other organizations. Certain clients have their own design department and construction unit, but most clients have to procure the necessary resources from other organizations, normally in the form shown in Fig. 11, i.e.:

- design services from consultants,
- civil engineering, building, and installation work from contractors,
- deliveries of plant, equipment, and materials from suppliers.

The client's procurement should ensure that the project is executed in the most effective way. Consideration must be given not only to the cost, but also to the resulting quality and the time needed for completion.

Certain clients, particularly public clients, also allow decisions to be influenced by other objectives, for example, the promotion of local contractors or the provision of training experience for their own staff. This may increase the cost of the project, but in the long run it helps develop the local construction industry. If objectives other than those directly related to the efficiency of the project should be considered, the client should provide the project manager with clear guidelines.

FIG. 11. RESOURCES REQUIRED BY A CONSTRUCTION PROJECT
There are many different ways of procuring resources, and the project manager will face questions such as:

- Which methods should be used?
- Which form of tendering is to be employed?
- Which forms of contract and payment shall be used?

The answers to these questions will vary from one project to another. It is, however, possible to point out some general principles that can be applied to procurement.

Participants

It is the responsibility of the project manager to ensure that resources are procured according to the planned project needs. When contractors have been invited to submit tenders, the project manager may require assistance from the appointed architect and quantity surveyor for the evaluation of the tenders received. In the case of more complicated projects for which equipment has to be procured separately from several suppliers, the project manager may need assistance from a procurement or purchasing section. Many countries have established special boards to handle the tendering procedures for public bodies. However, the special nature of construction contracts is not always recognized, and boards are expected to deal with these as they would with the procurement of consumable items. This rarely proves to be a satisfactory arrangement. It is best to have a separate board for construction contracts.

General procurement principles

There are two main ways in which contractors may be appointed: through competitive tendering or by negotiated contract.

Competitive tendering

Competitive tendering is normally governed by strict rules, especially when public bodies are involved. The general aims of such rules (or codes) are to guarantee fair competition between the different contractors submitting tenders ("tenderers") and to ensure an unbiased evaluation of the tenders submitted. These aims can be accomplished either by a call for tenders from a selected number of qualified contractors, or by an open invitation through an advertisement. Written tenders are then delivered in sealed envelopes and within a specified time period. Each tender should be based on the tender documents, which should include a detailed and unambiguous specification of the project. If tenderers are invited or permitted to offer alternative proposals to those in the tender documents, these proposals should be submitted separately from the regular tenders.

The opening, registration, and evaluation of tenders normally follow set procedures that may vary from client to client. The final choice normally falls on the contractor offering the lowest price. In some instances, though, other criteria such as high quality workmanship, or a short construction time, may also be used to evaluate the tenders submitted.

Negotiated contract

When it is difficult to specify the scope of the work, it may be necessary to negotiate a contract without competitive tendering. Since a negotiated contract in most cases implies a higher price and does not guarantee the same objectivity, it is less often used for the appointment of contractors. In certain cases though, it may offer advantages, for example, when a similar project has recently been successfully completed. Time and effort are then saved, if a new contract is negotiated directly with the same contractor on the basis of the earlier contract. A negotiated contract may also offer advantages if a contractor in whom the client has confidence can offer the special competence required to undertake a project.
Forms of agreement

The form of agreement may vary from a simple order and acknowledgement to lengthy legal documents. In principle any "conditions of contract" that the parties in the contract agree upon can be used. Normally though, it is advisable (and for public clients often mandatory) to use standard forms of contract. The advantage of these is that they have been thoroughly tested in practice and each party in the building industry is familiar with the particular roles and responsibilities laid down for them.

Forms of payment

Contracts may be classified into two main categories, depending on the form of payment, namely:

- fixed-price contracts, where the price is agreed before the contract is signed;
- cost reimbursement contracts, where the client pays for the actual costs occurring as the work is carried through.

The main difference between these forms of payment is that, with a reimbursement contract, the client will not know the final cost beforehand and will have to take the risk himself for any unforeseen cost increase that may occur. Reimbursement contracts are not in common use in the public sector, except for emergency works and term maintenance contracts, because of the need for public accountability.

The different forms of contract and payment for consultants, contractors, and suppliers are described separately later in this section.

Methods

The standard approach

The standard approach to a building project was described earlier. In this process the client procures external resources on just two occasions - once on the appointment of consultants, and once when competitive tendering for the post of main contractor takes place. Separate contracts could be negotiated with each consultant, but the task of coordination is entrusted to one of them, usually the architect. The main contractor is responsible for the implementation of all construction work including the work of subcontractors.

The standard approach is characterized by the preparation of complete working drawings and production information before any construction work is procured. This facilitates the tendering procedure and administration of the contract. This approach, which is widely accepted, has proved successful for most types of project (Fig. 12).

FIG. 12. PROCUREMENT OF RESOURCES: STANDARD APPROACH
Early selection

The need to shorten project implementation has encouraged the development of methods by which site operations can be started earlier than traditionally possible, through the overlapping of the designing and constructing stages. One possible way is by early selection of the main contractor (Fig. 13). However, as production information is not complete when the main contractor is appointed, it is difficult to require a fixed price for the work. Alternative forms of payment are more complicated and will increase the risk of disagreement between the client and the main contractor. However, this approach may be useful for a project consisting of a series of similar subprojects.

FIG. 13. PROCUREMENT OF RESOURCES: EARLY SELECTION APPROACH

"Design and construct"

Another way of shortening the implementation time is by using a "design and construct" approach (Fig. 14) - in other words, a "package deal". In this case, because the contractor has total responsibility, better coordination is possible between design and construction activities. This approach may however be difficult to combine with a competitive tendering procedure, and the client has to rely heavily on the integrity and competence of the contractor.

FIG. 14. PROCUREMENT OF RESOURCES: "DESIGN AND CONSTRUCT" APPROACH

Divided contract

A further possible approach is through a divided contract. In such contracts, a separate contractor is appointed for the earthworks, so that site operations can be started earlier than would normally be possible. The number of contracts may be further increased, and procurement will then be phased between several different contracts, e.g., for the
building frame, installations, etc. (Fig. 15). However, the divided contract approach will face the project manager with much greater problems of coordination than will a standard approach, since responsibility on the construction site will be divided between several contractors.

**FIG. 15. PROCUREMENT OF RESOURCES: DIVIDED CONTRACT APPROACH**

Direct labour

Smaller projects in developing countries are often executed with direct labour, i.e., labourers directly employed by the client. This approach is suitable for simple projects located in remote areas. Since no main contractor is appointed, the required production information and bill of quantities may be simplified. This approach is not normally suitable for larger projects as construction capacity is limited by a lack of plant and skilled staff.

Certain clients who are regularly involved in construction projects have found it useful to establish their own permanent construction units. If these are well equipped and staffed, they may also undertake larger or more complex projects.

**Appointing consultants**

**Procedures**

The selection of consultants is an important and difficult task. Experience from earlier projects is a decisive factor, and a contract may often be concluded after negotiations with only one firm. One recommended method of appointing consultants is to ask them to provide the client with the following information, thereby allowing comparisons between various consultants:

- the capacity of the firm, which should be large enough to undertake the project;
- earlier experience of the same or a similar kind of project, with references;
- the methods proposed for the execution of the project, including methods of coordination and control, timetables, and costs;
- the proposed project organization, including the names and qualifications of key staff.

Using this comparative information, and after checking the references, it should be possible to make a suitable choice. Where a team of consultants is to be appointed for a project, it is important to obtain a good combination of firms that can show that they have worked together successfully on previous occasions. Either the entire team can be appointed at one time, or a single consultant (normally the architect) can be appointed first, to assist the client with the selection and appointment of the remaining members of the design team.
Client-consultant contract

Even where a relationship of trust exists between client and consultant, it is advisable to establish a formal contract between the two parties. This contract can normally be based on one of the standard forms of agreement prepared by the various professional institutes, e.g., the International General Rules for Agreement between Client and Consulting Engineer, prepared by the International Federation of Consulting Engineers.

Payment of consultants

The normal form of payment is a fee calculated as a percentage of the final construction cost, or part of it. The actual percentage varies with the services provided and the type of project. The methods of calculating fees are normally defined by the various professional institutes. One disadvantage with this system, however, is that a consultant who puts extra effort into the design work in order to reduce construction costs will receive a smaller fee. The reverse is also true: the more expensive the proposed plan, the larger the consultant’s fee will be. Alternative forms of payment to consultants are a fixed-price system or cost reimbursement, based on a salary plus reimbursable costs. Since it is difficult to define the tasks of a consultant precisely, the fixed-price system is often unsuitable, at least during the briefing and early designing stages. Cost reimbursement is not in common use because of the difficulties of controlling the actual time spent on the project. One possibility, though, is a cost reimbursement contract with a ceiling price.

The consultant is usually paid stage by stage, depending on the amount of work that has been carried out. Usually the consultant receives the bulk of the fee on delivering the documents and the remainder when the client has approved them. As soon as the last stage of the project is finished and approved, the consultant will have been paid the total amount - no retention money will be held by the client as is the case with contractors (see below). However, in most countries the consultant is obliged to be insured for a period of 5-10 years against any defects that might be attributed to him.

Appointing contractors

Procedures

The recommended procedure for the appointment of contractors is competitive tendering from a selected number of qualified tenderers. Sometimes public organizations use a register of contractors considered suitable for various types and sizes of project. It is also possible to select tenderers on the basis of replies to an advertisement inviting tenders for a particular project. In any event, prior qualification is desirable so as to eliminate unacceptable contractors and encourage serious prices from all those submitting tenders.

It is advisable to select prospective applicants well before the tender documents are to be sent out. It is also important to give them sufficient time to prepare their tenders. The time needed for this will depend on the size and complexity of the job, but, for a normal-sized project, about four weeks will be required (see Fig. 16).

When all the tenders come from a selected number of well-known contractors, it is normal to accept the lowest offer. However, an evaluation should also be made of other information included in the tenders, such as:

- percentage additions to prime-cost items,
- the amount of liquidated damages per day,
- advances required,
- time for completion.

If quantities are used as the basis for calculating the price, the management team should examine the priced bills of quantities of the contractor and the apparently most favourable tender to determine any errors or abnormal prices.
Other forms of tendering may be applied when early selection of a contractor is needed. Two-stage tendering, using an approximate bill of quantities in the first stage, is one possibility. Another is a negotiated contract with a "design and construct" company. These forms of tendering, however, require a strong client organization to handle the necessary negotiations.

Client-contractor contract

In many countries different standard forms of contract are available depending on the type of project, or the form of payment, etc. These can include:

- standard building contract, with or without quantities included,
- cost reimbursement contract,
- contracts for civil engineering works,
- contracts for electrical and mechanical works.

International contract conditions for civil engineering works, and for electrical and mechanical works, have also been established by the International Federation of Consulting Engineers.

The contract will normally include the following items:

- an agreement between the client and the contractor,
- the tender,
- standard conditions of contract,
- particular conditions of contract,
- bills of quantities,
- a schedule of prices,
- drawings and specifications.

Payment of contractors

Payments to contractors are normally made on a fixed-price basis, in one or other of the following forms:

- a schedule of prices giving unit prices for most items in the bill of quantities;
- a lump sum for the complete works as defined by drawings and specifications.
When the payment is based on a schedule of prices, the total price is determined by the actual quantities, measured on the site, multiplied by the unit prices in the contract. During the construction works, interim payments are normally made monthly according to valuations of the work completed. This procedure is described in section 6. The use of a schedule of prices facilitates the preparation of interim valuations as well as the determination of prices for variations ordered by, or on behalf of, the client after the contract has been signed.

In the event of early selection of the contractor, a complete bill of quantities cannot be elaborated since the design of the project is not finalized. An approximate bill of quantities must therefore be used instead. The final price is calculated from the actual quantities and unit prices included in the bill. When the prices are incomplete or not applicable, new prices have to be established by a process of negotiation - a rather complicated procedure.

For smaller projects, or where it is difficult to break down the work into units, the price often takes the form of a lump sum. This form of payment is not advisable when the quantities of work are uncertain, owing, for example, to lack of information on soil conditions. In such cases, either the client or the contractor has to take the risk of increased costs. With a lump-sum payment the contractor takes this risk and, to cover himself, increases his tender price.

A fixed-price contract is not suitable for every kind of project. It may, for example, be necessary to appoint a contractor before the scope of the work can be defined satisfactorily. The only choice will then be a cost reimbursement contract, in which the contractor is paid for his verified costs and also receives a predetermined additional fee. This additional fee normally covers a defined part of the contractor's overheads, and his profit. The fee can be in the form either of a lump sum or of a percentage of the verified costs.

The danger of uncontrolled cost increases when a cost reimbursement form of payment is used may be reduced with a form of target contract. The additional fee is then determined in such a way that the client and the contractor share the difference between the actual cost and the agreed estimated cost.

In times of high inflation, or for projects with a construction time exceeding one year, contractors normally require some form of compensation for price escalations. If there is no fluctuation clause in the contract, the contractor will increase his initial tender price. If an official system for indexing construction costs exists, it is often advisable to accept a fluctuation clause in the contract. If no such system exists, it will be necessary to calculate actual increases in material costs, wages, and overheads, which is often a contentious and time-consuming activity.

The contractor usually gets 90% of the money from the valuation of the work completed by the contractor/subcontractors for each part or phase of the building. The remaining money - called retention money - is held by the client to cover the costs of remedying any defects in materials or workmanship. After a satisfactory inspection at the end of the construction stage, the client pays the contractor a part (usually half) of the retention money. The client holds the remaining retention money until the end of the defects liability period - usually 1-2 years - during which the contractor is responsible for remedying any defects in materials or workmanship that may emerge in the building.

**Appointing subcontractors**

**Procedures**

When a main contractor is appointed by the client according to the standard approach described earlier, he assumes total responsibility for the construction works. As he normally cannot undertake the complete work with his own labour, he will need subcontractors. The installation of utilities and the erection of a steel frame are examples of work often undertaken by subcontractors.
There are two main procedures for appointing subcontractors:

- direct appointment by the main contractor without the involvement of the client;
- nomination by the client before or after the main contractor is selected.

In both cases, the main contractor is responsible for the ordering of the work and for its satisfactory completion by the subcontractor.

The nomination of a subcontractor offers the client better possibilities of influencing the choice of materials and components and the quality of the work. Certain design work may also be undertaken by the subcontractor. When the fabrication of certain components takes a long time, this procedure may prove time-saving.

A frequent disadvantage with the nomination of subcontractors is lack of competition. This may be overcome if they are nominated through competitive tendering. Nomination often involves unclear responsibilities. It is therefore necessary for all parties involved to understand the contractual relationships, and for the lines of communication to be clearly stated.

Client-main contractor—subcontractor contract

Irrespective of which procedure is used for appointing a subcontractor, it is always the task of the main contractor to place the formal contract. Separate standard forms of contract exist for those subcontractors who are nominated and those who are not. Most of them are available from the International Federation of Consulting Engineers.

The client's nomination of a subcontractor implies an instruction to the main contractor to make a formal contract with the subcontractor.

As the main contractor is not responsible for design work carried out by the subcontractor, a special agreement between the client and the nominated subcontractor (a design warranty) may be needed.

Payment of subcontractors

The main contractor is usually responsible for paying all subcontractors, including those nominated by the client. The principles outlined earlier for contractors in general can be applied to the payment of subcontractors.

Appointing suppliers

Procedures

Most suppliers to a construction project are appointed by the main contractor. If the client wants to choose a certain make of equipment, he may nominate suppliers. The same principles as for the nomination of subcontractors will then apply. Certain items, such as plant and equipment for the building, may be ordered directly by the client.

Suppliers are normally appointed by means of competitive tendering procedures. As product quality and delivery time can vary significantly, attention must be directed to these factors, as well as to price, when evaluating tenders.

Client-supplier contract

When an item is ordered directly by the client, a formal agreement must be made with the supplier. Normally no special contract is required, and agreements are formalized simply by the client's purchase order and the supplier's acknowledgement. Standard forms for purchase orders are often used which include, among other things:
- terms of delivery,
- date of delivery,
- consignee,
- marking and packing instructions,
- terms of payment.

Payment of suppliers

Suppliers are normally paid on a fixed-price basis, either in the form of a lump sum for the complete delivery, or in the form of unit prices for different items.

6. CONTROL

Objectives

Control is an integral part of the project management process. It aims at regular measurement of achievement and monitoring by comparison with planned progress. When deviations from planned progress occur, plans may have to be changed. Time is all-important, and the control process should aim at early discovery of any departure from the planned course so that adjustments can be made in time to be effective (Fig. 17).

FIG. 17. OPERATION OF CONTROL PROCESS

Control information provides a basis for management decisions, and the following requirements should be satisfied by an effective control system.

- It should draw immediate attention to significant deviations from what is expected. It should focus on the exception rather than the rule.

- True and meaningful comparisons must be possible.

- The information should indicate in due time what corrective action is necessary and by whom the action should be taken. It should also, as far as possible, indicate what consequences any deviation from the plan is likely to have on any other planned activities, especially the time-schedule, in order to help the project manager to modify his plans accordingly.

- Control information should be expressed in a simple form so that it is readily understood by those who have to make use of it.

- Key areas of control must be chosen with care so that the results of control are worth the time and effort expended.
Control of a building project includes:

- progress control,
- quality control,
- economic control.

**Participants**

The project manager is responsible for overall control of the project. He will need assistance from the management team, especially during the constructing stage.

When the standard approach is used, one of the designers - on building projects, this is normally the architect - is responsible for control of the project during all stages. He is often assisted by a quantity surveyor responsible for economic control, and a clerk of works responsible for site supervision. Other designers and specialists may assist with quality control of the building structure and the installations (Fig. 18).

**FIG. 18. CONTROl: STANDARD APPROACH**

**Progress control**

The time-schedules and resource plans prepared during each stage of the project provide the necessary tools for the control of work progress.

It is the task of the management team to control the overall time-schedule and to ensure that the necessary decisions, approvals, and authorizations are made at the appropriate time. The team must also ensure that procurement is carried out satisfactorily and that resources are available when needed.

The briefing and designing teams should use a detailed time-schedule to control the design work of the different participants. In more complicated projects, the number of people involved is large, which in turn increases the need for thorough coordination and control. A useful aid is a list of events indicating dates when specific information, documents, and drawings should be passed from one participant to another.

During the constructing stage, it is the contractor’s responsibility to prepare and keep to a plan that allows the work to be completed within the contract period. The contractor will also be responsible for coordinating the work of the various specialist subcontractors, so that their work does not hold up the progress of the overall project.

Thus the management team should require the contractor to submit detailed time-schedules and plans for the work before he commences operations on the site. The team must use their professional judgement to assess the realism of these schedules and plans. They should be
particularly suspicious if the programme shows a very slow start to the job. This would indicate that any unforeseen delay would throw the whole contract out of balance in the crucial last stages.

While the contractor has prime responsibility for progress on the site, the management team should monitor his rate of progress in order to ensure completion of the project within the contract period. By regularly marking the actual progress of the different activities on the time-schedule (see Fig. 19), the current situation can be easily checked. If delays occur, the contractor should be notified and asked to take immediate action to make up any lost time.

**FIG. 19. MONITORING PROGRESS OF DIFFERENT ACTIVITIES ON TIME-SCHEDULE**

Fig. 20 illustrates a conventional, but "ideal", curve for the value of the work completed by the contractor during the contract period. By regularly marking on a graph the actual measured value according to interim valuations, the management team will have a further possibility of controlling the progress of the construction work. If the measured value is not achieved at the rate shown on the "ideal" curve, the contractor's progress on the site should be the subject of special attention.

**FIG. 20. "IDEAL" CURVE FOR VALUE OF WORK COMPLETED BY CONTRACTOR**
Delays

Delays may occur during any stage of a project, giving rise to increased costs (e.g., because of inflation) as well as difficulties for the future users. The cost consequences of delays are especially serious during the constructing stage, since considerable resources are engaged in the project by then. Responsibility for delays during this stage depends upon how they originated, e.g.:

- **Delays caused by the contractor, his subcontractors, or his material suppliers.**

  In this case, contracts normally stipulate that the contractor should compensate the client by paying liquidated damages calculated on a daily basis.

- **Delays caused by the client.**

  Included here are delays caused by the client's representatives, such as the project manager or the architect, and delays caused by nominated subcontractors or suppliers appointed by the client.

  For this kind of delay, the contractor will be entitled to an extension of time for completion of the work, and compensation for increased costs. Examples of this type of delay are failure to provide the contractor with the necessary information, or the ordering of variations.

- **Delays due to causes outside the control of either party.**

  These may be caused, for example, by exceptionally adverse weather conditions. Contracts usually stipulate that the contractor should have the right to an extension of the completion time when such delays occur. Except for special risks defined in the contract conditions, the contractor is normally not granted any financial compensation for such delays.

  It is often difficult to determine who is actually liable for delays. Consequently, they often give rise to disputes between clients and contractors. Hence the need for effective control of time-schedules by all parties concerned and for precise records of any event that might lead to a dispute.

**Quality control**

Quality control in a building project should aim at assuring the client that it will satisfy his stated needs and requirements. Quality control should be exercised during all stages of a project.

During the briefing and designing stages, a step-by-step decision-making process, incorporating "control stations" at which the developing design is formally reviewed, facilitates the necessary overall control (see Fig. 21). A further control option is the regular checking of the future users' opinions about the briefing and design. If any of the formal reviews reveal that the client is not satisfied with the design, a further examination of the available options may be required.

**Site control**

Before the constructing stage, the project manager must appoint the staff who will be in charge of quality control on the construction site. Their main task will be to ensure that the contractor fulfills the requirements stated in the contract. This control is normally exercised through continual site supervision by a clerk of works and through regular inspections by designers and specialists. It is often useful to establish a control plan stating when, where, and by whom checks are needed. As a rule, quality control should be preventive, otherwise faults can become "built-in" and very difficult to rectify. In any event it is wise to set required quality standards from the outset.
Variations and instructions

Although they should be minimized, it is difficult to avoid modifications to the quantities and qualities specified in contract documents. When such variations occur, they should always be formally ordered by the project manager on a standard form. The principles for the valuation of variations should always be agreed with the contractor before a variation is ordered. A fixed price is normally preferable.

As the production information in the contract is often incomplete, additional instructions to the contractor are sometimes needed. Such instructions can be given orally, but should always be confirmed in writing as soon as possible. When an instruction also involves a variation, this should be clearly indicated and a separate variation order issued.

Inspections

A thorough inspection must be made before a certificate of practical completion can be issued. When the contractor's maintenance period (the defects liability period) is over, a final inspection should be carried out so that a schedule of defects can be delivered to the contractor. Only when the contractor has rectified all the identified defects can a final certificate be issued and the contractor released from the contract. During the commissioning stage, special tests and examinations may be needed to ensure that the various installations in the building are completely safe and function effectively.

Economic control

General principles

The aim of economic control within a construction project should be active control of the final cost and not merely the passive registration of payments. The importance of decisions taken by the client in the early stages of a project is brought out most acutely by the process of economic control. To a large extent, decisions on functional requirements, quality levels, and building layout determine the final investment cost. The future costs for operating and maintaining the building are also influenced by them.

The client's decisions should be based on reliable cost estimates. Comparative estimates for a choice between alternative solutions, as well as total cost estimates, are needed. While the cost consequences of decisions taken in the early stages of a project are considerable, there is a lack of reliable cost information on which to base these decisions. Several different types of estimate and assessments of their accuracy are presented below.
The client's decision on a project budget provides the basis for overall economic control during the designing, constructing, and commissioning stages. This control covers the following interrelated aspects, which are described later in this section:

- Cost control - control of the final cost;
- Payment control - control of payments as related to contracts and variation orders;
- Control of cash flow - control of the availability and use of funds.

Cost estimates

The reliability of any estimate depends on the information actually available at the stage when the estimate is prepared. Three categories of information are necessary:

- Information about the building and its components. In the briefing stage, such information is normally restricted to rough floor area estimates. Only when the sketch plans have been prepared is it possible to measure other quantities with any degree of accuracy. A full knowledge of the quantities involved is available only when the working drawings have been finalized. Prior to this, though, it is possible to compile approximate bills of quantities.

- Information about resources. Only when the contractor undertakes the planning of the site operations is information about needs in manpower and machinery available.

- Information about prices. The contractor normally has a good knowledge of the actual prevailing prices for different materials and other resources. It is often more difficult for the designers to obtain reliable price information for the estimates prepared during the designing stage. Prices in bills of quantities from earlier projects can provide some information. During the briefing stage price information is normally limited to such data as the cost per unit of floor area, or per unit of building volume, as established from previously completed projects.

The method of estimation chosen will depend on the quality of the available information. An estimation of total construction cost proceeds through four main stages:

- "Preliminary estimates" used in the briefing stage and based on floor areas and costs known from earlier projects;
- "Approximate estimates" based on approximate quantities measured from the sketch plans;
- "Detailed estimates" based on accurate quantities measured from working drawings;
- "Operational estimates" based on the planning of site operations.

A cost estimate can never be more accurate than the information it is based on. Only an operational estimate can offer the requisite accuracy. The accuracy of earlier estimates is inevitably lower, with those at the briefing stage the least reliable. However, by starting to produce estimates of final costs at this very early stage, their accuracy can be progressively improved.

The forecast of the likely level of contractors' tenders will also require an assessment of the interests of local business competition, which will in turn vary with general economic conditions.

When submitting an estimate to the client at any stage, the management team should always add a note on the probable degree of accuracy achieved. This is often expressed as a percentage.
The project budget

A carefully prepared budget is vital for the effective economic control of a project, and it is also essential that it should be consistent with the aims of the project, the required functions, and quality standards. A decision on the project budget for investment costs should only be taken after a reliable cost estimate is available. This often requires the preparation of sketch plans.

The project budget should be prepared according to an accounting plan (Fig. 22). The choice of accounts and the level of detail will depend upon the client's information needs and the control requirements.

FIG. 22. PREPARATION OF PROJECT BUDGET

The project budget should cover the complete project costs, including costs for the briefing and designing stages and general costs, such as service connection charges. The accounting plan serves as a check-list so that no important item is forgotten. The budget for each account is based on the estimated cost with an addition for contingencies. The sum of individual budget accounts gives a total that is exclusive of price escalations and contingencies.

Price escalations can be dealt with in an account of index costs with a separate budget based on the net total, and a forecast of the likely percentage increase with inflation. The sums in the index budget are transferred step by step to the various accounts as resources are procured. This system allows budgets in individual accounts to be based on constant prices and so assists in realistic cost control.

To deal with general contingencies, a reserve fund may be budgeted for at the discretion of the client. This fund would cover such things as changes in the conditions upon which the budget was based and would only be used with the client's specific approval.

Cost control

Cost control should aim at active measures to ensure that the final cost of the project does not exceed the project budget (Fig. 23). To achieve this aim, regular cost checks should be carried out by the design team on the developing design. A good aid in this work is a cost plan, based on an approximate cost estimate, indicating the quality, quantity, and unit price for major cost elements such as floors, interior walls, roofs, etc. When the design is developed in further detail it will be possible to check that the design of each element is kept within the frame set out in the cost plan.

An essential aid to cost control is a forecast of the final cost which is regularly revised with regard to the current situation of the project. If deviations are observed between this forecast and the project budget, corrective action must be taken.
A good aid in keeping the cost forecasts up-to-date is a "cost diary" for each account, in which all events influencing the final cost are noted down. The diaries should include such information as:

- cost checks prepared during the designing stage;
- contracts with consultants, contractors, suppliers, and other organizations;
- variation orders, and variations foreseen; expected cost changes due to disturbances in the planned progress of the works;
- differences between the actual and the indicated quantities, and price fluctuations, as well as variation orders.

A form for forecasting the final cost is illustrated in Fig. 24.

Control of payments and cash flow

All claims from consultants, contractors, suppliers, and other organizations involved, should be certified by the project manager before they are paid by the client. No payment should be certified unless it can be proved that the client has got value for money in accordance with the contract.

At regular intervals, all payments should be summed up in a payment report showing the accumulated payments for each account (see Fig. 25). In order to monitor the cash flow of the project, the management team should regularly compare the actual total payments which have been made - as shown in the payment report - with the planned payments according to the client's financial plan.

The financial plan should indicate the expected distribution of payments over time, and the availability of funds during each stage of the project. It is important to ensure that the funds allocated to the project cover not only total needs, but also needs during each stage of the project.
FIG. 24. FORM FOR CALCULATING FINAL COST

<table>
<thead>
<tr>
<th>Project Price level (date):</th>
<th>Date:</th>
<th>Page:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Account No.</th>
<th>Description</th>
<th>Client's commitments</th>
<th>Commitment to date</th>
<th>Variations ordered</th>
<th>Variations foreseen</th>
<th>Estimated remaining costs</th>
<th>Forecast of final costs (3+4+5+6)</th>
<th>Budget</th>
<th>Budget deviation (8-7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
The procedures for paying contractors have a significant influence on the client's cash flow during the contract period. It is important that the management team should clearly understand the cash flow situation also from the contractor's point of view.

Normally, payments to the contractor are made monthly and are based on interim certificates of the work properly executed during the month. The valuations should also cover work caused by variation orders. A deduction (retention) should be made from each payment, in respect of an agreed percentage, and retained by the client to cover the costs for rectifying any defects in the contractor's work.

The final payment to the contractor will be based on final certificates including a final account. This account contains a summary of the variations, changes in quantities, and price fluctuations, etc., for which adjustments to the contract sum are stipulated.

Fig. 26 shows the three curves determining the contractor's cash flow pattern during the contract and maintenance periods. The curves show respectively:

- the contractor's costs for labour, materials, and plant (curve A);
- the measured value of the work completed according to the interim valuations (curve B);
- the cash paid by the client against interim certificates (curve C).

FIG. 26. CONTRACTOR'S CASH FLOW PATTERN (CONTRACT AND MAINTENANCE PERIODS)
The contractor's need for working capital could at any time be shown by drawing a vertical line between curves A and C. The size of the gap between these two curves (shaded in the diagram) depends on the retention percentage and on the time-lag between payment by the contractor for labour and plant, etc. and his receipt of cash from the client. If this time-lag can be reduced, for example, by the prompt issue of certificates by the management team, and by prompt payment from the client, the likelihood of the contractor completing the contract successfully will be significantly increased.

7. COMMUNICATION AND REPORTING

Communication

Management relies on clear communications and the ability to pass thoughts, ideas, and information quickly and effectively between people with different technical skills and interests.

Good communication between managers and staff helps to create enthusiasm where it is most needed. Bad communication, or lack of communication, produces indifference and even antipathy among staff. Much valuable staff effort is then directed towards overcoming this break in communication, instead of being spent more productively on solving more important problems. To achieve good communication it is necessary to create an appropriate and workable administrative organization.

The purpose of any administrative organization is to define the limits of each person's (or group's) responsibilities. Each tier or "position" in the administrative hierarchy has a set of actions to perform and certain limits of responsibility. Each person within the "position" has the possibility to influence the work undertaken there and the decisions reached, but only at that level in the hierarchy. The "position" is thus responsible for advice and recommendations passed up to a higher level, as well as for requests and orders passed down to a lower level.

Even if this process may seem laborious, it is the only way to ensure that intermediate managers have the information they need to do their jobs properly. If there is a tendency for "positions" in the hierarchy to be bypassed frequently, then it may be time to consider changing the hierarchy, or redefining the role of the bypassed "position".

This system, though theoretically correct, is rarely applied in full. Were the hierarchy of decision-making to be written as a computer programme, there would be little problem in limiting the step-by-step process of mechanical connections. But in an administrative hierarchy there are too many variables - people, human relationships, and personal contacts. While it is extremely tempting to use informal contacts which cut across or avoid decision-making levels in the established hierarchy, this should be avoided.

Personal relations

Relations with people are the core of effective management. The ability to handle human resources properly will be reflected directly in staff morale, team effectiveness, productivity, and project efficiency. Much more can be achieved by a few people with a sense of common purpose than by a large organization lacking drive or effective management.

The management approach must be adapted to the size and complexity of both the project and the administrative organization. In a small organization, informal contacts work best, since people find their own ways of keeping informed. In a large organization, formal communications are necessary so that everyone who needs to keep in touch is able to do so.

Communication between individuals, or groups, is not like a direct mechanical connection, but involves a number of uncertainties. First, both parties must be willing to communicate. Then, regardless of the message the sender is trying to convey, the receiver will develop
spontaneous ideas from his own background knowledge. In this way he will receive only a part of the meaning that was intended, plus other meanings that were not intended. The larger the group of people receiving the information, and the larger the information chain, the more uncertain the transmission of the information becomes. Not only do people interpret the information they receive in different ways, but faults of procedure and organization, as well as divergent attitudes, all create impediments.

Good communication means limiting the receiver's attention to the relevant aspects of a particular message, and by so doing eliminating all meanings that are not relevant or intended.

Communication is also a two-way process. It is therefore essential for the sender to know that his message has been received and understood. Such an acknowledgement may be shown in words or deeds, but it is not enough to have interaction unless it leads to action.

Just as important as the physical characteristics of communication are the human aspects. The early part of any message should try to establish a receptive relationship. Then, in formulating the message, it is best to discuss points of agreement first, thereby relieving any tensions between sender and receiver.

Communication media

Information can be transmitted in several ways, each with its advantages and disadvantages, and on every occasion a choice must be made as some of the considerations to be taken into account are in conflict. A personal visit or telephone call, for example, will be an interruption that may irritate or be a real nuisance. On the other hand, written communication is impersonal and may create discord which can be removed only by personal contact. Personal contact, however, must be carefully arranged and prepared and take place at the right time.

Letters and memoranda

Letters are essential for making clear statements and for putting matters on record where necessary. They are useful for confirming facts or decisions from meetings or telephone conversations, and there is the further advantage that they can be dealt with at the convenience of the receiver. In addition, they are often cheaper than other methods and provide their own record. A short letter stating facts or asking questions is always better than no letter at all, or a long letter too late. Memoranda perform a similar function but are less formal. They should be used for the simple exchange of information, questions, and answers within an office or design team, and also for noting telephone messages that need to be passed on to other individuals and then filed. They should always be brief.

Reports

Reports are written communications that present facts, deductions, conclusions, or recommendations. The written matter may be supported by schedules, drawings, illustrations, models, or any other aid to communication. Reports often need to be presented at a meeting with a spoken introduction and explanation. They are used when it is necessary to submit written explanatory information to a number of people simultaneously.

A typical example is the progress report, comprising general information about the progress of the project, its economy, time-schedule, resources, etc., which is presented by the project manager to the coordinating committee. Other examples are daily or weekly site progress reports, drawn up by the clerk-of-works.

Formal communications

Under this heading come drawings, schedules, specifications, bills of quantities, etc. The presentation method chosen should convey the information clearly and should be designed to suit the user, bearing in mind the principles of communication set out above.
The choice of medium must be based on common sense, but in some cases a combination of two methods may be appropriate. There is danger in too much reliance on the spoken word, where the repercussions of a spontaneous remark have not been thoroughly thought through and no record exists. Conversely, flexibility and time may be lost if every action or decision waits for a written communication or confirmation.

Meetings

Meetings are an important tool of communication and coordination. They enable a number of people to be informed, to exchange information, and to reach decisions simultaneously.

Meetings range from simple conversations and get-togethers, to conferences, subcommittees, working parties, and project meetings.

At a meeting called by a senior manager, he will, if he is wise, encourage a free expression of views. However, when all has been said, he must take the decisions alone and he will be held responsible for them. In contrast, the chairman of a committee is charged with the efficient running of the meetings. It is the members of the committee who reach the decisions and who are responsible for them. All the members of a committee bear equal responsibility for the decisions reached, and individuals can only dissociate themselves from majority decisions by resigning.

To conduct and take part in meetings of all kinds is itself an important management skill. If it is to be successful and effective, highly developed social skills must be brought into play, sound administrative arrangements made, and a proper attitude to participation cultivated.

Decisions

Decisions are usually dependent upon the information on which they are based and the interpretation of that information by the persons concerned. Decisions may also be influenced by the circumstances in which they are made and the pressures on those responsible for making them.

The interpretation of information by persons making decisions is influenced by many variables, including background knowledge, experience, and even prejudices. It is therefore important that those making decisions are aware of the circumstances surrounding them, are able to evaluate the available information effectively, have a general or even intimate knowledge of the issues involved, and possess a "feel" for the subject. "Feel" is difficult to describe, but it is dependent first upon a certain degree of basic knowledge, which can then be used to judge new knowledge and experiences, thus fostering a considerable degree of confidence in the expression of views and opinions.

Decisions may be influenced by the situation in which the person responsible for the decision finds himself, and whether or not he is familiar with it. Every decision-making situation places pressure on the person or persons involved to perform according to predetermined expectations. Every time a person is placed in such a situation, his reputation is at stake, for past performances always dictate an individual's standing when asked to make subsequent decisions. This is most likely to occur in the formal atmosphere of committee meetings. A decision to make no decision is not an admission of defeat, but can keep a situation as much under control as a decision for positive action.
8. SELECT BIBLIOGRAPHY


ANNEX 1

CHECK-LISTS

Briefing stage

CLIENT FUNCTION

. Consider the need and the opportunity to build
. Set up a project committee, if necessary
. Appoint project manager/management team
. Approve agreements with consultants
. Consider requirements and financial constraints
. Decide on project brief, time schedule, and budget
. Give instructions for further action

USER FUNCTION
(representatives of operational staff)

. Consider user requirements
. Provide all information necessary for briefing team
. Consider operating and maintenance factors
. Consider staffing, recruitment, and training
. Approve project brief

PROJECT MANAGEMENT FUNCTION
(project manager and supporting services, including architect(s)/engineer(s) entrusted with management functions)

. Establish a project organization
. Prepare detailed work plan and time-table for briefing
. Select consultants
. Agree terms of appointment with consultants
. Maintain and coordinate progress of briefing work
. Arrange briefing team meetings and maintain minutes
. Pass on information to briefing team
. Make necessary enquiries with authorities
. Determine site ownership, boundaries, rights of way, etc.
. Present reports with recommendations to client and obtain client decisions
. Prepare programme for further action

DESIGNING AND SUPERVISING FUNCTIONS
(architects, engineers, quantity surveyors, and other specialists)

. Examine site location and land use
. Examine environmental implications
. Examine user requirements
. Prepare department and room data programme
. Prepare floor space programme
. Examine site topography, soil conditions, access, drainage, water supply, sewerage, electricity, etc.
PERMIT-GRANTING FUNCTIONS
(public authorities involved)

CLIENT FUNCTION

USER FUNCTION
(representatives of operational staff)

PROJECT MANAGEMENT FUNCTION
(project manager and supporting services, including architect(s)/engineer(s) entrusted with management functions)

- Assess type of foundation, structure, technical standards, and services
- Assess local availability of building materials, import restrictions, means of transport, etc.
- Assess availability of labour (skilled/unskilled)
- Appraise level of local building costs and price trends
- Evaluate cost consequences of client's requirements
- Prepare approximate cost estimate
- Evaluate alternative layouts
- Prepare sketches to illustrate the layout
- Study project feasibility
- Provide information on land-use plans, water supply, electrical connections, access roads, etc.
- Give necessary advance approvals, permits, licences, etc.

Designing stage

- Make final decision on site, location, format, etc.
- Provide funds necessary for site acquisition, design work, etc.
- Take all appropriate action for site acquisition
- Consider and approve scheme design
- Approve production documents and tendering procedure
- Approve list of tenderers
- Approve choice of contractor and award contract
- Provide all information necessary for design team
- Consider operating and maintenance factors
- Consider and approve full scheme design
- Prepare programme for recruitment and training of personnel
- Prepare detailed work plan and time-table for designing
- Maintain and coordinate progress of design work
- Arrange design team meetings and maintain minutes
- Pass information on to design team
- Present reports with recommendations to client, and obtain decisions
- Maintain control of costs and payments
- 262 -

DESIGNING AND SUPERVISING FUNCTIONS
(architects, engineers, quantity surveyors, and other specialists)

- Apply for all necessary permits and approvals from public authorities
- Obtain quotations from sub-contractors and suppliers for prime cost items
- Propose tendering procedure
- Recommend list of tenderers
- Make enquiries to presumptive tenderers
- Prepare tender documents and invitations for tender
- Carry through tendering procedure
- Evaluate tenders and recommend choice of contractor

- Undertake design studies
- Prepare outline proposal
- Prepare cost plan
- Complete user studies and interviews
- Complete outstanding technical studies
- Prepare scheme design, including full design
- Undertake comparative cost studies
- Provide cost checks and review cost plan
- Carry out detailed design of all parts of the building
- Prepare production information drawings, specifications, schedules, etc.
- Prepare bills of quantities
- Assist with evaluation of tenders
- Assess alternative construction methods, cost, time implications, etc.
- Advise on construction programme
- Provide information on special trades, building materials, etc.
- Give quotations for prime cost items
- Prepare tender
- Give final approvals, issue permits, licences, etc.

CONSTRUCTING FUNCTIONS
(direct labour unit or contractor, subcontractors, and suppliers)

PERMIT-GRANTING FUNCTIONS
(public authorities involved)
Constructing stage

- Check and sign contract documents
- Release funds necessary for this stage
- Make any necessary insurance arrangements
- Honour interim certificates
- Note progress and approve justified increased costs
- Arrange insurance
- Honour certificate of practical completion
- Appoint operating and maintenance staff, and undertake training

- Prepare contract documents
- Approve contractor's programme
- Appoint site inspectorate
- Check client's insurance coverage
- Arrange handover of site to contractor
- Arrange site meetings
- Maintain control of final costs, cash flow, and payments
- Prepare regular progress reports
- Issue interim certificates and variation orders
- Issue certificate of practical completion
- Provide necessary complementary production information
- Review contractor's programme
- Prepare programme for quality control including special tests
- Issue instructions and variation orders for contractor
- Make regular inspections and, if necessary, establish site inspectorate
- Prepare periodical site reports
- Check drawings on site in advance of work
- Authenticate daily work records of materials, labour, and plant only
- Examine and adjust priced bill of quantities
- Prepare valuations
- Prepare training of operating and maintenance personnel
CONSTRUCTING FUNCTIONS
(direct labour unit or contractor, subcontractors, and suppliers)

PERMIT-GRANTING FUNCTIONS
(public authorities involved)

CLIENT FUNCTION

USER FUNCTION
(representatives of operational staff)

PROJECT MANAGEMENT FUNCTION
(project manager and supporting services, including architect(s)/engineers(s) entrusted with management functions)

DESIGNING AND SUPERVISING FUNCTIONS
(architects, engineers, quantity surveyors, and other specialists)

- Inspect building prior to practical completion
- List outstanding works
- Check contract documents
- Appoint site staff and project work force
- Appoint subcontractors and procure building materials
- Prepare construction programme
- Arrange contractor's insurance coverage
- Arrange production meetings
- Direct and coordinate construction work, subcontractors, and deliveries
- Collaborate in inspections prior to final completion
- Check accordance with building permit

Commissioning stage

- Approve building ready for takeover
- Arrange insurance
- Collaborate in final inspection
- Honour final certificate
- Take building over for occupation
- Receive building owner's manual, as-built drawings, and keys
- Undertake training of operating and maintenance personnel
- Report defects that require immediate action
- Keep record of defects occurring during defects liability period
- Assist in final inspection
- Arrange handover meeting
- Maintain and coordinate progress of commissioning
- Issue certificate of rectification of defects
- Issue certificate for release of residue of retention fund
- Issue final certificate
- Inspect building prior to practical completion, list outstanding works
- Take part in handover meeting
- Hand over building-owner's manual and as-built drawings
- Assist in training of operating and maintenance personnel
CONSTRUCTING FUNCTIONS
(Contractor or direct labour unit, subcontractors, and suppliers)

- Inspect building well before end of defects liability period
- Prepare schedule of defects
- Prepare and agree final account
- Undertake final inspection
- Provide architect with records for as-built drawings
- Prepare operating instructions and maintenance manuals
- Take part in handover meeting
- Hand over keys
- Assist in training of operating and maintenance personnel
- Complete outstanding works
- Start up and trim mechanical systems
- Correct urgent defects
- Prepare and agree final account
- Collaborate in inspections

Project administration

ORGANIZATION OF MANAGEMENT
FUNCTION

- Work plan
- Organizational chart
- Staffing
  - Job specification for responsible staff: duties, responsibilities, and authority.

PLANNING

- Time-schedules and resource plans needed
- Degree of detailing during each stage
- Planning methods
- Responsibility for planning

PROCUREMENT

- Procurement needed during each stage
- Use of client’s own resources
- Procurement methods
- Forms of tendering
- Forms of agreement
- Forms of payment

CONTROL

Control of work progress

- Control methods
- Frequency of checks
- Responsibility for control
Quality control

- Control plan
- Instructions and variation orders
- Inspections

Economic control

- Estimates and due accuracy needed
- Accounting plan
- Project budget
- Cost control procedures
- Payment procedures and cash flow
- Valuations
- Certificates

COMMUNICATION AND REPORTING

Meetings

- Titles and purpose of meetings
- Participants, chairman, and secretary
- Matters for discussion, standard agenda
- Frequency, suitable days and places
- Distribution and follow-up of minutes
- Forms for requests for attendance, and minutes

Contacts with authorities

- List of authorities, and topics
- Routines for processing matters
- Check-list for applications to authorities

Reports

- Necessary reports
- Contents
- Frequency of reports
- Author, distribution

Registration, filing, and distribution of documents

- List of documents
- Numbering system
- Registration
- Project records
- Distribution lists
- Bills of delivery
- Address list
- Incoming, registration, and distribution stamps
- Forms
. Scales
. Formats
. Layout of drawings
. Numbering, title block
. Classification
. Filing
. Registration, drawing list, distribution list, bill of delivery
. Copying, colours, folding, number of copies
. Extra copy orders
. Key drawings
ANNEX 2

JOB DESCRIPTION: PROJECT MANAGER

ORGANIZATIONAL STATUS

The project manager reports directly to the client or to the project committee appointed by the client and is responsible for planning, directing, and controlling the project.

DUTIES AND RESPONSIBILITIES

The duties of the project manager are:

- to obtain the necessary resources to carry out the work in accordance with the approved plans;
- to organize, instruct, and supervise subordinate personnel;
- to make all necessary contacts with statutory authorities (including both inspecting and permitting authorities);
- to inform subordinate personnel about decisions taken;
- to set up and periodically review budgets for the project;
- to ensure that cost control takes place in conformity with established routines;
- to set up and periodically review time-schedules and resource plans for the project;
- to recommend suitable design and contract procedures;
- to recommend and, after approval by the client, engage and supervise suitable consultants, suppliers, contractors, etc.;
- to ensure that insurance and securities are adequate and in force at all times;
- to brief the coordinating committee (if any) and seek its advice when necessary;
- to convene and chair project meetings, and ensure that accurate minutes are kept and distributed to all interested parties;
- to supervise the construction and defects liability period;
- to prepare periodic reports for the client on progress, cost, and quality of work.
The Project Manager is authorized:

- to use funds, personnel, and other resources subject to budgets and plans approved by the client;
- to lead project personnel and set up work targets for them;
- to make decisions regarding variations to contracts within limits approved by the client;
- to certify costs arising within the project;
- to act as the client's agent in relations with consultants, contractors, and suppliers.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accumulated payments</td>
<td>The running total of payments which have been made by the client.</td>
</tr>
<tr>
<td>Approvals</td>
<td>Acceptance by local, statutory, or other authorities that the proposed construction project conforms to the regulations of those authorities.</td>
</tr>
<tr>
<td>Bill of quantities, approximate</td>
<td>An interim form of &quot;bill of quantities&quot; which uses approximate quantities instead of established quantities for materials and workmanship.</td>
</tr>
<tr>
<td>Bill of quantities, full</td>
<td>A document prepared from complete production information which describes in detail all the building materials and components required.</td>
</tr>
<tr>
<td>Briefing stage</td>
<td>The initial stage in the building process when a general outline of requirements is prepared to provide the client with proposals and recommendations, so that he may determine the form in which the project is to proceed.</td>
</tr>
<tr>
<td>Briefing team</td>
<td>The team of users, designers, and specialists, and, in some cases, contractors and suppliers, involved during the briefing stage of the project.</td>
</tr>
<tr>
<td>Builder</td>
<td>see Constructor</td>
</tr>
<tr>
<td>Capital projects</td>
<td>Projects that require capital investment.</td>
</tr>
<tr>
<td>Cash flow</td>
<td>The flow of funds necessary in the course of a project.</td>
</tr>
<tr>
<td>Certificates:</td>
<td>When an architect supervises the constructing stage of a project, he makes use of three types of certificate:</td>
</tr>
<tr>
<td>final</td>
<td>A form that sets down the amount outstanding, including retention monies to be paid to the builder by the client, after the final account has been agreed and any defects in materials or workmanship, arising out of the works, that have emerged during the defects liability period have been rectified.</td>
</tr>
<tr>
<td>interim</td>
<td>A form that sets down the amount to be paid to the builder by the client for work done during a specific period, usually one month. The certified amount is the result of subtracting the retention money from the valuation.</td>
</tr>
<tr>
<td>practical completion</td>
<td>A form that, after a satisfactory inspection at the end of the constructing stage, is issued to certify that the work has been completed. Once a certificate of practical completion has been issued, the client pays part, usually half, of the retention money to the contractor. The defects liability period then commences.</td>
</tr>
</tbody>
</table>
Clerk of works

On all large and many medium-sized construction projects, it is common to have a clerk of works as the resident superintendent of the works. He is responsible for checking the quality of building work. It is possible for him to be employed either by the designer on behalf of the client, or directly by the client.

Client

The organization or group that, at a superior level, has the responsibility for the ordering of the project, the appraisal of the proposals, and the allocation of funds.

Commissioning team

The team of users, designers, specialists, contractors, and suppliers involved during the commissioning stage.

Competitive tendering

A form of tendering in which open invitations to submit a price for the construction of a project are sent to contractors. Stringent rules are usually attached to the attendant administrative procedures.

Construction team

The team of users, designers, specialists, contractors, and suppliers involved during the construction stage.

Consultant

One who provides professional or expert advice.

Contract

A binding agreement between two or more parties.

Contract, conditions of

Any condition or prerequisite written into a contract on which the respective parties agree.

Contract, standard form of

Contract documents, standardized as regards conditions, arrangement, and layout, that are generally used and accepted.

Constructor/Builder

The person or private organization, usually a contractor or a direct labour force, responsible for carrying out the construction project.

Contingencies

Allowances for costs resulting from unforeseen events, chances, accidents, etc., conditional on something uncertain.

Coordinating committee

An ad hoc committee established by the client to coordinate the work of the parties involved, and to advise the Project Manager.

Cost checks

Checks undertaken on the price of materials or manpower, or the current accumulated cost of the project.

Cost control

Active measures to ensure that the costs of the construction project do not exceed the project budget.

Cost diary

A record of events influencing the costs incurred in the project.
Cost forecast
An estimate of the likely or probable final costs of the project.

Cost plus fee
A fee which includes an additional payment based on a percentage of the verified costs for a project.

Cost reimbursement contract
A form of contract in which the contractor/consultant is paid for those costs he can show have been incurred, plus a preagreed additional fee.

Defects liability period/Maintenance period
A period following the completion of the project, during which the builder is responsible for remedying any defects in workmanship or materials that may emerge in the building.

Department/Room data programme
A schedule outlining the functions and floor space requirements of each department or room in the project.

"Design and construct" company
A firm that undertakes both the design and construction of building projects, providing a single source of responsibility.

Design(ing) team
The group responsible for design of the project; varying in size, it may consist of a number of professionals drawn from various disciplines, though sometimes the task is entrusted to a single architect rather than a team.

Divided contract
A building contract in which separate contractors are appointed for different parts of the project, such as earthworks, foundations, etc.

Feasibility study
A detailed investigation and analysis, often forming a part of the briefing stage, which is conducted to determine the financial, technical, or other advisability of a proposed project.

Final account
A summary of the final construction cost of the project to the client, excluding fees, interest charges, etc. This account includes the cost of savings, of any variations to the contract documents, or alterations to provisional or prime cost items.

Final cost
The actual cost of the project to the client, including construction, consultant's fees, fitting-out, moving, and occupational expenses, interest on monies, salaries, and overheads of client staff.

Fixed price contract
A contract defining precisely the consultant's or contractor's tasks, for which a fixed fee, irrespective of external variations, has been negotiated.

Funds
Monetary reserves for undertaking the project.

Index costs
Allowances for costs due to price escalation during the course of the project.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>Directives issued to the contractor during the construction phase of a project and resulting from variation to, or amplification of, the information contained in the contract documents.</td>
</tr>
<tr>
<td>Interim valuation</td>
<td>An estimate of the value of the construction work completed.</td>
</tr>
<tr>
<td>Invoice</td>
<td>A bill for advising the despatch of goods or services delivered, with particulars of their price and quality.</td>
</tr>
<tr>
<td>Liquidated damages</td>
<td>A sum specified in the contract to be paid to the client by the contractor if he fails to complete the works within the specified time.</td>
</tr>
<tr>
<td>Lump sum</td>
<td>A fixed-amount payment.</td>
</tr>
<tr>
<td>Management team</td>
<td>The team of specialists, such as planners, administrators, and supervisors, working under the direction of a project manager, who are responsible for managing the project.</td>
</tr>
<tr>
<td>Negotiated contract</td>
<td>A form of contract in which a price for the construction works is negotiated by the client with a contractor.</td>
</tr>
<tr>
<td>Nominated subcontractor/supplier</td>
<td>Subcontractor or supplier selected before appointment of the main contractor.</td>
</tr>
<tr>
<td>Operational estimate</td>
<td>A precise form of cost estimate based on the actual prices and costs as incurred during the course of a project.</td>
</tr>
<tr>
<td>Owner</td>
<td>Another name for the client, usual in American terminology. The term &quot;building owner&quot; is used in the United Kingdom.</td>
</tr>
<tr>
<td>Payment report</td>
<td>A report summarizing the payments that have been made and the present financial status of the project with regard to the project budget.</td>
</tr>
<tr>
<td>Periodic cost forecast</td>
<td>An estimate of future costs which is drawn up periodically.</td>
</tr>
<tr>
<td>Prime cost items</td>
<td>Items of work included in tendering documents, i.e., bills of quantities, schedules of rates, or drawings and specifications against which a price has already been placed. These usually refer to work to be undertaken by nominated subcontractors or materials to be provided by suppliers.</td>
</tr>
<tr>
<td>Production information</td>
<td>Drawings, specifications, schedules, and bills of quantities prepared by the design team and describing, for the construction team, what has to be constructed.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Project budget</td>
<td>The sum established by the client as being available for the entire project, including land acquisition, construction, equipment, professional services, interest, and contingencies.</td>
</tr>
<tr>
<td>Project committee</td>
<td>An ad hoc committee established by the client to direct the work and activities of the project manager.</td>
</tr>
<tr>
<td>Project management</td>
<td>The process of planning, executing, and controlling a project from start to finish in a given time, at a given cost, for a given end product, using available human and technical resources.</td>
</tr>
<tr>
<td>Project manager</td>
<td>The person with authority and responsibility to manage the project according to his terms of reference.</td>
</tr>
<tr>
<td>Provisional items</td>
<td>Items of work, usually given as provisional quantities or provisional sums, included in tender documents and normally consisting of items that may have to be carried out as part of the project but cannot be determined with certainty before the work commences.</td>
</tr>
<tr>
<td>Quality control</td>
<td>Activities and methods aiming at ensuring that materials, methods, workmanship, and the completed project will meet the stated requirements.</td>
</tr>
<tr>
<td>Quantity surveyor</td>
<td>One who estimates the amount and cost of the materials and labour required for the building work, and advises the client on cost matters.</td>
</tr>
<tr>
<td>Resident engineer</td>
<td>A person often employed on large construction projects, in addition to the clerk of works, as the site representative of the engineer.</td>
</tr>
<tr>
<td>Resource plan</td>
<td>A plan summarizing the availability and allocation of resources thus permitting effective planning of their future utilization.</td>
</tr>
<tr>
<td>Retention money</td>
<td>An amount subtracted from the valuation of the work completed by the main contractor and subcontractors and held by the client to cover the costs of remedying any defects in materials or workmanship.</td>
</tr>
<tr>
<td>Scale of fees</td>
<td>Approved graduated payments for various valuations of work undertaken by specialists; such scales are published by professional bodies as a basis for ensuring quality of service.</td>
</tr>
<tr>
<td>Schedule of payments/rates</td>
<td>An alternative method to payment by valuation of work done. Usually the number of payments and their value are agreed upon before construction work commences.</td>
</tr>
<tr>
<td>Sketch plans</td>
<td>Drawings, often made in free-hand, to determine the general approach to the layout, design, and construction of a building.</td>
</tr>
</tbody>
</table>
Specifications
A comprehensive description and explanation of the project, its components and materials, and the workmanship required.

Target contract
A contract in which the difference between the project's estimated cost (the target) and the actual cost is shared by the client and the contractor.

Tender documents
The set of documents on which the tenders are to be based and which are sent to the would-be tenderers. The documents usually include the project description, specifications, bills of quantities, plans and elevations, and working drawings.

Tenderers
Those contractors submitting replies to the invitation to submit tenders regarding their price and conditions.

Time-plan/schedule
A time-based plan of the work to be undertaken, indicating the order of the activities in the project, with starting and finishing times.

Two-stage tendering
A form of tendering used when an early selection of a contractor is desirable and an approximate bill of quantities is used as the basis for price negotiations.

Type designs/drawings
Standard design proposals for a particular type of building or parts of a building.

Variations
Additions to, or subtractions from, the production information after the contract between client and contractor has been signed. The additional or reduced costs of these variations are negotiated with the contractor either by the client directly or by the consultants.

Work plan
A statement or diagram indicating the sequence of the work to be undertaken, who will undertake it and how long it should take.

Working drawings
Drawings intended for use by the contractor or subcontractor, which form part of the contract documents and provide all the information needed in order to carry out the project.
PHYSICAL AND FUNCTIONAL EVALUATION
OF EXISTING FACILITIES

John Postill

CONTENTS

1. Evaluation: the missing link. .............................................. 278
2. Benefits of evaluation ...................................................... 278
3. Scope of evaluation ......................................................... 279
4. Measurement ................................................................. 280
5. Continuity ................................................................. 280
6. Gathering information .................................................... 280
7. Evaluation techniques .................................................... 282
8. Approach and attitudes ................................................... 289
9. The evaluation team ....................................................... 289
10. Presentation of findings and feedback ............................... 292
11. Evaluation: diagrammatic representation of procedural steps 293

1. EVALUATION: THE MISSING LINK

A manufacturer of a commodity will take the sensible step of periodically reexamining his product and distribution system to assess its success or otherwise as a commercial enterprise. Equipment will be looked at closely for wear and tear, use of floor space adjusted in order to improve efficiency, and sales distribution streamlined: all with an eye to cost-saving and improvement. What is applicable to the manufacturing scene is equally so to the management of health facilities. Examination and reappraisal require close scrutiny in order that the facilities can be made to perform effectively and efficiently in terms of space utilization, deployment of staff, supply, building design, and maintenance of building equipment.

Continuing with the analogy of the manufacturer, a company running a number of factories will always monitor size and location, taking the opportunity to expand, contract, and build new plant, as the conditions of the market alter. The health facility distribution network is similar in that it is subject to changes in population, infrastructure, and medical care techniques. However, what may be normal practice in the management of a factory in terms of reappraisal is all too frequently neglected in the area of health facility stock and function.

The contribution of both planners and architects should not stop once the facility has been opened. Monitoring the results from a building, once it is completed, enlarged, or renovated, should be an essential and intrinsic part of health facility development. Evaluation, feedback of information, and updating of data on medical, technical, and economic development will help to ensure improved design, operation, and area-wide planning in the future. Unfortunately this exercise is rarely carried out in the developing countries, where evaluation has a low priority or none at all. Little, if any, time and resources are put into finding out how facilities and equipment are actually used, and with what results. As a consequence, maintenance policies and priorities are overlooked, facility distribution is too frequently subject to ad hoc decisions, and mistakes in type plans go undetected and are therefore perpetuated.

It is difficult enough, at the embryonic design stage, to appreciate and predict how a facility will eventually be used. Nevertheless, experts usually accept the need for long deliberations at this stage. But, curiously enough, the relatively simpler task of determining how efficiently the facility is actually being used, once it is opened, is rarely considered, although this would provide invaluable feedback to the designers.

This situation may be due to lack of staff at ministry level, but it means that design mistakes which could well come to light through evaluation are repeated, resulting in added expense and wasted resources which certainly outweigh the cost of evaluation. Planning based on assumptions, opinions, and theories, rather than factual evidence gleaned from thorough investigation, is of doubtful benefit. Evaluation and information feedback constitute an essential stage of the whole building development cycle: concept, brief, design, building, commissioning, evaluation, and feedback. This important stage in the cycle should be given high priority by the developing countries, and resources and manpower allocated accordingly.

2. BENEFITS OF EVALUATION

The benefits to be derived from evaluation studies cannot be overstressed. Evaluation must penetrate every aspect of health facility planning and operation, highlighting the strengths and weaknesses of organization and performance. The process focuses attention on a vast range of issues, both simple and complex. The results of particular studies can have a bearing on legislation and policies at all levels of government administration. For instance, studies of facilities might well reveal inadequacies in fire protection implying the need for amendments to the existing legislation or even the introduction of new laws. A careful analysis of the causes and consequences of such shortcomings will result in recommendations for changes - physical, functional, or organizational - that will improve the efficiency of the facilities evaluated. When mistakes are found to be common to a number of facilities, this will lead to a modification of general standards, type plans, and organizational patterns, thus helping to raise the efficiency level of facilities throughout the country.
When either the cause of, or the remedy for, a given shortcoming is not immediately clear, further in-depth or separate studies should be carried out. Deficiencies thus highlighted will either be of a significant nature, for instance, when design principles are at fault; or they will be such that a small modification to the fabric, services, or layout will bring a remedy without causing too much upheaval in the running of the facility. In-depth studies of layouts, programmes, materials, construction, basic installations, and equipment will reveal situations that can be altered to the benefit of the users, introducing greater economic efficiency, cost savings, and building flexibility.

A national permanent inventory of facilities, covering their type, location, number, equipment, condition, and main problems, will provide a basic knowledge of the country’s resources in health care facilities. Though rarely carried out, such an inventory is needed to provide the data base for all future planning.

3. SCOPE OF EVALUATION

Evaluation studies can address themselves to a number of general areas including:

1. A rational look, on a regional or national scale, at the network of facilities (type, size, location).

2. The analysis of the physical and functional content of individual facilities, or groups or parts of facilities. This could include the identification of series of interrelated activities or, within one facility, an examination of activities, both on a comparative basis and in relation to similar buildings designed to standard plans. Again, it may be necessary to observe and assess the influence on similar activities of alternative building shapes and administrative policies. Another approach may require time and motion studies using one specialized activity or space as a basis - for instance, the organization of a nursing station. Alternatively, it might be felt necessary to analyse the spatial requirements of a piece of new equipment in a number of alternative settings. Studies can be undertaken to assess the internal environment, possible underuse or overcrowding, the flexibility of the buildings, the workload envisaged compared with the reality, the size and relationships of individual rooms or departments, the amount of non-functioning equipment, and the use of waiting areas. The list is endless and varied.

3. A further series of evaluation studies can centre on maintenance, including programmes, operation, staff, finance, frequency of maintenance activities, and preventive maintenance. One of the major weaknesses noted in a recent evaluation study was lack of maintenance as regards both buildings and equipment. Too often maintenance was undertaken only in an emergency, it did not form a part of any systematic review, no regular checks were made on buildings, and there was no national priority system for the upkeep of facilities. Funds were allocated for the construction of new buildings in preference to the regular maintenance of existing ones. Many countries operate a system whereby the larger hospitals have their own maintenance teams and stores, the smaller units being independently maintained by government or outside agencies, or, alternatively, relying on a central hospital to meet their needs. Again, evaluation studies could have a wide impact showing, perhaps, the need to alter the distribution and storage system for maintenance and repair materials in order to make repair work at the peripheral units more effective.

---

4. MEASUREMENT

It is sometimes very difficult to pinpoint and actually to measure the weak and strong points of a facility, as subjective and transient factors, such as the morale and motivation of the staff, are involved. Measurement will be easier when seen as the quantifying factor, e.g., with regard to the work that has to be carried out and the environment within which the work takes place, or the evaluation of building structure and form from the standpoint of areas that must allow for growth and change and those that can be relatively static.

Objective evaluation will be easier and more meaningful if comparisons can be made between the original planning concepts, brief, and plans, and the present lay-out of the facility. Changes become even more apparent if operational policies were written down in the first place. The reasons for the changes and their significance will be instructive for future designs. Analysis will show whether or not there was enough thinking ahead at the time when the plans were drawn up. For instance, was the evolution of population and medical care adequately anticipated? If the reasons why original planning decisions were taken are not spelt out, the task of evaluation will be that much more difficult. It is therefore wise to obtain as much of this background information as possible. The more pertinent background information that can be assembled, the better.

5. CONTINUITY

Too often architects or engineers are only called in to deal with a problem that has become acute over a period of time as a result of no-one going along to discover what problems were emerging so that action could be taken before a crisis situation was reached. Where a project is under way over a number of years, there should also be a continuous record of policy and design decisions. The connexion between policies and design is crucial. Although lessons may be learned too late to be incorporated into a scheme, the more flexible the design, the greater will be the chances of adjustment and modification during development. Where it is the intention to build a large number of buildings of a particular design, if possible, evaluation of models should take place and simulations should be carried out before the first one is built. Then a prototype should be built, operated, and submitted to a thorough evaluation before subsequent facilities are built. Improvements and modifications can then be included in the new facilities. Another approach, in a similar situation, where multiple buildings on the same standard plan are to be erected, would be to establish evaluation teams at selected large facilities at the commencement of operations, in order to monitor their functioning and assess the materials and environment. Regular meetings could then be held between teams to discuss findings and feed information back to the architects, design teams, and committees responsible for the future development of standard facilities.

6. GATHERING INFORMATION

Information for the evaluation of facilities will be obtained from existing documents, planning policies, and designs, together with data on building and running costs, plus statistical returns. The evaluation team will be able to enlarge on these sources of information by the addition of surveys, observations, and interviews. It is important that, from the beginning of the whole evaluation exercise, objectives should be clarified, methods and procedures for the collection and analysis of information defined, responsibilities allocated, and time scheduling and cost implications worked out in detail. The following résumé of objectives and methods was used in an "all-embracing" pilot study of health care facilities in the Sudan by a WHO evaluation team in 1978.¹

The procedural extract below illustrates one possible approach in a study of this nature.

Objectives of the study

The objectives of the study were to identify constraints and opportunities in the planning, design, and operation of health care facilities, within the context of the national health services system.

The study was directed in particular at a selected sample of health facilities of all levels, with the aim of finding out:

(a) to what extent their functions were appropriate to the level at which they operated;
(b) whether their location and design were well adapted to these functions;
(c) whether their staffing, management pattern, and referral system were adequate to the situation;
(d) what kind of support to primary health care they provided; and
(e) whether alternative solutions, meeting the above points either more satisfactorily or more cost-effectively, could be considered.

The immediate objectives included:

(a) analysing of the information obtained on the following:
   (i) the context in which facilities were planned and were operating;
   (ii) the range of options available to the planners, designers, and managers of the facilities (in relation to (i));
   (iii) the standards and criteria used in planning, designing, construction, and operation;
   (iv) the adequacy of the facilities in meeting the needs and expectations of the community.

(b) making the results of the study readily available to the Sudan National Health Administration and to other developing countries, in the context of technical cooperation among developing countries.

Methods and procedures

The methods used for the study principally consisted of:

(a) surveys: data collection through field studies, review of documentation, site visits, examination of buildings, activity studies, and interviews;

(b) analysis: evaluation and interpretation of data through team discussions with nationals and WHO consultants and staff.

The working tools used were:

(a) a methodical framework for the elements relevant to the study: background information: functioning of the system, both planned (policies) and in operation (realities); and health care facilities (again, both policies and realities);
(b) check-lists for the in-depth study of each facility examined; these can be used in any country in the future, irrespective of size or degree of sophistication, and provide a means by which information gathered in various countries may fit into the same framework.

In the adoption of the working tools, the collaboration and contribution of the nationals at all levels proved invaluable.

As a method of analysis, the activity studies proved extremely revealing, since they allowed for quantification of many of the factors in the functioning of facilities, e.g., overcrowding, patient movement between different parts of the facility, use of equipment, and the employment of staff time. No matter how many discussions take place over questions of this nature, it is only by actual observation that a true picture emerges.

Data collection

This was achieved by:

(a) interviews with officials, doctors, specialists, heads of divisions at the Ministry of Health, personnel from other ministries, the supplies department, assistant provincial commissioners, local councillors, staff of the facilities visited, and members of the public, information on the health system and policies being collected from those in a position to speak with authority;

(b) published documents;

(c) forms from the facilities visited and the Ministry of Health, relating to statistical returns, patient attendances, registrations, etc.;

(d) statistical records re attendances, lengths of stay, patient residence, diagnosis, etc., covering a period of two weeks and tabulated for the study by the staffs of the facilities visited;

(e) maps from the Survey Department, the Ministry of Health, and the district assistant commissioners;

(f) plans of facilities from the Ministry of Construction and Public Works, either already in print or drawn up for the study;

(g) examination of facilities: their relationship to the community, design, layout, infrastructure, materials, equipment, supplies, storage, staffing, activity studies, patient care, disease patterns, hygienic standards, etc.; these data were either collected in note form or plotted on the plans.

Analysis of the data

The analysis was aimed at the identification of the main relationships between function and building structure, and of the issues and problems that deserve the future attention of national planners and decision-makers. The analysis phase required more time than the data-collection phase.

7. EVALUATION TECHNIQUES

A number of well-tried evaluation techniques can be adapted to the study of facilities in developing countries.

1 See facing page
In order to sort out many of the unforeseen problems that will arise in a large survey, a trial run is strongly recommended. This will help the team to arrange a check-list format, draw up a time-table, and establish the size of the undertaking, bearing in mind the personnel available. Observation, interviews, and activity studies are essential tools. The numbers and movements of staff, patients, and visitors will need to be verified at both slack and busy times in order to gather a true picture of the situation. The time taken to undertake tasks, their frequency, and distances travelled will give additional information. Surveys may require the interviewer to follow a pattern of procedures or personnel around a facility, or simply to stand still and observe. An architect who attempts to design a facility, or component of a facility, without first observing and evaluating existing situations and ascertaining in detail the use of space required, will be deprived of valuable information for his guidance. When studying a complex facility for the first time, a rushed approach in which masses of comments and notes on material finishes are jotted down at each floor-level, should be avoided. Some time should be spent getting to know the lay-out and observing generally. Later on, the various points of note can be summarized and material finishes and their general condition tabulated floor by floor. A check-list will act as an aide-mémoire, help with the task of drawing comparisons between facilities, and permit the same questions to be asked at each facility. In spite of the advantages and convenience of check-lists, there is no universally suitable check-list system. Many questions asked in one country will be inappropriate for use in another. Differing social values, religious customs, and living standards mean that check-lists will have to be tailored to individual countries. The check-list given below as an illustration was devised for the use of a small working team, usually consisting of two architects and a doctor, during the WHO study of facilities in developing countries already mentioned. It was found to be reasonably applicable to countries at varied stages of development.

Condensed evaluation check-list with general application to developing countries

A. Architectural section - General

1. Administration - National level
   - State level

   Facilities - Types and definitions
   - Numbers
   - Sizes
   - Historic development
   - Distribution - theoretical
      - observed
   - Plans for the development of the infrastructure
   - Basically a summary of the main points included in "Description of individual facilities" (below, under B)
   - Function
   - Form
   - Operational policies
   - Plans
   - Construction
   - Materials

---


2 The check-list is architecturally oriented and does not cover medical/administrative questions such as epidemiological factors, staffing, facility management, job descriptions, records, supplies, supervision, training, and referral systems.
Site
- Catchment area
- Location plan, relation to other facilities, referral patterns
- Description of site features and surrounding area
- Accessibility to population served, major communication systems
- Landscaping
- Location relative to climatic features
- Land stability and subsoil conditions
- Physical and legal constraints of site

Building elements
- Plans, elevations, sections
- Operational policies
- Concept, including degree of building sophistication
- Disposition of buildings and relationships
- Shape
- Orientation
- Site cover
- Number of floors and building heights
- Expansion possibilities externally and internally
- Disposition of departments
- Centralization of services
- Recreational facilities
- Constructional system
- External materials and appearance
- Internal materials and appearance
- Internal detailing: floors, windows, walls, skirtings, doors, lighting, ceilings, stairs, other details
- Basic installations and services
- Fixed and loose equipment
- Phasing
- Flexibility

Staff accommodation
Contractual procedures
Building costs
Maintenance services
Hygienic standards
Patient welfare
Legislation
- Construction
- Water
- Electricity
- Earthquake
- Fire
- Handicapped

2. Appendices
- People met
- List of plans and maps, etc.
- Bibliographical references

B. Architectural section
- Description of individual facility

Facility
- Name
- Location
- Type
- Bed numbers (or workload, if without beds)
- Departments

History
- Building development, dates, constructional costs, and phasing

Future development
- Anticipated building needs and functional changes in the facility
- Projections for regional infrastructure, industry, and population
- Equipment list: fixed and loose
- Maintenance: building, equipment, service procedures
- Adequacy of building structure in terms of: desirability, flexibility, weather protection

Staff accommodation

Basic installations and services
- Water, electricity, medical gases, energy, communications (external and internal), drainage, refuse disposal
- Ventilation
- Transportation

Functional characteristics
- Accessibility
- Signposting
- Vehicle parking
- Security
- Patient/staff flows
- Under-use/overcrowding
- Departmental relationships, growth, and change
- Multiple use of space
- Use of space and features
- Traffic routes and segregation
- Adequacy of services, storage, departments and rooms, etc. (badly located, missing, too large, too small)
- Departments (studies in detail)
- Patient/staff: comfort, convenience, privacy
- Internal environment
- Hygienic standards
- Operational costs
- Fire protection and escape procedures
- Provision for the disabled

Community participation
- Management, building, and financial

User/staff satisfaction

Social implications
- Separation of sexes
- Visitors
- Families staying with patients
- Nomadic

An earlier check-list drawn up in the United Kingdom proved to be far too sophisticated for the majority of the countries visited. Many questions simply did not apply to countries with a simplified health service. On the other hand, important aspects, such as questions relating to the part played by the community in building its own facilities (which in some cases, such as health centres, have a large impact on the planning system) were not considered at the time of compiling the check-lists. Only experience gained within a country will produce an appropriate check-list for that country.

A further check-list consisting of a series of questions aimed at individuals in charge of particular activities, such as pharmacy or transport, proved a very useful addition. Here is an example of a questionnaire put to the person in charge of a small rural health post in the Sudan.
Primary health care unit (PHCU)

Community health worker (CHW) in charge

1. Number of staff/categories?
2. Education: how was worker selected for education, when did he graduate?
3. When did he start working at this PHCU?
4. When did the PHCU start operating?
5. What is the catchment area of the facility (which villages is the facility serving)?
6. What are the responsibilities of the CHW?

Participation in community projects?

Advice to the community on:
- water supplies
- collection and disposal of refuse
- good nutrition based on local foods
- health education, e.g., demonstration of food and diet
- use of latrine?

Which diseases are being diagnosed?

7. Which of his responsibilities does the worker find most important?
8. On which part of his different areas of responsibility does he spend most of his time?
9. Who is supervising him? Frequency/methods/manner?
10. Cooperation with/supervision by the villages development committees, the rural council?

11. Is worker keeping records? What information is included?
12. Is he keeping a register of other activities performed?
13. To whom is he reporting/sending the records? Is he discussing his monthly reports with the village council?

14. Does he register births, issue certificates? How does he get to know about these events?
15. Does he register deaths, issue certificates?

15. Pattern of events during a typical day/week (peak traffic)? Patient-handling? Workload?

16. Is worker on call?
17. If not, where do the patients go in case of emergency?
18. Who replaces worker when he is on leave or sick? Way of getting a replacement?
19. From where does he get his salary? How?
20. Has he any contact with other CHWs or medical staff?
21. Has he attended, or will he be able to attend, a refresher course or obtain further education?

22. Library?

23. Voluntary fees? Amount per month/how used/who decides on use?

24. Number of traditional practitioners within the area? Importance/worker's opinion of them?

25. Infectious diseases: notification/isolation?

26. Referrals of patients: procedure/where to?

27. Drugs: ordering, supplies, approval, delivery, frequency; consumption of drugs, supplies and quantities remaining; expiry dates?

28. Information available on drugs and their side effects?

29. Security, poisonous drugs?

30. Burglars/keys/guard?

31. Drugs available today?

32. Drugs lacking today?

33. Replacement of equipment, method?

34. Shortage of equipment?

35. Postal and messenger services?

36. Has the building been maintained? Is any maintenance planned? Ways of coping with urgent needs/repairs?

37. Are some groups not using the facility? For what reason?

38. Water supply? Regular/quantity/quality?

39. Electricity? Regular?

40. Sewerage system? Toilets?

41. Infected waste: handling/disposal of?

42. Changing facilities for staff? Protective clothing/laundry?

43. Cleaning routines/training of cleaner?

44. Sterilizing facilities?

45. Refrigerator? Functioning/run on?

46. External transport for staff? Paid for?

47. Site work?

48. Staff housing?

49. Health and safety/immunization?
8. APPROACH AND ATTITUDES

Improvement of the current situation will depend on the correct evaluation and analysis of two sorts of problems: those concerning the facility as a whole, and those affecting a single department or procedure, or even an individual. The director of a hospital can give an overall view of the organization and running of the facility but, in order to have a fuller understanding of its operation, it is necessary to talk not only with the staff at all levels, especially those directly concerned with the day-to-day management of the various sectors of the facility, but also with patients, members of the hospital advisory group, and local community leaders. It is assumed that the necessary talks with ministry officials will be held at appropriate times.

The right psychological approach and climate for discussion are necessary. People may not answer fully straight away. They may be shy or influenced by the presence of other officials, especially their superiors. They may be inhibited and reluctant to reveal information. It is important to establish a rapport and gain confidence, and to make sure that those being questioned feel at ease, are treated courteously, and know exactly why questions are being asked. The reasons why the evaluation is being carried out need to be fully explained. Quite often answers will need to be double- and treble-checked, either by asking several people for their opinions on the same point, or asking the same person the question in a different way. It is important to make sure that the person being questioned has not just made up his answers because he either does not want to show his ignorance or is reluctant to state that a question does not make sense to him.

Discussions should be as informal as possible. One question will naturally lead to another. Hasty assumptions must not be made. The deeper the probing, the more likely it is that the real truth will emerge. In some instances, a whole range of factors may be involved. For example, an increase in floor space might raise a number of questions - is it due to the introduction of new equipment, advances in medical science, changes in referral patterns, an increase in the population being served, or changes in the infrastructure resulting in easier access to the facility? How much does it cost? Is it worth it? Another situation might be that patients have difficulty in finding their way round a facility - is this due to lack of signposting, a proliferation of unrelated buildings, or a lack of linking corridors between buildings so that access is difficult in the wet season, or are departments badly related to the site entrance and traffic routes? Again, broken surfaces or missing tiles may be due not to poor maintenance, but to the fact that the original tiles were imported and no longer available, or to lack of local materials and skills. It is necessary to probe beneath the surface with questions in order not to draw incorrect conclusions. Often problems hinge on one another. For instance, staff shortages may be due to an insufficiency of staff housing, which in turn may be due to a lack of local funds.

On the point of making arrangements for visits, it is useful to send on copies of the evaluation brief to the staff ahead of the visit. Convenient meeting dates and perhaps a preliminary visit can be arranged. Patients, trade unions, and professional organizations should be informed of the visits. It should be stressed that the aim of the evaluation is not to look for culprits but to find, in conjunction with the persons interviewed, solutions that will be beneficial to all. The evaluation should be conducted against a background that is as normal and everyday as possible.

9. THE EVALUATION TEAM

A team brought together from within a developing country will no doubt be restricted in numbers, because there will be few people available with the necessary experience and time to spare. Where possible, there should be medical, nursing, administrative, architectural, and engineering representatives on the team, plus specialists as required. The size and
composition of the team, and the time spent on the exercise, will naturally depend on its aims, but the numbers should be kept as small as possible in order to avoid too much disturbance and distraction to the staff. As stated, the team should not present itself in a critical role, but be there simply to observe, take note, interpret, and suggest. The members will undoubtedly have other commitments in their respective areas of work and will not be formed purely as a permanent evaluation task group. It will, however, be extremely useful if the teams can build up a selective, discriminative approach through evaluation on a regular basis. It would be a waste if a team were to be disbanded after one assignment, and a new team appointed to undertake the next investigation. This would be prejudicial to continuity of work experience, established methods of tackling a job, and the full understanding of fellow team-members' contributions, which it may take some time to appreciate.

The team may be answerable to a higher authority for guidance and advice, this authority being responsible for coordinating future programmes and disseminating results of general interest. Time spent on preparing the survey will be time saved in the field. If all members have clear tasks to perform and meetings are held at frequent intervals during the evaluation exercise to discuss and iron out problems, the operation is likely to run more smoothly.

It is interesting, especially for those countries unfamiliar with evaluation work, to look at the approaches and recommendations of a number of evaluation teams commissioned to undertake studies in the health field, as they give some useful guidance on the preparation of studies and the composition of teams.

1. In 1966 in the United Kingdom, the King's Fund commissioned the evaluation of two hospital buildings:

"The objects of the evaluations were to advise the hospitals of items of structure or use which might with advantage be changed and on matters relevant to the building of subsequent stages of the hospitals. It was hoped that the studies would also produce data which would be of use to other planners and designers, and that the experience gained would help in clarifying the possible organization and content of future design-in-use studies."1

The team, which evaluated Addenbrooke's Hospital, Cambridge, was led by a medical-planning officer and included an industrial psychologist and research consultant, a nurse, and a number of hospital administrators, architects, and engineers with specialized knowledge of hospitals. The industrial psychologist interviewed patients and staff, recorded and analysed conversations, and conducted an attitude survey. At the same time, for a two-week period, the team leader was getting the feel of the hospital, watching procedures, and talking to patients and staff. The results of these two separate sets of observations were circulated to team members. The findings showed similarity on almost every item. In other words, the views of the hospital users and the views of the observer were almost identical. The two reports were used to focus attention on those subjects that needed particular study. The final survey was carried out during a seven-day period and required approximately 110 man-days, in addition to the 26 man-days needed for the preliminary attitude survey and earlier team leader's visit. The team leader carried out the main evaluation, and the representatives of each discipline tackled their part of the evaluation in the way they deemed most suitable. The main lesson learned in carrying out the study was that an unstructured approach was a mistake. This approach resulted in a mass of uncoordinated data that was difficult to weld together into a comprehensive report, particularly as the team was disbanded immediately after completion of the survey. A further problem was that the time-scheduling went adrift because of a delay in the return of the draft report submitted for comment to the hospital. The exercise was further complicated by the team leader having to divide his attention between the hospital and another survey being carried out at the same time.

---

2. In 1973 at the invitation of the Kingdom of Saudi Arabia, an evaluation team went to that country from the United Kingdom to study the existing pattern, building condition, and operation of hospitals, in order to formulate plans for future hospital development. In contrast to the Addenbrooke's exercise, a highly structured approach was adopted. Thirteen members of the field team spent 23 days studying 41 hospitals. The team consisted of health planners, architects, structural and service engineers, and one quantity surveyor. Much initial groundwork was already covered during discussions with government officials. No plans of facilities were available or drawn up by teams during the visit.

A structured approach to evaluation was considered important by the team. The presentation of clear objectives, timetables, and check-lists was of great value. At the same time it was necessary to have alternative approaches ready for the occasions when information was not readily to hand or arrangements for meetings had to be unavoidably changed. The structured approach was accordingly tempered by a certain flexibility.

3. Between 1978 and 1980, WHO teams conducted case studies in six countries in two continents. These were conceived as part of a systematic field study intended to document, in some detail and in different contexts, the range of options available, the constraints encountered, and what original solutions, of possible application to other countries, had been evolved as answers to the various problems besetting facilities in developing countries. It was a concrete search for technical information that could be organized, evaluated, and disseminated so as to allow decision-makers to study alternative models to those from affluent countries. As mentioned previously, a team was normally composed of two architects and one medical doctor. The pattern of surveys was similar in all countries in that the discussions were held at ministry level for approximately two weeks prior to field surveys. The latter normally took six weeks. A short period would then be spent back in the capital to discuss findings. The bulk of the analysis and report writing took place on return to Geneva. The smaller units catering for both preventive and curative health care were the subject of concentrated observation, comprehensive study, and intensive fact-finding. Studies at the major hospitals were confined to selected areas such as out-patient departments, although general observations were made on building, form, siting, structure, maintenance procedures, use of space, statistical returns, environment, and basic services. The basic check-list, detailed earlier, was used for the guidance of all facilities.

There were marked differences in levels of sophistication between the countries visited; this was immediately apparent in such areas as standards of hygiene, maintenance services, organizational ability, and management. Although variations were noted in some cases between facilities within a country, it was generally found that, if standards were low at one level of health care facilities, they were low at all levels, from small rural health posts to major hospitals. Conversely, within other countries, high standards were the rule at all levels. Evaluation studies quickly brought into focus those facilities suffering from a lack of trained personnel, shortage of finance, outdated buildings, or buildings in a pitiful state of repair, coupled with harsh climates and difficult terrain. The ability to cope with major problems was, at times, outside the scope of facility staff and their organizational skills. Such was the case, for instance, with the granting of funds needed for major repair works. However, many improvements could have been instigated by the staff and management committees. It is not a Herculean task to clear hospital grounds of broken phials and blood-stained bandages; to clear out an open-channel drainage system, repair mosquito netting, alleviate overcrowding when there is space available, repaint dirty walls in an injection room, or simply to provide a container for refuse. On occasions, those responsible seemed unwilling, or unable, to get to grips with problems of this nature, and even unaware of their existence. Often the excuse of the hospital directors or doctors was that they were too busy handling clinical problems to devote enough time to their management role. Delegation of tasks was not undertaken. Evaluation revealed that it was often a matter of just how much importance, or lack of it, was attached to a particular problem, rather than whether resources and solutions were readily available.

Standards in other countries were in marked contrast: a generally good level of hygiene; excellent maintenance services; a cheerful atmosphere for patients and staff; facilities well utilized in terms of spatial layout and flow of personnel. In many cases, individual energy and enterprise ensured success in spite of external constraints and heavy workloads. Enthusiasm and dedication were very evident in most staff at practically all facilities visited in the different countries. In facility evaluation, problems may be measurable in terms of what needs to be done, but often they are due to a complex and far from obvious series of factors. It is easy to tabulate problems, but, in many situations, extremely difficult to set about initiating change in a system or a long-established procedure. Evaluation can pinpoint structural faults in a building that can be repaired, or inadequacies in standard plans that can be amended in future designs, but it is more difficult to institute change of a less direct nature, which may be tied up with such factors as custom, patient education, and national priorities.

10. PRESENTATION OF FINDINGS AND FEEDBACK

In presenting findings, it is necessary always to bear in mind the size and type of audience to which the evaluation will be addressed. Complex diagrams and wording will have limited appeal. Clear diagrams, photographs, charts, and sketches will enliven a long factual text. The message behind activity data, patient/staff-flow numbers, etc. can be illustrated to good effect. Plans that are too elaborate can be redrawn and simplified for purposes of reproduction. Isometric drawings can make the interpretation of plans easier for those not used to reading them.

Evaluation of a new building should be carried out, and the report completed, soon after the building has become operational and work procedures are fully established. The earlier necessary alterations are highlighted and stated, the better.

Older buildings that are being assessed may well be outmoded, and it will therefore be necessary to distinguish between necessary functions and key activities that can be undertaken irrespective of the setting, and procedures dictated by the actual lay-out of the building.

In presenting the information, a further distinction will be necessary between ideas and views, and data based on precise and recorded observation. The report should also be divided between description and actual evaluation. The description of the facility should include a history of its evolution and a record of changes in its functions and use of space from its opening to the present day.

A separate section can be devoted to information for the general guidance of future health facility planners, based on lessons learned in the course of the evaluation. Criticism of individuals should be avoided. The feedback information will be most useful if it is presented as soon as possible in a precise, tabulated manner, with the summary of findings clearly set out, and the content pruned down to the most significant issues. Only relevant data should be published, the emphasis being on principles. Where details are included, these should be confined to aspects that repeatedly cause problems.
11. EVALUATION: DIAGRAMMATIC REPRESENTATION OF PROCEDURAL STEPS

**BACKGROUND**
- Need
  - Political/social pressures
  - Planning considerations

**Type of evaluation to be undertaken (for example)**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility study</td>
<td>Network distribution study</td>
<td>Maintenance study</td>
</tr>
</tbody>
</table>

- Based on standard plans: Types, location
- Based on nonstandard plans: sizes, numbers
- Older/obsolete units: infrastructure
- National/local policies: National/local policies
- Financial procedures: National/local policies
- Environmental factors: National/local policies

**EVALUATION**
- Existing information/new information
- Physical/functional appraisal
  - Statistics
  - Documentation
  - Operational policies
  - Observations
  - Interviews
  - Activity studies
  - Surveys
  - Reality as opposed to policy
  - Inventory of building stock
  - and selected equipment

**ANALYSIS**
- Use matched against future proposals
  - Operation of facility
    - Performance measured against proposed use (Operational policies)
  - Distribution matched against need
  - Review of existing patterns

**FUTURE STRATEGY**
- Better use of existing stock
- Changes proposed to standard plans/policies/management
- Revision of proposals and patterns/types/numbers/sizes
- Priorities for maintenance stock/service
- Redeployment of resources, personnel and revised costs/stock/management/policies

**Information feedback**
# CONTENTS

<table>
<thead>
<tr>
<th>1. Introduction</th>
<th>297</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>297</td>
</tr>
<tr>
<td>Need</td>
<td>297</td>
</tr>
<tr>
<td>Objectives</td>
<td>297</td>
</tr>
<tr>
<td>Classification</td>
<td>298</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. The commissioning team</th>
<th>299</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>299</td>
</tr>
<tr>
<td>Size</td>
<td>300</td>
</tr>
<tr>
<td>Timing</td>
<td>300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. The commissioning programme</th>
<th>301</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>301</td>
</tr>
<tr>
<td>Type</td>
<td>301</td>
</tr>
<tr>
<td>Preparation</td>
<td>302</td>
</tr>
<tr>
<td>Monitoring</td>
<td>306</td>
</tr>
<tr>
<td>Critical and noncritical tasks</td>
<td>306</td>
</tr>
<tr>
<td>Corrective action</td>
<td>307</td>
</tr>
<tr>
<td>Record-keeping</td>
<td>307</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Operational policies</th>
<th>307</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function of facility</td>
<td>308</td>
</tr>
<tr>
<td>Major overall policies</td>
<td>308</td>
</tr>
<tr>
<td>Departmental policies</td>
<td>308</td>
</tr>
<tr>
<td>Departmental procedures</td>
<td>308</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Organizational development</th>
<th>309</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal structure</td>
<td>309</td>
</tr>
<tr>
<td>Relationships with other health facilities</td>
<td>309</td>
</tr>
<tr>
<td>Informal aspects</td>
<td>309</td>
</tr>
<tr>
<td>Relationships with the community</td>
<td>309</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Training</th>
<th>310</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs</td>
<td>310</td>
</tr>
<tr>
<td>Types of training</td>
<td>311</td>
</tr>
<tr>
<td>Procedure manuals</td>
<td>312</td>
</tr>
</tbody>
</table>

---

*Llewelyn-Davies Weeks: Architects, Planners, and Health Services Consultants, London.*
7. Building .......................................................... 312
   Variations ...................................................... 312
   Faults and defects ........................................... 312
   Handover and defect liability .............................. 312
   Cleaning and environmental checking .................... 313

8. Equipment ....................................................... 313
   Documentation ................................................ 313
   Stages .......................................................... 314
   Maintenance .................................................... 316

9. Consumable supplies ........................................... 316

10. Phasing of occupancy ........................................ 316

11. Evaluation ...................................................... 317
    Aim ........................................................... 317
    Aspects to be evaluated .................................... 318

12. Case studies .................................................. 318
    Commissioning of a 350-bed private hospital in a developing country 318
    Commissioning of a mobile health clinic .................. 321
    Commissioning of a rural health centre ................... 322
1. INTRODUCTION

Definition

The commissioning of health care facilities is the process of speedily and efficiently bringing health care facilities into use and ensuring that each facility operates to the desired standards and makes the best use of the resources available.

During the process of designing, developing, and constructing a facility, whether a hospital or a clinic, there is a commissioning stage. It follows the design process, and is largely completed before ongoing management starts. Commissioning commences with the designation of the first member of the commissioning team and is completed when the unit is fully operational and has been evaluated.

Need

All types of health care facility, from the large teaching hospital to the clinic manned by a single health worker, have to go through a commissioning stage, even if no new building is involved (as in the case of a vehicle-based mobile facility or an existing building that has been converted). The size of the facility will increase the number of problems of commissioning, but these problems will be of the same nature. More staff and other resources (e.g., office accommodation, transport, computer facilities) are usually required for the commissioning of a large unit.

Objectives

Two groups can be identified:

(i) qualitative

(ii) economic.

(i) Qualitative

The qualitative objectives are difficult to define in a practical way. Because the balance between patient flow and quality of care will vary with each project, it is better in our view to follow an agreed policy on this rather than leave it to the choice of individuals.

The criteria for quality of service will be a local choice dependent upon the numbers and quality of staff and other resources, e.g., equipment, the available medication, and the effective demand for the service.

A prime objective of all health care is that it should not, overall, be injurious to the patient. The start-up period is a time when staff are unfamiliar with their new environment, procedures, and equipment and are not yet experienced in working as a team. The risks of clinical accidents are higher than usual. These can be reduced by simulation exercises in many departments, often using other staff or local volunteers to act as patients. Such exercises not only expose faults in procedures but help staff become more familiar with each other as members of a team.

The operational systems should be simple, clearly documented, and designed to produce, as far as possible, information suitable for monitoring performance.

(ii) Economic

The economic objectives are easier both to define and to monitor.
Speed. Speed in bringing a new facility into use is a valid and important economic objective. The basic principle of spending money on a health care facility is that it will bring benefit to the population it will serve. By the time a large hospital is complete, it represents a major investment often running into tens of millions of dollars. To delay the opening of such a unit by one month represents a real loss in that the money could have been invested elsewhere or, in the case of loan-financed projects, not borrowed until later, thus saving interest. If a facility costs $10 million to build, then a delay of one month in commissioning will have lost "benefit" to the population equal to at least $100 000. Even in a small project, a delay of one month could equal the cost of several health workers' salaries for a year. This demonstrates the importance of the commissioning team and its work.

Consumption of resources. The operation of a health care facility requires resources in terms of staff, equipment, and consumable supplies. The operational systems established in the commissioning phase will affect the amount, the quality, and the type of resources required to operate the facility. For example:

- The choice of automatic equipment in laboratories or the radiology department may reduce the need for trained staff but increase capital and maintenance costs.

- The extent to which items are reprocessed, or disposable items used, will have implications as regards both economy and supplies.

It should be the aim of commissioning to ensure that the facility operates to a given standard of care and patient flow with optimum use of resources, i.e., that it is cost-effective. There is a danger of losing sight of this aim if a pattern of operation from another country is used as a model for a new facility, without taking account of the relative scarcity and cost of resources locally.

Classification

A fundamental classification of commissioning is based not on the size of the facility but on its type, as in the following instances:

(i) replacement of an existing facility
(ii) extension of an existing service into a new geographical area, usually requiring a new building
(iii) provision of a new service, usually requiring a new building.

(1) Replacement of existing facilities

In this instance, existing operational staff are usually available to advise, and existing systems and procedures can probably be adopted, which makes commissioning easier.

However, a new building or facility provides a good opportunity for introducing improvements in procedures and standards, and this opportunity should not be overlooked.

The community's and staff's expectations of a replacement facility can be very high. Close and active involvement of existing staff in the planning and commissioning are essential.

A particular problem with this type of facility-commissioning is to ensure continuity of service during the transfer from one building to another.

For example, it is not possible to close a maternity service, and arrangements must be made well in advance for "decanting" it from the old building to the new.
(ii) Extension of an existing service into a new area

The majority of commissioning undertakings in developing countries are of this type, and it is possible to benefit from the experience of existing units in a number of ways:

- by temporary placement of key staff of a new facility in an existing unit
- by transfer of staff from the existing unit to help in the initial operating phase of the new unit
- by transfer of various systems and procedures.

(iii) Provision of a new service

In this case, it is necessary for many aspects of the operation of the facility to be created because no similar facilities exist. This type of commissioning activity is not as frequently undertaken as (i) and (ii), but when it does arise, it should be allocated sufficient resources for planning and management, because as the first of its kind it often sets a pattern for subsequent facilities.

2. THE COMMISSIONING TEAM

Composition

Although commissioning falls sequentially between design and management, it is closer to the latter in nature, and commissioning staff should be drawn mainly from management, if possible. Among the requirements of a commissioning team are:

- involvement of the future managers of the facility
- continuity of planning from the project design team
- specialist advice, particularly:
  - nursing
  - medical
  - engineering
  - other technical (laboratory, radiology, etc.).

Whatever the size of the project, it is desirable to have the following functions and disciplines represented on the commissioning team:

Coordination/programming/administration. It is essential that these functions be assigned to one individual. In a large project, he may be the manager/designate of the facility on a full-time basis. In a smaller project, it may be possible for the manager/designate to undertake the function on a part-time basis, particularly in the early part of commissioning when the workload is intermittent. Until such a manager/designate is available, a member of the project planning team should be nominated for the requisite duties.

It is worth remembering that, in small facilities, the "manager" may be a health worker with no management training and with little awareness of his management role. In such circumstances this role may be assumed by an outsider, but the future manager should play a substantial part in the decisions on operational policies.

Nursing. A large part of most health care consists of nursing services, and a nurse or other health worker with extensive training has a major part to play in the commissioning team.
**Medicine.** The medical input required in commissioning can usually be obtained from one doctor nominated on a part-time basis, who will refer patients to various specialist medical staff as and when necessary.

**Engineering.** The participation of an engineer is desirable in any commissioning exercise. In a large project, consulting architects and engineers may be employed to supervise the builder but a hospital engineer still has an important role in the following areas:

- advising on maintenance and installation matters when equipment is being selected
- checking on behalf of the commissioning team that all electrical and mechanical services in the facility are operational
- inspecting equipment on delivery.

The establishment of a commissioning corps that would move from project to project is not recommended. Such a corps might be lacking in commitment to the subsequent operation of the facility and foster dissatisfaction in local managers. It must be emphasized that the best use should be made of available personnel, in particular those interested and willing to participate in commissioning. By tradition, pharmacists play a large part in the supply and management aspects of health facilities in many areas and can often contribute to commissioning.

**Size**

For a major hospital of, say, 500 beds, a full-time commissioning team of four to six people would be expected. They would be supported by specialist advice on a part-time basis as required. For a smaller project, the same mix of skills would be needed, but on a reduced time basis. This can be achieved by using staff from other facilities in the same district or area. In the early stages, such staff would be required for only two or three days a month. As the opening date approaches, the staff time required increases, but by then permanent staff for the facility may be installed and thus available for commissioning duties.

**Timing**

The project development process usually comprises the following stages:

- definition of need
- application for funds
- approval of funds
- design
- appointment of builder
- building
- bringing into use
- operation.

Ideally at the design stage, a member of the design and planning team is designated as the first member of the commissioning team. This provides continuity between design and commissioning, helping to ensure that the design objectives and assumptions are communicated to the commissioning team and carried through.

If, as is often the case, no commissioning responsibilities have been defined, then it is necessary to establish the commissioning team at some time during the building programme. Here the timing will vary with the type and size of project, but there are two key indicators:
- the period required for equipment-related activity, and
- the period required for personnel-related activity.

As can be seen from Table 1, the duration of the personnel programme can range from a few weeks in a small facility with readily available personnel to several years where the technical training of large numbers of staff is required.

Similarly, the duration of the equipment programme can vary from a few weeks where all items are available locally on short delivery, and the purchasing process is simple, to over two years for a project requiring sophisticated equipment to be purchased through a lengthy tender procedure with a long delay for manufacture and delivery.

If an examination of these two programmes shows that either takes up the remaining building period, then a commissioning team should be established immediately. If either extends beyond the remaining building period, then exceptional action will be required, e.g.,
- to reduce the programme
- to reduce the scope of the facility temporarily
- to defer the opening.

The commissioning team should begin to investigate these options; this aspect is discussed later.

At the earliest stage in the programme it may not be necessary for any member of the commissioning team to be full-time.

A working base will be required for the commissioning team, and this should be near or in the new facility; in a large project, this is especially desirable. The builder may be able to make space available in his accommodation on the site; if not, it may be necessary to rent a small building near the site or use a caravan on a temporary basis.

3. THE COMMISSIONING PROGRAMME

Purpose

Preparation, monitoring, and the revisions indicated on the commissioning programme are the vital tasks in commissioning. In our experience, attention and effort are often concentrated on the preparation of a programme, while subsequent monitoring and revision are often neglected. The programme is a management tool that permits not only the logical sequential ordering of activities within a time framework but also makes possible the identification of critical elements and the monitoring of the degree of completion of the activities. In the light of the information obtained through this programme monitoring, resources can be redistributed to those activities most in need of them and overall progress can be maintained.

Type

Unless the staff available are very experienced in producing programmes, it is better not to produce an all-inclusive single programme. Such a programme is difficult to prepare and difficult to amend, and it can be more of a showpiece than a useful tool. A simpler approach is to have several separate programmes, showing the detailed stages for various activities, with an overall programme, which could be called the consolidated programme, showing only the main stages and correlations.
Preparation of programme

(1) Method

Having determined the activities to be programmed, it is necessary to determine how far they are interdependent. Each activity should be considered against all other activities on the list with the following question in mind: is it necessary to complete one activity before the other can start? For each activity, it is also worth considering whether there are other critical activities, not yet included in the programme, which have to be completed before the activity under consideration can proceed.

The easiest way to assemble simple programmes is to work from the opening date backwards, assembling chains of activities. This can be done by means of a simple graph with units of time on the horizontal axis and activities arranged on the vertical axis. The longest chain of activity represents the shortest time in which the programme can be achieved. This is the critical path, while for other chains of activity there is more than enough time within the programme. This simple approach to programme preparation should be sufficient for all but the largest health care facilities. For a very large project, the use of staff specialized in programme preparation may be justified.

It is important that certain activities should not be carried out too early, e.g., if staff are recruited and arrive at the facility substantially earlier than required, they can become frustrated at the lack of work, be unnecessarily critical of the facility, and establish an atmosphere that is detrimental to patient care.

(ii) Content

To prepare the programme, information needs to be collected from a variety of sources.

The building

The builder and/or the architect must provide information on key dates in the progress of the building. These dates will mark the following stages:

- access available to specific areas for installation of fixed equipment
- mains services - water, electricity, sewerage - available and connected
- storage space available within building for equipment
- handover of building (usually on a phased basis, except in the case of a small building).

The dates for arriving at these stages may have been established at the beginning of construction, but the current progress of the building will indicate whether they can still be met.

These are inter alia the bases for the commissioning programme and must be realistic. The builder or architect should provide monthly progress reports for the commissioning team, indicating whether the agreed dates are still possible or need revision.

The building programme is fundamental to the commissioning programme. The commissioning team must keep itself informed on the progress of the building. It is also important that the commissioning team should not delay the building works by requesting changes in design or fittings.
The staff

(a) Numbers

It is necessary to determine the number, types, and grades of staff required to operate the facility. Estimates of staffing may have been included in the application for funds to build the facility, but these estimates may not be sufficiently detailed for later use.

In many countries there are central and/or regional advisers on health care manpower, who can provide information on staffing levels and on the availability of personnel. Senior staff working at existing units of the same kind can also give useful advice. If such advice is not available locally, reference can be made to published data or, in the case of a large facility, foreign experts. Budgetary restraints must also be taken into account when planning staff levels, and it is usually necessary to apply for approval of funds for posts.

(b) Sources

Having determined what personnel are required, it is necessary to consider where they are to come from and the time it will take for the whole recruitment and training programme for each type of staff. Illustrative programmes for various types of staff are shown in Table 1. The time required can vary from a few weeks for a small project, where all necessary types of staff are easily available, to several years where large training facilities are involved. If large numbers of staff are required, or if there are special difficulties, a full-time personnel specialist may be needed on the commissioning team.

(c) Local situation

It is necessary to investigate the availability of local staff, and for this the following channels may be useful:

- other facilities that employ similar personnel and can thus advise on sources and availability
- training schools, which can provide information on the availability of trainees
- the local community, which can be approached through advertisements, notices or announcements in schools, churches etc., to obtain information on staff that may be available in the future - it sometimes happens that trained staff, native to the region but currently working away from it, would be willing to return when they hear of a new local facility.

1 While the procedures described here correspond to what most generally happens in developed countries and in such developing countries as have sufficient means to remedy any lack of staff relatively easily, we think it imperative for most developing countries to consider the question of staffing not at the commissioning stage but at the stage of the feasibility study. It is only after the needed functions of a health care facility have been established, and after it has been ascertained that the staff necessary to discharge these functions is, or will be, available, that the decision to build the facility can be taken. We know that very often this procedure is not followed but it frequently results in hospitals being utilized to only a fraction of their capabilities, in expensive equipment lying unused and deteriorating, and consequently in a loss of money much needed by the health service (Editors' note).
### Table 1. Typical Staff Programmes

<table>
<thead>
<tr>
<th>Activity</th>
<th>Month of typical building programme</th>
<th>Opening Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Month</td>
<td>1</td>
</tr>
<tr>
<td>Skilled manual staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify staff required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advertise and receive replies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interview and appoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notice period, induction, commence work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled and senior staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify staff required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advertise and receive replies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interview and appoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notice period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction, commence work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff requiring vocational training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify staff required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advertise and receive replies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interview and appoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notice period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction, commence work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL: 19, 1/2 months minimum, extending to 4 or 5 years
(d) Maintaining the commissioning programme in the face of staffing difficulties

Certain trained staff may be unavailable, and to select unskilled staff and train them would delay the whole project considerably. In this case it is necessary to consider possible solutions that do not delay the project. For example:

- to reduce the level of skill required by selecting different equipment, e.g., a noncontact tonometer, which can reduce the need for medically qualified staff in an ophthalmic service

- to arrange for specialized staff from a nearby facility to serve on a visiting basis one or more days a week

- to employ overseas staff - this is often very expensive and should be considered only as an interim solution to be used while local staff are being trained

- to use outside contractors on an interim basis, e.g., to maintain equipment

- to reduce the scope of the service offered by the facility until the necessary staff are trained.

Tasks related to the equipment

The time required for the following activities will need to be estimated:

(a) scheduling and specifying equipment

(b) preparation, issue, return, and evaluation of tender or other purchase procedure

(c) processing and issue of orders

(d) manufacture and delivery

(e) receipt, unpacking, checking, distribution, installation, testing and calibrating, and demonstrating.

(a) Scheduling and specifying

Scheduling and specifying equipment will often be the task of the commissioning team. In the case of replacement or extension of services, it will be comparatively easy to obtain information on the equipment required and the relative suitability of various types or models.

For a new service, more investigation will be needed in order to determine the equipment required, and it may be necessary to have a full-time equipment specialist on the commissioning team.

(b) Tender procedure

Once the equipment has been scheduled and specified, it will be necessary to estimate its cost and apply for funds before the purchasing procedure can start. Funds may be allocated only once a year and, if this is the case, the programme must allow for the application for funds to be made at the appropriate time.

(c) Processing and issue of orders

Many countries have a centralized government purchase system whereby all tenders are issued through one department. There can be considerable delays in such a system - for instance, in holiday months. The tender authority and local suppliers should be approached for information on the time each is likely to require for fulfilling orders.
(d) Manufacture and delivery

Manufacture and delivery times will vary considerably according to the source of supply and the type of equipment. Large scale X-ray equipment may require 12 to 18 months and, although simple equipment and furniture manufactured locally may be available quickly in small quantities, if a large amount is ordered there may be considerable delays while raw materials are being obtained.

In a large project, it can be beneficial to have discussions with possible local manufacturers at a very early stage to see which items can be specially produced locally, if necessary under licensing arrangements from overseas manufacturers. This will only be achievable if sufficient time is available for such arrangements to be established. The benefits of such an arrangement include:

- a reduction in the foreign exchange required
- subsequent ability to replace and repair items
- the stimulation of local industry.

(e) Receipt, unpacking, etc.

The receipt, unpacking, checking, distribution, installation, testing, calibration, and demonstration of equipment can take only a few days in a small project with simple equipment, but may take several months in a major project with sophisticated equipment.

Where manufacturers or agents have to install equipment, only one manufacturer should be permitted to carry out installations in a particular area at any one time. If several are allowed in the same area at the same time, the responsibility for probable damage to the building or equipment cannot be established. The time required for installation should therefore allow for this constraint, particularly in the case of operating theatres.

Monitoring

To monitor the programme successfully, activities requiring a substantial time to complete should be split into a number of steps, each capable of being monitored so that any delay can be detected as soon as possible. For example, if equipment is being purchased abroad and there is a lengthy shipping period, the manufacturer should be instructed to inform the commissioning team when the equipment has been dispatched. In this way it is possible to detect delay and either correct or plan for it at an early stage.

To monitor successfully, it is also necessary to obtain information on the degree of completion of the various tasks in the programme. Some of this information should be provided on a regular basis through progress reports. These would include information on progress on the building and, in a large project, separate progress reports on personnel and staffing, these being required at least once a month, and more frequently at critical times.

Progress on other items will need to be checked by ad hoc enquiries. It is necessary to obtain information at appropriate times on all items in the programme and not just on critical items.

Critical and noncritical tasks

For critical tasks, the estimated time required is equal to the time available in the programme, and any delay will result in a lengthening of the whole programme.

Noncritical tasks are those for which the time required is less than that available in the programme. However, if a noncritical task is delayed, there will come a time when other activities dependent on that task also become delayed and the task then becomes critical to the programme. It is the role of the commissioning coordinator to monitor the programme and take appropriate action when delay is detected.
Corrective action

A number of steps can be taken when delay is detected:

- It may be possible to put the activity back on schedule by using more resources to complete it. A simple example would be for the builder to employ more tradesmen and labourers, if the rate of construction is behind schedule.

- It may be possible to remove the activity from the critical category by meeting the conditions required for subsequent activity. For example, if the electricity supply is not connected in time to allow the installation of equipment, a temporary supply from a generator may meet the need, thus permitting the installation to go ahead without delay.

- If the delay cannot be made up, it will be necessary to revise the programme to accept the delay. This will mean rescheduling many subsequent activities and informing those undertaking the activities of the new timing.

Record-keeping

Much of the information on which the commissioning team works will be contained in the commissioning programme, and possibly in the operational policies, if these have already been produced (see section 4).

It is important however that the leader of the commissioning team and his staff should keep full and accurate records of their activities and decisions, for the following main reasons:

- These records will facilitate a smooth handover to the managers when the unit is ready to open. Variation orders and refinements and changes of policy made during the building/commissioning stages will affect the subsequent running of the unit.

- Changes in personnel (both commissioning and management) are not infrequent. In order to ensure continuity, clear written records and policies are essential.

- It is not unusual for reference to be made back to decisions made during commissioning, e.g., where contractual claims are involved. Clear written records may provide important evidence in this event.

4. OPERATIONAL POLICIES

The various stages in the production of policies and procedures are shown below. Some or all of these may have been drawn up as part of the planning process to inform the design team.

<table>
<thead>
<tr>
<th>Function</th>
<th>What is the facility for?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major overall policies</td>
<td>How is the facility to operate?</td>
</tr>
<tr>
<td>Departments</td>
<td>How is the work to be divided?</td>
</tr>
<tr>
<td>Departmental policies</td>
<td>How will the department operate?</td>
</tr>
<tr>
<td>Departmental procedures</td>
<td>What are the tasks of individual staff-members?</td>
</tr>
</tbody>
</table>
Function of facility

The function of the facility should have been defined at its inception, and then developed in more detail during planning. However, this is not always the case. The commissioning team should ensure that the function is stated simply, with sufficient detail to be meaningful, covering at least the types of services to be provided and the population to be served.

Major overall policies

The major overall policies are those decisions which have a substantial impact on the scope and design of the facility and its equipment requirement.

These involve such issues as:

- What will be the likely work-load?
- Who will be accepted for treatment?
- Will this facility provide: staff accommodation, an ambulance, a laundry, food for patients?
- What diseases are to be treated?
- Is training to be carried out at the facility?

Schedule of departments

The major overall policies will determine the departments to be found in the facility. It is necessary to have a complete list of them. The way in which the facility is physically divided into departments will need to be reflected in the organizational structure.

Departmental policies

The departmental policies may have only been considered in outline by the design team, in so far as they affect design, and it will be the task of the commissioning team to develop them in detail. This will be necessary in most cases before equipment can be selected. Departmental policies will detail how the department will operate and the interrelationships between services.

Departmental procedures

Departmental procedures concern the work of individual staff and how it is to be performed. It is necessary to go into considerable detail in this area because:

(a) staff from a variety of backgrounds and familiar with different systems will need to be familiarized with an agreed system;

(b) staff without previous experience will need to be instructed.

The heads of each department are usually recruited in advance of opening, allowing sufficient time for them to participate in drawing up detailed procedures. Once these are drawn up, it will be necessary to consider how best to communicate them to the staff, e.g., through demonstration and the preparation of diagrammatic descriptions for lower grades of staff.
5. ORGANIZATIONAL DEVELOPMENT

Commissioning involves the creation of an organization, be it a group of only two or three staff in a small clinic or several hundred staff in a large hospital. As such, it is necessary to consider the formal structure of the organization, the probable informal aspects, and the links between the organization, the community, and other health facilities.

**Formal structure**

The formal management structure may be a reflection of existing arrangements in other facilities, e.g., an integral part of a health service, or designed specifically for the new facility. It is of benefit to the staff, patients, and the community if the management structure is easily understood. Functional management structures stretching beyond the individual facility are of doubtful benefit in the developed countries, and are not recommended in developing countries with greater problems as regards communications.

There may be networks of advisers and a professional review procedure above the level of the individual facility, but direct management authority over all activity at the facility is recommended.

**Relationships with other health facilities**

Relationships between the facility and other health facilities require a formal framework. This will determine the way in which patients are referred, in particular the type of clinical work that should be the subject of referral and the health facilities to which patients should be referred.

The new facility, unless at the primary level, will itself receive referrals and may offer other health workers the use of certain services, e.g., access to the laboratory or radiology unit or to a library.

**Informal aspects**

The formal structure of the organization will only operate in so far as it is compatible with certain informal aspects. In commissioning, it is necessary to avoid, or plan to cope with, clashes between the two. It is only possible here to indicate a small sample of the problems that can arise in the hope that it will alert the reader to other possibilities. No comprehensive theory or method of prediction can be offered.

- The provision of a free service may be the official policy, but, in a society where personal service is usually paid for, a variety of staff may expect and extract gratuities from patients in return for quality of service.

- The formal structure may show nursing staff as responsible for the supervision of orderlies, porters, and cleaners, etc., on wards in a clinic or in an operating theatre. However in some areas the traditional role and status of female nurses are such that it would be very difficult and require special care to implement such a structure effectively.

**Relationships with the community**

Whether by design or otherwise, there will develop a set of relationships between the community and the facility. A primary-level facility will often have an easily identifiable and cohesive community to serve. In this situation, the establishment of a strong relationship with the community will be easier than it would be at secondary or tertiary level.

A range of factors, including those listed below, can affect the relationship between the community and a health facility.
(i) **Origin of staff**

If all staff are from outside the area and especially if they are of a different nationality or tribe, the facility will be seen as outside the community.

(ii) **Rules of behaviour**

While it is necessary to operate the new facility according to certain rules of behaviour, those affecting patients and their family can, if not carefully considered, be a source of friction between the staff and the community. For example, a hospital serving a wide area with inadequately developed communications should allow flexible visiting hours, provide if possible some basic covered accommodation where visitors from a distance can spend the night, and, if a family arrives to visit a relative, allow all of them in rather than restrict the number of visitors.

(iii) **Opening hours**

In the choice of opening hours for clinics and other facilities, care should be taken to ensure that patients can attend without loss of working time and wages, and that the hours are convenient for those who have to come a long way using minimal forms of transport.

(iv) **Understanding of function**

It is essential that the community should understand the function of a new facility. One or two "open days" prior to the start of operation will make this possible and allow the naturally inquisitive to see the facility without having to pretend to be patients.

Attention to the relationship between the facility and the community is an important aspect of commissioning. Once the nature of that relationship is established, it is very difficult to change it.

6. **TRAINING**

**Needs**

The first task in training is to identify the needs in outline. This must be undertaken early in the commissioning process to enable the programme to be prepared. Three types of training can be considered:

(a) basic vocational training - e.g., for doctors, nurses, and technicians

(b) skill modification or upgrading

(c) induction.

Types (a) and (b) will be needed only if sufficient staff of the required level of skill are not readily available. In a new facility, however, all staff will require induction to a greater or lesser extent.

The first review of training needs should concentrate on basic vocational training and skill modification. The selection of staff for training, arrangements for staff to receive training at other facilities, and preparations for the training of staff on site in the facility will then have to be undertaken by the commissioning team, with appropriate assistance from individual specialists. A training specialist may be available at national or regional level to give advice on existing training facilities and their suitability. If large numbers of staff are to be trained for the project, then a full-time training organizer and coordinator will be required on the commissioning team.
Types of training

(i) Basic vocational training

This type of training gives personnel their working skills and is normally undertaken in special training schools, or apprenticeship programmes with regular intakes, operating on a long-term basis, the training itself requiring several months or years to complete. The training of doctors, nurses, technicians, and primary health workers is undertaken in this way.

Facilities for such training usually exist within the country but often the programme of commissioning is too short for the organization of the training needed to supply the initial staff requirement. With large projects, the intakes of existing training schemes may need to be increased or a new training facility opened, but this would require a correspondingly longer planning and commissioning period, probably starting well before the building work.

(ii) Skill modification or upgrading

There are several ways in which the skills of personnel can be modified or upgraded to meet the requirements of a new facility. Careful selection and permutation of the options available can do much to solve staffing problems. Some of those options are outlined below.

- Formal short refresher courses, which may be available in existing training schools, can be used to introduce trained staff to new techniques.

- Staff of the new facility can be sent on short-term placement to an existing unit that applies the techniques and standards required.

- Staff with the requisite skills can be sent to train as instructors; they can then train new staff at the facility. This approach can be supplemented by the production or purchase of appropriate teaching materials.

- Training staff specializing in the relevant branches of education can be used at the facility to organize specifically designed training courses.

- Maintenance technicians can be familiarized with particular pieces of equipment by visiting the manufacturers' workshops locally or abroad for a short period; alternatively, the manufacturer can provide a service engineer to train technicians on site.

(iii) Induction

The process of induction involves introducing staff to, and familiarizing them with:

- the lay-out of the facility
- the function of the facility
- the role of their own department
- the formal organization
- the policies and procedures concerning them, e.g., personnel, safety, etc.
- the detailed policies of their own department
- the equipment they will work with.

The type of induction required for different types of staff has to be determined, and the material for induction prepared, by the commissioning team with the help of heads of department.
Procedure manuals

Staff will be brought together from different areas and from different units to work in the new facility. Some will have experience, while others may be fresh from training school or completely new to health care. It will be necessary to harmonize the duties of individuals with the intended method of operation of the department by means of documents setting out operational policies and procedures. These documents will be elaborated in increasing detail as the planning and commissioning processes go on.

7. BUILDING

The commissioning and acceptance of a building should be undertaken with the assistance of an engineer. In a large project with sophisticated engineering services, an engineer or team of engineers will usually be available or, if not, must be found by the commissioning team. In small facilities, it may be necessary for the commissioning team to inspect and accept the building without the assistance of an engineer.

Variations

When inspecting the building at any time prior to handover, it is important to recall that the builder is building to a contract and programme and that any changes may involve additional cost and provide a justification for delay. It is natural for people new to a project to suggest alterations and improvements in the detailed design on the basis of their own personal experience, but such changes should be avoided unless they are absolutely essential for the operation of the facility. To control this situation, only one person - in a large project, this is usually the engineer - should have authority to instruct the builder. All instructions on variations should be recorded in writing.

Faults and defects

If engineering staff are not available for the handover of the building, it will be necessary for the commissioning team to inspect the building and prepare a list of defects prior to handover. The list should be discussed with the builder. He will be able to remedy many of the defects before handover, but some may require longer to remedy, for instance if the builder has to obtain a replacement item.

Those features that cannot be completed before handover should be listed, and a date agreed upon for their subsequent completion. It may be necessary to plan for operation with these features in an unsatisfactory condition and to plan access for the builder when he has to put them right.

Handover and defect liability

When checking the building prior to handover, it is necessary to inspect every room and corridor and to look at the roof and exteriors. However, the builder should be responsible for correcting the defects in the building during a "defect liability period", usually one year, whether or not the commissioning team has inspected it. In a small project, especially if the builder is not local, it may be difficult to implement such an arrangement and attention should be concentrated on identifying defects prior to accepting the building.

The following simple check-list shows the items to be inspected in each room. This task will take a considerable time, even on a small project.

Room check-list - Building handover

Door:

Does it fit?
Is the direction of its swing correct?
Does handle/lock work?
Are there keys for all locks and spares, identified by number?
Lighting: Does it work? Is position correct? Is switch accurately placed?

Water: Do taps work? Does sink drain properly? Is flow adequate?


Ceiling, walls and floor: Is finish smooth, level, and damage-free? Are tiles undamaged? Are surfaces adequately edged and joined?

Fixed items (hooks, rails, etc.): Are they firmly fixed in correct positions? Are all the specified fittings installed?

When construction has ended, the builder may have small stocks of certain items used in the building which it may be advantageous to buy from him. These can often be bought at a discount. In particular, such items as wall tiles, paint, ceiling tiles, light fittings, and door furniture, if not readily available as standard models locally, are worth purchasing from the builder in small quantities for future repairs.

Cleaning and environmental checking

The building contractor will normally be responsible for carrying out a "builder's clean" prior to handover. This is a basic cleaning operation, in which building areas are cleared and surfaces and finishes wiped down.

It will almost certainly be necessary for the commissioning team to arrange for a further, more thorough cleaning prior to moving equipment and furniture, etc., into individual rooms and areas. The sequence in which rooms are cleaned will be determined by a number of factors.

In most areas, particularly clinical areas, it is recommended that environmental tests should be carried out after thorough cleaning and before the disturbance caused by bringing in loose equipment and supplies. Further tests of this kind will be required before opening.

The doctor/pathologist advising the commissioning team should be responsible for programming and supervising these tests in liaison with the commissioning leader, who will ensure that the areas are cleared of other personnel during the periods set aside for the tests.

8. EQUIPMENT

Documentation

The distribution and checking of equipment are facilitated if two documents have been prepared when scheduling the equipment, namely:

(i) room equipment schedules

(ii) consolidation by location.
(i) **Room equipment schedules**

The equipment for each room is listed on this document, and a copy of the appropriate section should be placed in each room.

(ii) **Consolidation by location**

This document allocates the equipment by item, indicating the location of each piece. When the equipment has been inspected and checked, it makes it possible to distribute it. Once all the equipment has been distributed, the room equipment schedules can be checked for completeness. This procedure will be repeated on handover to the responsible department head.

If required, the room equipment schedules can then be maintained as an inventory.

**Stages**

The following stages can be identified in the equipment process, following the placing of orders:

(i) monitoring of suppliers
(ii) coordination of mechanical and electrical services
(iii) receipt and inspection of equipment
(iv) distribution of equipment
(v) installation/assembly/connexion of equipment
(vi) calibration, testing, and demonstration of equipment.

(i) **Monitoring of suppliers**

Once the orders have been placed and if delivery is not for some months, then the progress of the suppliers should be monitored. For equipment being imported or travelling a long distance, the manufacturer should be asked to provide information on date of shipment.

For equipment manufactured locally, it will be possible to visit the manufacturer and inspect work in progress. It is often useful to have a sample item produced by the manufacturer before the order is placed and check work in progress against this, in order to control quality as well as monitor progress.

(ii) **Coordination of mechanical and electrical services**

In the case of fixed equipment requiring services - electricity, water, drainage, steam, suction, and gas - the supplier should give exact details of any service connexions, including size and type of services, type of connexion, and position required. This information should then be used to check either what is being provided, if the design goes into such detail, or to instruct the builder as to what should be provided.

(iii) **Receipt and inspection**

When equipment is received, it should be carefully unpacked and inspected:

- for superficial damage in transit
- for completeness (are all the accessories, connectors, etc., included?)
- for quantity.

If space is prepared and available, the equipment can be unpacked in the room for which it is scheduled. If this is not possible, it should be repacked after inspection and stored in a
designated area. If the equipment is not checked on delivery but after several days, it may be difficult to establish responsibility for any damage or loss and the freight insurance may be invalidated by the delay.

Storage. Once equipment is received and accepted, it usually becomes the responsibility of the facility, not the supplier. Thus it is necessary to provide secure storage for it. Possible hazards include theft, fire, and damage by rodents or climate. For equipment not sensitive to temperature, redundant old metal containers 6.10 m or 12.20 m (20 ft or 40 ft) long, as used for freight, can be useful for temporary storage, if space is not ready within the building.

Equipment which is to be installed and tested by the supplier should normally be delivered only when a representative of the supplier is present. He, not the commissioning team, should accept the delivery. If this is not possible, the equipment should be placed in a safe storage area without unpacking and the supplier informed. If there is any visible damage to the packing such as a dent or evidence of damp, this should be recorded on the delivery note.

Customs clearance. Equipment purchased from abroad through local agents will be cleared through customs by the agents. If equipment has been directly ordered from abroad by the commissioning team, it will be necessary to obtain customs clearance and arrange transport to the site. This can be done by an agent or by the commissioning staff.

(iv) Distribution

It is usual for one area to be designated for the receipt and unpacking of equipment, and one or more areas for temporary storage. Items of equipment, especially delicate and valuable items, should not be distributed until the areas in which they are to be placed have been fully completed by the contractor and handed over. Once an area has been handed over, the commissioning team becomes responsible for security, fire precautions, and the operation of mechanical and electrical services. In particular, if the room has major defects, such as leaking pipes or damaged walls, equipment should not be placed in it.

Porterage and assembly. The distribution of equipment and the assembly of items shipped in knock-down form will require an appropriate number of porters, as well as various unpacking tools, suitable dollies, platform trucks, etc.

Protecting the building. During distribution, care should be taken to protect the building from damage. The floors of main corridors should be covered with hardboard or similar material to prevent marking. The interior of lifts should be similarly protected.

(v) Installation/assembly/connexion

Major equipment, such as X-ray apparatus, should be installed by the supplier or his agent. It is necessary to programme such work and ensure that the necessary power, lighting, etc., are available in the rooms concerned. While the supplier is installing the equipment, he should be given keys to the area and held responsible for the equipment until the commissioning team accepts it formally. Liaison with the builder will be essential.

Other, less complicated equipment may be installed and connected by the facility's maintenance staff or with the aid of local tradesmen. The builder may be willing to install some minor equipment with the aid of his tradesmen, but may request additional payment for such work.

Some equipment may be shipped in knock-down form, requiring assembly on site. The work is usually simple, but on a larger project it may be substantial.

(vi) Calibration, testing, demonstration

After installation, some equipment will require testing, calibration, and demonstration.
For calibration and testing, it is advantageous if the appropriate user can be present, e.g., doctor, nurse, technician. The user's presence is obviously necessary for demonstration. Appropriate user instruction books should be handed over with the equipment to the departmental head.

**Equipment maintenance**

In selecting equipment, careful consideration will have been given to the following:

- **The likely maintenance requirement.** Generally the more sophisticated and automated equipment is, the more demanding is its maintenance. An exception to this is electronic equipment, which is often less demanding than electrical or mechanical equipment.

- **The maintenance personnel available.** These may be the maintenance staff of the facility, local tradesmen, the staff of a local agent, or the manufacturers' staff who may have to visit from abroad.

- **The availability of spare parts.** These may be kept by the manufacturers, the agent, or the facility itself. It is useful to keep simple low-cost spares, such as fuses, bulbs, etc., at the facility.

Once equipment has been delivered, the commissioning team should ensure that the maintenance arrangements are known to the departmental head. For most items, a warranty period will be provided. In this case, maintenance can be provided under several arrangements:

- Manufacturer or agent will send technician to site.

- Equipment will need to be returned to manufacturer.

- Equipment will be repaired by local maintenance men using spares sent by manufacturer.

9. **CONSUMABLE SUPPLIES**

At an early stage in the commissioning process, storage space for consumable supplies must be checked for adequacy and suitability. The commissioning team must ensure that all the supplies needed for operating the facility are available, and that appropriate arrangements have been made for their subsequent replenishment.

It will be necessary for the commissioning team to establish an inventory of all consumable items to be stocked at the hospital and formulate a stores record system with holding levels and re-order points. This will allow space requirements to be calculated. If adequate and suitable storage has not been provided in the design of the facility, then arrangements may be needed to allocate extra space on site. Another way of mitigating a lack of storage space is to arrange for suppliers to deliver on a more frequent basis.

There will often be existing supply channels and, in many countries, a central government or ministry purchasing system covering a proportion of items. Such systems may include warehousing, etc., enabling stock levels to be reduced at the facility.

10. **PHASING OF OCCUPANCY**

In all but the smallest and simplest new health care facilities, it is recommended that the new unit should be brought gradually into use over a defined period of time.
This process can take a number of forms, depending largely on the functions of the new facility:

- The number of "open beds" may be gradually increased, ward by ward, or unit by unit, in line with the build-up of the occupancy rate and the recruitment of nursing (and other) staff.

- The number of clinic sessions held may be increased as outpatient demand builds up and referral patterns develop. Again, the increase in sessions can be related to recruitment of further staff.

- Certain health care facilities may be designed in such a way that future expansion is possible. This may mean that some parts of the building are constructed in "shell" form only, or else areas on site are left for future expansion. In both cases, the phasing-in of full occupancy takes place over a longer period, as demand and finance dictate.

There are a number of reasons why phasing-in is important:

- It allows for the workload of the facility to build up gradually and realistically.

- It enables staff to "iron out" a number of the inevitable early problems before their daily workload makes this impracticable.

- It enables staff to become acclimatized to their new environment, new equipment, etc., at a less stressful, and therefore safer, pace.

- It enables new operational policies and procedures to be tested and adjusted, if necessary, before the facility becomes fully operational.

- Phasing-in is often dictated by delays in some aspect of the building and/or commissioning programme, which need not delay the main completion date or opening day, for example:

  - delays in completing certain building work or remedial building work in nonessential areas

  - delays in the arrival of certain equipment or supplies

  - delays in the arrival of certain staff or the completion of their training, or inability to recruit sufficient staff.

11. EVALUATION

Aim

In evaluating a new health care facility, the aim is to learn from the experience of that facility in order to benefit future facilities. It may also be possible to alter and improve the existing facility through evaluation. The process is usually one of identifying problem areas. Attention to the planning of the evaluation exercise during the commissioning will make it considerably easier and increase its validity.

It is desirable for the facility to be operational for a period - normally a year - before evaluation is undertaken. It is not necessary for all the commissioning team to take part, but at least one member should be involved.
Aspects to be evaluated

Evaluation will cover a variety of aspects of the planning and commissioning:

(i) Use of space. During the planning and commissioning, assumptions are made as to the ways in which space will be used. If these are documented in plans and notes, then it is possible to check the facility after a year of operation to see if it is being used as planned. Information gathered on change in the use of space is a useful input for planning similar facilities in the future.

(ii) Durability. If records are kept of the maintenance of the building and equipment, then examination of these records after a year of operation will show whether equipment, materials, and fittings have been satisfactory. Physical inspection for signs of deterioration is also indicated after a year.

(iii) Utilization. Facilities are planned to provide services to patients. After a period of operation, a statistical analysis of patient activity can ascertain the degree of utilization of the facility.

Account should also be taken of any waiting lists that have built up for access to particular services, or other rationing systems reflecting underprovision.

Consultation and discussion with managerial and other staff actually working in the new facility is an essential element of any evaluation exercise.

12. CASE STUDIES

Commissioning of a 350-bed private hospital in a developing country

The hospital was situated in a city with a population of 1 million in a Middle-Eastern country. This country has two medical schools, a university tradition, and a high rate of literacy, but an underdeveloped public health service running alongside a well-developed private health care system. The doctor/patient ratio is high for the geographical area.

The hospital was being expanded from an existing, rather rundown 120-bed unit to an up-to-date 350-bed unit on the same restricted site.

The patients would be drawn from the public-sector "free" system and the private system on a ratio of about 1:2. The patients from the public sector were paid for on a capitation system, which was based on admissions and on the provision of an accident service on specific days of the week.

When commissioning started, the building was finished apart from the installation of fixed and movable equipment and fittings.

There were no operational policies and no staff planning had been done.

The requirement was to open the hospital with the greatest possible speed, because of an investment on which interest was being paid.

At this stage there was a Hospital Director and his secretary who had the task of starting commissioning, including:

- completing the detailed design
- scheduling and specifying equipment
- ordering equipment
- taking delivery, testing, and installing the equipment
- drafting operational policies
- recruiting and inducting staff.

All of this had to be completed to an unspecified but "as short as possible" time-table.

The staff in the existing section of the hospital would be of undoubted assistance, but they were inexperienced in commissioning.

The first decision was to increase the strength of the commissioning team, and an experienced Hospital Administrator from the United Kingdom was recruited within three months of the arrival of the Hospital Director and stayed for a period of three months.

The second decision taken was to recruit a team of senior nurses from the United Kingdom. This was completed and they were installed within a year of the Hospital Director's arrival to take up his appointment.

These two decisions and their implementation meant that a team of 10 persons was now available to tackle the commissioning tasks set out above. A second Hospital Administrator was recruited from the United Kingdom for a 4-month period at the end of Phase One and the beginning of Phase Two.

**Phase One**
- staffing requirements and potential sources assessed
- staff training needs and possible sources assessed
- operational policies drafted to departmental level, i.e., up to but not including departmental procedures
- all outstanding design issues settled.

Completed within 9 months of the Hospital Director's arrival.

**Phase Two**
- departmental procedures written
- all equipment specified and ordered.

Completed within 15 months of the Hospital Director's arrival.

**Phase Three**
- staff recruitment and induction
- installation of equipment and testing
- start of phased opening.

Completed 19 months after the Hospital Director's arrival.

**Phase Four**
- hospital opened totally.

Completed 2 years after the Hospital Director's arrival.

**Commissioning team's roles**

1. The role of the **Hospital Director** was to set up the programme. This involved:

   - analysing the existing situation, deciding what was needed and what still had to be done to achieve the opening of the hospital in the shortest possible time
   - deciding what resources were needed to achieve this programme and where these could be found
   - setting a target opening date, bearing all the above in mind
   - monitoring the progress of the programme, and amending and altering it to meet the opening date.
In addition, he had to take over the task of selecting and appointing the senior departmental heads, including:

- Director of Nursing
- Deputy Director of Nursing
- Deputy Hospital Director
- Chief Accountant
- Medical Records Officer
- Catering Officer
- Hospital Engineer
- Domestic Services Supervisor
- Pharmacist.

He had also to make arrangements for the medical staffing of the hospital. Because of the existing hospital, this task was easier than it would have been in a completely new facility.

The large increase in the size of the hospital necessitated an increase in the number of doctors with admission privileges and in the number of interns and resident medical staff.

The Hospital Director was entrusted with liaison with the Ministry of Health in connexion with arrangements for public patients and with the public relations activities involved in informing the private sector of the opening of the "new" hospital.

These included the holding of an official "opening" and an "open day", a newspaper campaign, and meetings with officials from other hospitals.

He ensured the overall coordination of these activities.

(ii) The respective tasks of the two temporary Hospital Administrators were:

A - to establish staff schedules
  - to ascertain sources of staff
  - to implement recruitment
  - to draft operational policies.

B - to schedule, specify, and order all equipment
  - to establish operating budgets.

(iii) The senior nursing staff had responsibilities in the following areas:

- nursing administration
- nursing personnel
- operating theatre suite
- paediatrics
- obstetrics and gynaecology
- general surgery
- general medicine
- orthopaedics.
The specific tasks were:

- drafting departmental procedures
- familiarizing themselves with equipment
- supervising the receipt, installation, and testing of this equipment
- interviewing staff for their departments
- arranging for stocks of consumable items to be purchased and stored on a departmental basis in consultation with the existing medical staff
- inducting staff, both nursing and ancillary, into the use of new equipment and the operation of the department.

In many of these tasks they were helped by having a Deputy Director of Nursing who had been the Director of Nursing of the existing hospital and whose local knowledge was essential.

(iv) In all cases except one, the heads of the nonclinical departments were locally recruited. They were responsible for:

- assisting the Hospital Director in drafting their departments' operational procedures
- familiarizing themselves with equipment ordered
- supervising receipt, installation, and testing of this equipment
- arranging for the ordering and storage of consumable items
- interviewing and appointing staff
- inducting staff and training them in the use of equipment and the intended operation of the department.

Commissioning of a mobile health clinic

This case study illustrates a small-scale commissioning task carried out in a short time. The vehicle concerned had been made redundant from another health programme and stood unused for a period.

The need for a primary health care service for a shanty settlement of workers and their families living approximately 8 km from existing facilities had been ascertained. The settlement was of a short-term nature and would eventually be moved as it was planned to develop the site. It was decided to place the mobile unit at the settlement.

The commissioning team consisted initially of an administrator and a senior nurse. Staff for the unit - a doctor and a nurse - were obtained on loan from an existing facility until approval for additional posts and recruitment could be completed. A site on the settlement was found and approval obtained from the municipal authority for its temporary use.

The unit was a trailer comprising a consulting and examination room and a small nursing station/dispensary. The unit had water storage tanks and an electricity generator. Operational policies to be determined included:

- The range of drugs and dressings to be held in the unit. This was agreed on in discussions between the doctor and the health authority pharmacist.

- Supply systems. The existing supply system for health clinics was adopted, and it was agreed that deliveries would normally be made once a week by an existing supply vehicle. Special arrangements had to be made for a water supply to be delivered to the settlement by water tanker.
- Referral. It was agreed that the doctor at the clinic should be able to refer patients directly to specialists at the main outpatient clinic, but that he would not have direct access to radiology or laboratory facilities. Emergency admissions by ambulance could be arranged through a radio link. Any emergency supplies would be brought by staff transport.

The unit was driven to its new site approximately four weeks after commissioning commenced. After a further week, which was spent on stocking and cleaning the unit, it was brought into use.

**Commissioning of a rural health centre**

The facility provided both an outpatient service and 24 beds. An operating theatre catered for minor surgical cases and emergencies. A small laboratory and a simple X-ray machine were included. The facility had its own ambulance and staff "pick up".

Purpose-built residential accommodation had been constructed for nursing staff and two houses for medical staff.

Although this was a small facility, its commissioning was to require the assistance of many staff. The commissioning team comprised a nurse, who was to work at the facility, an administrator, an engineer, and a doctor.

Commissioning activity was not started until the building was nearing completion. An initial review showed that it would be several months before the whole facility could be brought into use.

In view of this, a phased programme was planned whereby the facility would provide outpatient facilities as the first stage and inpatient facilities at a later date.

Inspection of the building revealed many serious problems. It was possible for these to be remedied while outpatient services were operating.

An outpatient service could be provided by staff travelling daily from the nearest town until the on-site residential accommodation was completed.

The equipment required was split into two categories:

- essential for outpatients
- other.

The "other" category included equipment for the X-ray department and operating theatre, as well as for the inpatient service. The equipment essential for outpatients was very limited, and it was possible to obtain it quickly.

The outpatient service was brought into use approximately two months after the building was handed over. The inpatient service took a further four months to commission.

The delay can be attributed not to the size of the facility but rather to the range of services it was intended to provide and the late formation of the commissioning team.